

Information Technology

Office of the Vice President for Information Technology



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Office of the Vice President

The Office of the Vice President for Information Technology was instrumental this year in several unique efforts: sponsoring the January meeting of the Common Solutions Group, and coordinating follow-on activities of university changes after the shootings of April 2007.

Common Solutions Group

The winter 2008 meeting of the Common Solutions Group was held in Blacksburg in January. Common Solutions Group (CSG) is an organization of research universities. CSG works through regular participation of representatives of these universities in meetings and project work. Member universities are characterized by strategic technical vision, strong leadership, and the ability and willingness to adopt common solutions on their campuses.

The January meeting was held at The Inn at Virginia Tech. As the local host for the meeting, the Vice President's office arranged for the facility, meals, special events, and transportation. The CSG agenda is available from the website (www.stonesoup.org).

Internal review reports

The Information and Communications Infrastructure internal review report was released in August 2007. The events of April 16, 2007, and the response, investigation, and recovery that followed placed extraordinary demands on telecommunications network resources and Information Technology professionals. This report provides a comprehensive inventory and analysis of the communications infrastructure and information systems used during this time period. It addresses resources depended upon by emergency responders, investigating law enforcement officers, university officials, media, faculty, staff, students, and families of the university community. It includes information about communications resources owned and operated by the university and relevant resources owned and operated by providers and responders. To prepare this report, Earving L. Blythe, Vice President for Information, convened the Telecommunications Working Group including a broad group of experts representing information technology law enforcement, and university administration. The report examines these areas:

- Data communications utilization and performance
- Web communications utilization and performance
- Radio communication systems utilization and performance

- 911 systems utilization and performance
- Cellular service utilization and performance
- Traditional telephone service utilization and performance
- Video, campus cable television, and related systems utilization and performance
- Information technology support services
- Data preservation
- Data retrieval
- Managing personal information
- Response centers
- Cyber-security
- VT Alerts automated notification system

The recommendations of this group were evaluated by other appointed university review bodies, and incorporated into a set of recommendations that the university continues to work toward.

Group membership was drawn from varied university areas, including the Virginia Tech Police, the teaching/research faculty, research institutes, University Relations, university legal counsel, and Information Technology. Members from Information Technology were the following individuals:

Morgan W. Allen, Director, Systems Development and Administration, Network Infrastructure and Services (NI&S)

Phillip E. Benchoff, Senior Network Engineer, NI&S

Earving L. Blythe, Vice President for Information Technology; Chair, Telecommunications Working Group

Jeffrey M. Crowder, Program Director for Network Virginia, Mid Atlantic Terascale Partnership, VORTEX; NI&S

William C. Dougherty, II, Assistant Director for Systems Support, NI&S

Mary B. Dunker, Director, Secure Enterprise Technology Initiatives; Enterprise Systems

Richard G. Hach, Associate Director of Network Administration, Special Projects and Initiatives; NI&S

Mark C. Harden, Manager, Video/Broadcast Services, NI&S

Carl E. Harris, Director, Network Engineering and Operations, NI&S

Billy J. Hutson, Systems Architect, NI&S

Judy L. Lilly, Associate Vice President, NI&S

Randolph C. Marchany, Director, Security Lab, Information Technology Security Office

John D. Nichols, Information Technology Manager, NI&S

John F. Pollard, Director, Field Engineering and Service Operations, NI&S

Patricia L. Rodgers, Director of Business Technologies, NI&S

Jeb E. B. Stewart, Information Technology Chief of Staff and Director for Planning and Administration; Office of the Vice President for Information Technology

Brenda A. Van Gelder, Director, Strategic Partnership Initiatives; Office of the Vice President for Information Technology

The recommendations of this group, along with those of the Security Infrastructure Group and the report of the working on the interface between counseling services, academic affairs, judicial affairs, and the legal system, were evaluated at the university executive level and grouped into

prioritized working recommendations. Jeb Stewart, Chief of Staff, Information Technology, staffed the process.

Financial summary

The organizational units of Information Technology were provided resources totaling \$59,135,106 for the fiscal year. The sources of these funds spanned several categories:

Educational and general funds	\$31,527,668
Equipment Trust Fund	1,963,241
Auxiliary operations	19,550,539
Self-supporting operations	4,891,745
Sponsored grants	500,160
Continuing Education	164,209
Overhead	537,544
Total	\$59,135,106

Use of funds

Educational and general funds supported academic, research, and administrative activities, totaling \$22,471,709. Network Infrastructure and Services (NI&S) provided telecommunications, video, data, and networking services for \$7,909,573, plus \$813,046 in mail services. NI&S also provided specialized digital imaging and volume printing to university departments. Printing Services support for university activities totaled \$4,588,818.

The Communications Network Services auxiliary expended \$17,914,903 in network infrastructure and communications support. The Student Software Sales auxiliary used \$1,148,693 supporting software sales to students.

eCorridors

The eCorridors unit of Information Technologies serves as a window to the Information Technology initiatives that support Virginia Tech's tri-fold mission of learning, discovery, and outreach. Our activities involve telecommunications policy, communications infrastructure, research and other computing applications, as well as community networks and economic development in a networked world. eCorridors is a primary means through which Information Technologies conducts outreach with government, private sector industry and community stakeholders. The group is led by Virginia Tech faculty member Brenda van Gelder and, in 2008, included two full-time staff and one graduate student. In the fall of 2008, eCorridors acquired a 50% allocation of time of Peter Sforza, a faculty member in the Department of Geography. He will serve as an important link to faculty expertise and research activities, and his addition to the team will complement and deepen the existing pool of expertise that can be brought to bear on projects in the geospatial arena for both research and administrative purposes.

Learning

The eCorridors website, www.ecorridors.vt.edu, is available to the public and is our primary education vehicle. The site links to other notable community networks throughout the United States, and provides access to research papers, presentations, legislative and policy materials, news, and other information related to economic development through the use of advanced network infrastructure. The website also serves as a clearinghouse for emerging initiatives and focus areas and provides access to interactive tools like the Community Broadband Map and speed test.

Our team counsels policymakers about the impacts of rules and legislation on the availability and affordability of broadband network access; on technology and telecommunications policies that affect higher education; and on network security concerns and opportunities.

We are often contacted by localities seeking assistance in developing strategies for enhancing broadband network access for businesses and citizens, often as part of their economic development effort. Emergency services organizations also participate in learning initiatives aimed at identifying, testing, and proving technologies for emergency communications and disaster recovery.

Activities related to education

In May 2008, eCorridors hosted an educational workshop on rural broadband featuring speakers from the Federal Communications Commission (FCC) and the United States Department of Agriculture. The workshop addressed issues such as an overview of broadband technology platforms, funding programs, the FCC's rural healthcare pilot program, and spectrum issues. The workshop was open to anyone who wished to attend and drew nearly 200 from as far away as Maine, Vermont, Georgia, Ohio, and Alaska. This was the first in a series of six workshops across the country, for which Blacksburg was selected as the location due in large part to the work done by eCorridors to spur interest in broadband in rural parts of Virginia.

Research

Part of the Information Technology mission is to “participate in, support, and enhance research.” eCorridors is comprised of personnel whose competencies and credentials result from their engagement in university research efforts. The staff understands the technical, social, and political implications of access to advanced technologies. Our depth of knowledge enables us to contribute at all levels to technology policy analysis and development in network infrastructure deployment, security, quality of service, ecommerce, and the rights of individuals and municipalities. Our research specialties include spatial analysis and public and private strategic alliances as well as the regulatory and policy issues associated with advanced network infrastructure, ecommerce, fiber and wireless technologies, and economic development best practices.

Enterprise GIS Research and Development Administration. During this year, the Enterprise GIS Research and Development Administration group within Information Technology was launched for hosting and associated services for geographic information systems (GIS) research and administrative data and applications university wide. The group is also in discussions with Aneesh Chopra, Virginia's Secretary of Technology, regarding a potential research initiative related to exploring Google Earth applications and capabilities for Virginia localities in the future in cooperation with the Commonwealth Preparedness office.

Broadband service availability. We conducted a number of analyses of broadband service availability data in Virginia and associated state legislation as it relates to that availability and pricing.

Web-enabled GIS applications. The staff assisted multiple university researchers, including those in Forestry, Civil Engineering, and Geography, in the hosting and development of Web-enabled GIS applications for their projects.

Wireless asset inventory tool. eCorridors obtained sponsored research funding from the Commonwealth of Virginia's Productivity Investment Fund to develop a wireless asset inventory tool for the Region 2000 Planning District Commission to help reduce costs for localities wishing to attract commercial wireless infrastructure providers.

Outreach

The Information Technology strategic plan includes an objective to “foster outreach, develop partnerships with communities and promote the capabilities of advanced networking and communications.” eCorridors has a national reputation as a reliable guide in the development, planning, and optimization of advanced telecommunications systems. We have worked with communities throughout Virginia to expand advanced network and communication infrastructure and services. Similarly, among private sector collaborators, Virginia Tech is a respected player in rural and community networks. Because of our emphasis on public-private partnerships, entrepreneurs and small businesses, as well as national companies, approach us for information, insight, and advice before approaching rural communities to introduce new products.

Community broadband map. During the year, we continued development and utilization of the community broadband map (<http://www.ecorridors.vt.edu/maps/broadbandmap.php>) and broadband speed test and the associated analyses. Interest in the broadband map has reached new heights of visibility with inquiries from a number of national broadband policy organizations and other states, as well as international interest in adopting the model for use in Europe. The broadband map was mentioned in testimony to the FCC on July 18, 2008, and was featured in a *Richmond Times-Dispatch* article, generating over 200 new markers on the map in a 24-hour period. The eCorridors staff has given multiple presentations intended to disseminate awareness of the map to both internal and external stakeholders. These include one by Brenda van Gelder for the Broadband Properties Summit in Dallas in May 2008; Jean Plymale at the Broadband Census for America Conference in Washington, D.C. in September 2008; and Seth Peery on April 4 at the Virginia Tech GIS and Remote Sensing Symposium.

Advocacy map. We developed an “Advocacy Map” for internal use by Educause in identifying the congressional districts of its members in order to better facilitate communications and policy advocacy for higher education technology and networking issues.

Broadband Census Conference. eCorridors co-sponsored the first Broadband Census Conference, held September 26, 2008, in Washington, D.C. Other co-sponsors of this conference include Carnegie Mellon University and the University of Texas at Austin's Robert S. Strauss Center for International Security and Law. The conference included government officials, academic researchers, and other key stakeholders for a program that seeks to improve our understanding of current practices in broadband data collection and discuss ways of improving and expanding publicly available data within the United States.

Internal service functions

With the launch of the Enterprise GIS Research and Development Administration unit, the eCorridors team has developed a strong and increasingly relevant internal service role, primarily in the areas of safety/security and GIS mapping.

Campus map data. We assisted Facilities, Communications Network Services, and other on-campus stakeholders by hosting and serving campus map data that is developed and maintained by the newly created Facilities Information Systems unit reporting within the vice president for administrative services area.

Incident map. The new unit developed a prototype “incident map” for the Virginia Tech Police Department (VTPD) by displaying police report data in an easy to use Google Maps interface. This project began in the spring of 2008 and is ongoing; to date, we have had several meetings with the VTPD to iteratively refine the incident map to suit their needs, and we expect the map to go live for public use in the coming months.

Location of origin. We developed a Web-based GIS tool for emergency dispatchers to quickly and easily visualize the location of origin (building or emergency phone) for a call placed from an on-campus extension. We are collaborating with CNS in this effort and were encouraged by Chief Flinchum to continue the development of this tool.

Liaison with VTPD. We also serve as a liaison between Information Technology and the Virginia Tech Police Department, helping to ensure that our technologies and expertise are fully utilized in the improvement of safety and security on the campus, as was recommended by the April 16 internal review committee.

Enterprise Systems

Enterprise Systems supports the missions of the university by developing, coordinating, and managing application software systems that provide critical information services for all university constituents. Enterprise Systems' role is to facilitate an enterprise-wide view of university applications while insuring that these systems maintain an effective balance between information technology and university functionality.

Enterprise Systems consists of the following areas:

- Application Information Systems
- Information Warehousing and Access
- Integration and Portal Services
- Database and Application Administration
- Document Management Systems

The functional objectives of these units include:

- analyzing and implementing applications from an enterprise-wide view that addresses availability, scalability, security, integration, and software standards;
- evaluating and maintaining a portfolio of enterprise applications, priorities, and projects to insure alignment with strategic needs of the institution;
- maintaining technical currency and knowledge of application trends, university business processes, and software evolution to insure sustained relevance of enterprise systems;
- continually developing, supporting, and enhancing information systems to insure long-term viability and usage of enterprise software investments;
- working hand-in-hand with university users to utilize information creatively for strategic value and to facilitate process transformation;
- ensuring that university information is available for operations, analysis, and reporting while safeguarding against loss, abuse, and corruption.

Enterprise Systems organizational improvements

The most significant accomplishment of Enterprise Systems this past year has been the implementation of a reorganization of Enterprise Systems to more effectively utilize the expertise of our staff and address the evolving needs of the university. In particular, requirements for document management systems, approvals, and workflow applications needed resources dedicated to these projects and skill sets. Leveraging portal technology to provide an infrastructure for the integration and organization of applications was also an area of critical need for enterprise systems. To address these university needs more effectively, some of the changes made to the organization include those below.

Integration and Portal Services. Staff members were reassigned from the Secure Enterprise Technology Initiatives group to Enterprise Systems to join a portal team within Enterprise Systems. In addition, within Enterprise Systems, the team and responsibilities for Banner General were moved to the portal team. The resulting group, Integration and Portal Services, has the core expertise and responsibilities needed to address application integration and portal deployment.

Document Management Systems. A new group, Document Management Systems, was created within Enterprise Systems by reallocation of staffing from the Banner Finance team and other positions. In addition, within Enterprise Systems, the group providing support to Information Technology Acquisitions was also moved to the Document Management Systems area. This new group has begun addressing document management, content management, workflow, and a variety of other documentation needs of the institution.

Budget Tuition Plan. Staffing and support for the Budget Tuition Plan system was reassigned to the Banner Finance Team to align these services more effectively with other activities of Banner Finance.

Database and Application Administration. Database and application administration responsibilities were restructured to report to the associate vice president for enterprise systems. This restructuring enabled incorporating these responsibilities within the leadership team of Enterprise Systems, which is of particular importance in facilitating the coordination required for the portal, integration, and document management objectives of the organization.

Implementing reorganization, in and of itself, does not enable more effective operation. To insure benefits from the organizational changes, Enterprise Systems has spent considerable efforts focusing on communications within Enterprise Systems, within Information Technology, and within the university community concerning the changes being implemented, the logistics of the changes, and expectations for the new organizational structure.

Another significant change to the organization was the relocation of the Application Information Systems Human Resources Team to the Andrews Information Systems Building. The physical move of this unit has provided benefits to the organization through greater collaboration with other units of Enterprise Systems. This move is of particular significance as Enterprise Systems begins to address new technology architectures and works to provide document management and portal technologies across applications. The Human Resources department was instrumental in the success of the relocation and worked collaboratively with Enterprise Systems to adapt processes to this change.

Enterprise Systems technology directions and planning

Enterprise Systems has begun discussions and planning for transitioning enterprise application infrastructure to service-oriented architecture (SOA). Over time, enterprise application systems have evolved into a mix of vendor products, in-house development, and open source systems that

must be merged into an integrated and, most significantly, secure unified application environment for the university. As the demands for information technology administrative solutions increase, SOA represents a key architecture for improving Information Technology's agility in creating integrated, flexible applications. While Enterprise Systems is at the beginning stages of adoption, SOA represents a critical component in addressing ongoing viability of the systems and in creating an infrastructure for process governance.

Enterprise Systems has also begun the investigation and planning for migrating applications to rich Internet applications (RIA). RIA represents the evolution of the Internet browser from a static response interface to a dynamic, asynchronous interface. Providing effective user interfaces is increasingly vital in deploying successful and, to a large extent, efficient systems as user expectations are progressively driven by online Internet experiences. The user experience on the Web more closely resembles the traditional desktop applications, with Google applications as the most visible examples of RIA applications today. The Research Administrative System will be the initial application for Enterprise Systems that uses RIA technology.

The other notable technology direction for Enterprise Systems is in addressing effective processes for managing prioritization and administration of projects. Enterprise Systems has been working with the Office of the Vice President for Finance and Chief Financial Officer to define overall project directions and planning, with particular emphasis on gains in efficiency. From the perspective of Enterprise Systems, more emphasis on project prioritization and coordination is essential to meet the converging demands of new technology, accelerated pace for project implementations, and resource constraints. Staff training and optimizing the talents of each employee will be critical as we begin to implement new technologies, while still maintaining existing systems and providing continuing support for the university.

Enterprise Systems goals and objectives

- Develop a strategy and plan for transitioning the Enterprise Systems application infrastructure to service oriented architecture, model-driven development, and rich Internet applications including staffing, project impacts, and training
- Continue the implementation of a research administrative system that supports principal investigators, departments, and research administrative units—specifically focusing on tools to promote increased research activity and ensure regulatory compliance
- Implement a portal infrastructure that effectively supports application integration, using the uPortal framework with SungardHE Luminis components, initially within the Research Administrative System
- Determine an effective strategy and software platform for an enterprise imaging solution that has appropriate security and infrastructure for enterprise-wide deployment
- Develop a long-range plan for warehouse expansion that enables the warehouse to become the source of university-wide analytical and reporting information, and evaluate reporting tools environment and develop long-term plan for providing effective tools

- Implement departmental systems that include broader usage and adoption of the warehouse and provide support for departmentally focused services
- Continue to develop strategies for addressing directions for enterprise systems including open source systems, security standards, project management and prioritization, software development standards, integration processes, and data stewardship

Application Information Systems

Application Information Systems (AIS) provides the university community with information technology and support to complement its teaching, learning, research, and outreach. AIS serves as the central resource responsible for supporting administrative information systems including acquisition, development, and maintenance of the university's core business systems. The organization is dedicated to the continual improvement of the services we provide to students, to the faculty and the staff, and to the public through effective implementation and management of information technology products, services, and support. Application Information Systems consists of teams for Advancement, Human Resources, Student Systems, and Finance.

The focus of Application Information Systems' work over the last year has been in the following areas.

Banner maintenance and upgrades. Maintenance and upgrades are normal activities for AIS in order to stay current with Banner releases.

e-Procurement. The Finance Team contributed a large part of their effort to enhancing HokieMart, Virginia Tech's implementation of HigherMarkets from SciQuest Inc. In addition, there was significant effort to integrate these systems with eVA, Virginia government's Web-based purchasing system.

Additionally, technology support is provided for the university's comprehensive campaign, and several AIS teams continue to assist and support university areas related to the April 16th tragedy.

Advancement Team

The Advancement Team completed 3352 service requests (an 18% increase from 2007) including 2061 production control, 796 programming requests which included mail files, Banner form fixes, report modifications, new *ad hoc* and Banner reports, batch updates, report corrections, duplicate corporate record clean-ups, person record clean-ups, report analyses, validation table updates, and new tables and 495 desktop support requests.

Major activities in the Advancement Team this past year include the following:

- Implemented version 7.4 and 7.5 of Banner Advancement software and tested, troubleshot, and verified the impact of the Oracle 10.2.0.3 upgrade
- Purchased software for preliminary data mining efforts; began meeting with annual giving director to determine data mining needs; and created a new report for research to use in preliminary data mining efforts
- Created multiple reports in support of the comprehensive campaign including the faculty/staff campaign report, regional campaign household giving report, and the regional campaign statistics report
- Created a new report to count individuals of record, number solicited and donors for *US News and World Report* statistics
- Created two pledge fulfillments reports, one for annual fund pledges, and one for other pledges
- Created acknowledgement reports for the Taubman Center for the Arts and for athletics coaches
- Created a report that produces a delimited file of secondary contacts for corporations
- Created a report for rated prospects by donor category
- Created a report for notification when a pledge is ending
- Created a report that retrieves the attributes needed to print the cover letters for endowment reports
- Created a process that computes campaign giving and stores this data in AZBTRND which will be used in trend analysis
- Created a report to track unpaid pledges for endowments and created another report that displays the final pledge payment of endowment pledges
- Created a report of active revocable pledges based on date and college
- Created a report for entities with selected exclusion codes
- Created a report for Veterinary Medicine's alumni giving and another report for pet memorial donations
- Created a report for Special Events which expands all abbreviated address fields
- Created a process to inactivate e-mail addresses, insert new e-mail address or insert do not e-mail exclusion codes using data collected from e-mail solicitations and flashes
- Created a new report for prospect review
- Created a new report to compute counts and amounts of fundraiser solicitations, outright gifts tied to the fundraiser and personal contacts made
- Created a report displaying solicitation amounts greater than the upper amount of the current dev rating
- Created a new process to build alumni records for graduating students to replace the vendor-supplied process which was not creating all records correctly
- Created a new report for external stewardship contact persons for memorial and in honor of gifts and pledges
- Updated all servers in the Student Calling Center
- Began updating all workstations in the Student Calling Center to Vista
- Rebuilt tape servers complete with new tape drives
- Created document retention compliance system, and provided information from this system for university's 4/16 documentation

Professional engagement and development includes the following:

- Siegfried Hill and Peter Franchi provided network and equipment support for the 2007 Mid-Atlantic Banner Users Group conference (hosted by Virginia Tech).
- Janet Linkous attended Sungard Summit 2008.
- Pam Croy and Kim Smith attended 2008 APRA Summit on Prospect Data Mining and Modeling.
- Bruce Boling, Muriel Kranowski, Roger Brickey, Kim Smith, Janet Linkous, Pam Croy, Stephen Carpenter and Michael Ringenbach attended the 2007 Mid-Atlantic Banner Users Group conference hosted by Virginia Tech.
- Siegfried Hill and Peter Franchi attended two SANS security training sessions and earned certificates in GIAC forensic analysis, forensics investigations and responses, Internet and systems audit and security.

Finance Team

The Application Information Systems Finance Team primarily serves as the support unit for the Banner Finance module. The central audiences for this module are the Office of the Controller and the Office of Sponsored Programs. Through coordination with these offices, AIS Finance extends its support of financial functionality throughout the university.

This past fiscal year several new applications have been developed in support of the goal to streamline processes and reduce paperwork.

University employees and students are now able to sign up for direct deposit via a Web-based application. Some 4,000 applications have been processed in less than one year. Security of this application has been of key focus. In coordination with the Information Technology Security Office, several additional measures have been taken to secure both the application and the associated data.

The Web-based budget tuition application now allows students to enroll in the Budget Tuition Plan online using the online payment gateway. Of total enrollment, 67% used the online application to enroll. With the implementation of this application, the Commerce Manager module of the payment gateway was installed. This module should allow for greater ease, and less technical intervention, in future additions of storefronts.

A new Web-based invoice image viewer is now available to departments. With the advent of HokieMart, Virginia Tech's version of SciQuest's e-procurement solution HigherMarkets, most invoicing was centralized and an image of the invoice was created. To enable departments to view their invoices, an invoice viewer application was developed and deployed via the HokieSPA.

Several service centers throughout the university will be able to use a Banner form developed to allow them to submit charges to be relieved. This new process eliminates the submission of data files to the Office of the Controller for processing and gives these centers greater control of their finances.

The Office of the Controller requested that direct deposit processing be modified to allow for sending payments to vendors via direct deposit, accomplishing another goal for the office under Higher Education Restructuring Act.

A form has been developed to store department head information and an associated report is available. This information is based on the Finance-related department. This form has met a significant university need for this information.

Security and compliance continue to be concerns and with that, two applications were delivered this year to address some of these concerns. A security audit report is available to central security staff in the Bursar's Office to aid them in monitoring Banner access. The Office of the Controller performs a compliance survey every year and this year, the Finance Team assisted in the search for an application to meet this need and provided technical resources in the development of the survey. Open source software was found that met a significant number of the requirements set forth. Because a purchase or development of survey software did not have to be made, the Business Practices Compliance Survey was delivered on time and with little post-delivery technical interaction.

Major activities in the Finance Team this past year include the following:

- Updating of the Title IV process for new regulations
- New Web-based projections report
- Additional changes to CARS interface due to restructuring
- New auxiliary ICR charge process
- Banner Finance 7.3 release with associated reapplication of local modifications
- New Accounts Receivable Security Access report giving the Bursar's Office security staff better control over what access is provided in Banner
- Continued refinements to the HokieMart/Banner integration, including delivered upgrades to the SciQuest application
- Changes to existing tuition remission applications to adapt to new procedures
- New and modified reports dealing with encumbrances
- Provide training on the use of HokieMart, accounts receivable, and tuition remission

Human Resources Team

Major accomplishments of the Human Resources Team this past year include the following activities:

- Completed approximately 150 service requests
- Implemented changes to the leave report system to allow for the tracking and expiration of authorized closing leave
- Implemented the electronic interface of personnel information with the state personnel system including a snapshot file of all salaried employees and a pay action file of increases each month, relieving Human Resources (HR) from having to perform duplicate data entry—once in the Banner system and once in the Personnel Management Information System
- Implemented the use of an electronic W-2 for all employees through Employee Self Service (HokieSPA), reducing the number of printed W-2s by approximately 6,000
- Modified, tested, and installed the year-end tax and W-2 release; made additional changes to the W-2 and 1042 programs and reports
- Began design and programming an electronic 1042 tax form for foreign national employees
- Provided information requested by Human Resources and the state used as part of the restructuring initiative
- Continued to improve the HRIS web reports to improve the headings, spacing, etc. based on user input
- Created reports, available through web job submission, of the PeopleAdmin employment application data to provide management information to various offices
- Provided information on new hires and 403b participants to Great West to meet the governor's requirement of auto-enrolling all new employees in a tax shelter plan unless they opt out or self enroll in a 403b
- Worked with the Office of the Provost to validate and correct faculty data, provide reports, etc. to prepare for the upcoming accreditation by the Southern Association of Colleges and Schools (SACS)
- Involved in the normal yearly processing for the HR system: performance reviews, position roll, salary increases, benefit premium updates, tax updates, Combined Virginia Campaign, tax shelter limits, leave roll, etc.
- Continual changes to the system to automate more paper processes and to improve data quality, system performance, and customer satisfaction

Student/Financial Aid Team

During the past year, the Student/Financial Aid Team continued the support of, and enhancements to, modules associated with the Banner Student module and Banner Financial Aid module. Throughout the year, corrections have been made to those production processes which are not performing as the functional area requires. Over 150 service requests for modifications/enhancements were submitted during this period.

Corrections and maintenance

- Ongoing daily support of student/financial aid processes as required

- Assisted in the implementation of several point releases for the Financial Aid module
- Continued to support processes to feed student data to such areas as Communication Network Services, Educational Technologies, the Institute for Distance and Distributed Learning
- Continued to provide student name and address data to peripheral areas needing it—Schiffert Health Center, Career Services, Student Athlete Academic Support Services, etc.; continued to develop ways for these areas to process requests themselves
- Continued to run processes to clear PIDMs associated with recruit records no longer needed thus reducing the size of several general tables
- Continued to work with Information Resource Management to identify and implement additional student affiliations to more accurately reflect an individual's relationship to the university
- Expanded the distribution of self-service data extracts from the student data mart in the Data Warehouse
- Supported enhancements to Noli Transfer in the Office of Undergraduate Admissions to load applications from CollegeNet
- Supported Noli Web imaging/workflow system in International Graduate Student Services, as needed

Enhancements and expansions

- Developed a Web-based crisis management system for the Dean of Students Office
- Replaced the processes/programs that support the implementation of Electronic Loan Management in the Office of University Scholarships and Financial Aid with a new sub-system designed specifically for this area
- Continued work to support the SACS accreditation process; enhanced preliminary Web-based information pages associated with course and instructor information based upon data in Banner
- Implemented DARS IA, a Web-based service for students to better access DARS information
- Due to new state law, developed processes to capture an access code to allow FERPA release of information to parents
- Worked on, and created a prototype for, the implementation of the “Parent SPA” using the guest access system being developed
- Implemented a module for the Office of the University Registrar to track NCAA academic progress rate data within Banner
- Developed a Web-based system for spot assignment of classrooms
- Developed functions to display student photographs on the Hokie SPA for faculty members and advisors
- Developed functions to capture emergency contact information from students during the course request period or drop/add period
- Supported the implementation of wider use of Noli Web imaging/workflow system in the Graduate School
- Enhanced the Web-based advisor comment tracking system to allow more flexibility

- Continued to enhance the Web for Student and Faculty/Advisors capabilities for areas such as the National Student Clearinghouse and the New Student Orientation program
- Assisted in the implementation of prerequisite checking during course request and drop/add processing

Information Warehousing and Access

The mission of Information Warehousing and Access (IWA) is to design, develop, and implement an enterprise data warehouse that allows easy access to management information for analysis and reporting.

IWA works together with the central administrative offices and the data users to develop the Virginia Tech Enterprise Data Warehouse. The warehouse is being built in iterations by subject area. Each subject area of data is called a data mart. The various data marts are linked together to form an integrated warehouse using the Ralph Kimball (www.rkimball.com/) design methodology. The resulting Enterprise Data Warehouse is used to report across the spectrum of university data to support both day-to-day administrative functions and management decision making.

The data warehouse now contains financial data, human resource data, and student data. The Job Applicant data mart was implemented this past year, and work on two new data marts was initiated. Work with Institutional Research on a student census data mart is underway, and implementation is planned for March 2009. Work with Educational Technologies in the development of a course evaluation data mart is in progress.

Although new data marts continue to be developed, and new data continues to be added to the data warehouse, focus is changing to include dashboards, *ad hoc* query access, and parameter-driven reports.

Accomplishments

Several modifications and additions were made to existing data marts to provide additional information to users:

- Calculated files were added to the Virginia Tech Foundation data mart to facilitate balancing the general ledger.

- The finance data mart had specific data elements added pertaining to deans, directors and department heads, making the identification of a department head associated with an organization easier.
- The human resources (HR) data mart had data elements added pertaining to deans, directors and department heads, permitting easier creation of reports and mailing lists that are generated for the departments.
- Retirement deductions were added to the HR data mart.
- Tenure organization was added to the HR data mart, providing the capability for an individual to have multiple areas of tenure, and needed to support reporting to government agencies.
- A degree dimension was added to the student data mart to provide detailed information about Virginia Tech degrees received.

IWA developed several new dashboards in addition to making changes and additions to existing dashboards:

- A course evaluation dashboard developed for the Department of Mathematics and used as a prototype for the course evaluation data mart
- A dashboard for Virginia Bioinformatics Institute that provides them with information about their principal investigators (PIs) and grants funding to measure their goals
- A dashboard for the Office of Research Compliance that helps locate and manage information from grants that require their oversight—human subjects, hazardous materials, government grants that require certain types and levels of security
- A dashboard for the Corporate Research Center that provides summary and detailed data associated with financial statements and balance sheet
- A dashboard for the River Course that focuses on financial data
- A dashboard for Human Nutrition Foods and Exercise that includes information about their students with majors and concentrations, the courses they are taking, and their advisors
- A dashboard for the Office of the Vice President for Research that contains demographic information about PIs in addition to the data from the grants and proposals dashboard
- A dashboard for University Unions and Student Activities for their departmental budget managers that provides a financial snapshot including a statement of revenue and expenditures by fund and account

IWA provided training on the data warehouse, the Hyperion Intelligence Client, query building, and dashboard navigation. Training was provided for individuals who have been granted access to a data mart by the appropriate data steward.

Sponsored Programs	15
Finance	36
Human Resources	30
Student	9
Foundation	9
Tool training	12
Total	111

More than 340 requests for assistance were received. IWA continues to address requests expeditiously and emphasize customer service and responsiveness. This responsiveness is reflected by feedback from several users:

"I really enjoyed the training. Good job, and terrific data base"—Beate Schmittmann, Professor and Department Chair, Physics

"With the excellent help of the Data Warehouse group, I can now pull this data for any time period throughout the year."—Rodd Hall, Associate Vice President, Research

"I just wanted to let you know that this tool has made reporting much more convenient, reliable, and faster for me. I greatly appreciate everyone's hard work on this. I couldn't imagine trying to prepare detailed financial statements or identifying what makes up certain balances without the use of this tool."—Odie Fthenos, Director of Accounting and Financial Reporting, Corporate Research Center

Improving the quality of university data

IWA and data stewards determine data quality control (QC) checks for each data mart. In fiscal year 2008, 250 data-related problems were identified and addressed through the data quality processes used to load and support the data marts. These QC checks help ensure the quality of the data in the warehouse, and improve the quality of Banner data. IWA continues to add QC checks to improve the nightly process, and to ensure the validity of the data that is loaded into the warehouse.

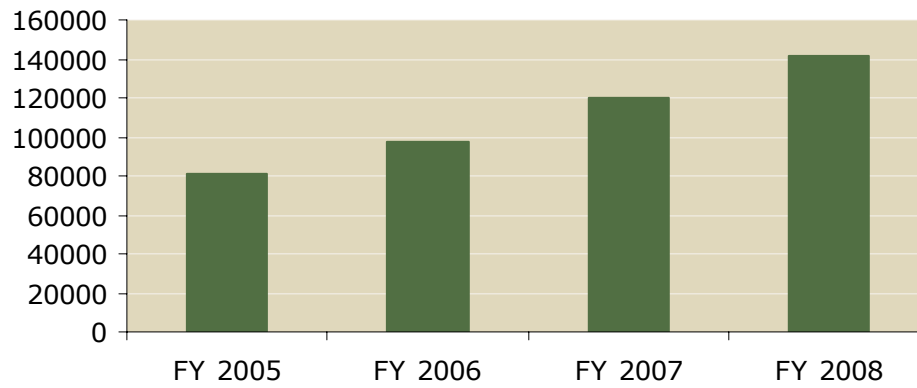
Operational statistics

The use of Web Job Submission and Web Distribution continues to grow. Both of these services increase the efficiency of retrieving and receiving information. Web Job allows the user to select from parameters and submit reports to run when needed for the information that they choose. Using Web Distribution, a user can schedule a report to run periodically and distribute the output. Data files can also be requested.

Web Job submission statistics

FY	Total executions	Warehouse executions	Banner executions	Inter-active	Logins	Total submits	Scheduled submits	Folder submits	Definition submits	Saved submits
2008	141311	121419	19687	38953	92564	141494	19670	6828	96727	44767
2007	119654	105975	13622	28307	75506	119656	16687	6381	81770	37886
2006	97551	93882	3665	9246	55669	97473	11096	6412	68717	28755
2005	80743	80529	214	14	43480	80750	6143	5171	60294	20455

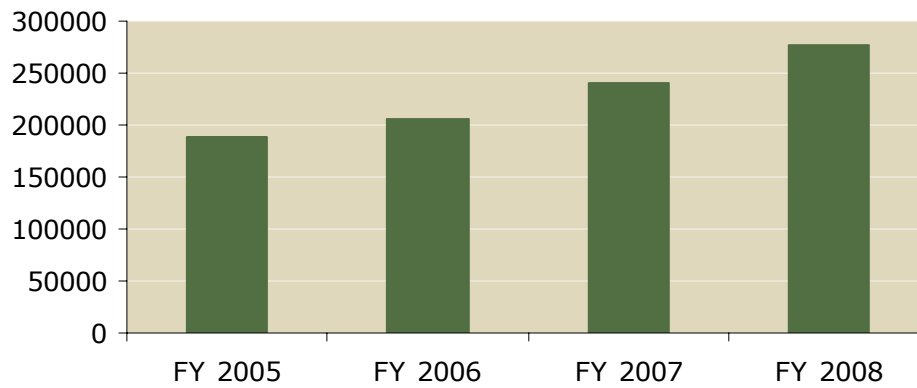
Web Job reports



Web distribution

FY	Reports	Sessions	Logins	Views	View text	View Postscript	View PDF	View Excel	Zip	Docuprint	Labels	Local printer	Distribute	Release
2008	277866	418472	53743	423305	205639	45725	143048	13815	3200	3	206	629	5403	2258
2007	240863	380353	49789	388042	204716	33771	124168	11547	3634	4	263	809	4677	2138
2006	206382	334146	40441	334841	187005	21417	112885	8090	3335	35	289	709	5429	2244
2005	188553	290808	35888	291260	170680	11499	98134	68134	2459	429	348	835	5205	595

Web Dist reports



Outreach—working with other universities

IWA hosted the Higher Education Data Warehousing 2008 Conference in Blacksburg in March. There were 238 participants from 121 institutions with 18 international institutions including Canada, Australia, and United Arab Emirates.

IWA shared our experiences and knowledge with other colleges and universities including the University of New Mexico and the University of Pittsburgh.

Training and staff development

Vicky Shaffer

- Participated in the Higher Education Data Warehousing (HEDW) Forum hosted by the University of Texas; involved in all aspects of the planning for that event
- Serves as the treasurer for HEDW

Georgiy Kolomiyets

- SANS workshop on Web Application Security
- Attended spring SANS workshop at Virginia Tech
- Attended VASCAN annual conference at Virginia Commonwealth University
- Attended the Mid-Atlantic Hyperion Users Group Spring meeting

Alan Moeller

- Served as conference chair for the 2008 HEDW Conference hosted by Virginia Tech
- Attended Oracle Town Hall Meeting covering future plans for Hyperion
- Presented “Three Elements for Success at VT” at the Virginia Association for Management Analysis and Planning in Roanoke

Sonj McCoy

- Attended the Data Warehouse Institute HEDW 2008 pre-conference seminar

Tim Moore

- Attended the Data Warehouse Institute HEDW 2008 pre-conference seminar

Integration and Portal Services

Integration and Portal Services (IPS) provides information technology support in the areas of portal administration, integration processes, the Banner General Person module and processes, web user interfaces, and Enterprise Directory interfaces. IPS currently provides design, development, management, configuration, and maintenance support for the following technologies and services:

- Alumni Directory Authentication Gateway
- Banner General Module
- Enterprise Directory Group Manager
- Guest Account Management Service
- My VT Portal
- PIDGen
- Research Administration System Portal
- VT Alerts Mobile
- VT Search
- uPortal
- SungardHE Luminis system

IPS was formed in the summer of 2007 by merging the Enterprise Systems General Team and Secure Enterprise Technologies Initiatives Collaborative Technologies Unit (CTU). The main focus of IPS is to leverage new integration technologies to reduce redundancy and increase agility, with the overall goal of increasing efficiency and improving the user experience for all Virginia Tech constituents.

Major accomplishment of Integration and Portal Services during the past year include the following:

- Installed SunGard Higher Education's Luminis Platform 4 and began integration with other Banner products
- Began planning and requirements analysis for new Research Administration System
- Deployed the front-end web application for VT Alerts, the application that collects contact information and notification preferences from users for Virginia Tech's urgent notification system (launched on July 7, 2007)
- Developed and deployed the front-end web application for PIDGen, the application used by Virginia Tech affiliates to create their unique Personal Identifier (launched on December 11, 2007)
- Deployed Groups Manager web application that manages access groups in the Enterprise Directory

- Developed portions of the Guest SPA and Guest Access Management Service web application
- Added student pictures to Faculty Access/Hokie SPA, providing access to student pictures to instructors and advisors
- Participated in the acquisition, training, and installation of the new enterprise content management system, Ensemble
- Installed Banner General 7.4.1 and re-applied all modifications
- Installed Banner General 8.0 and re-applied all modifications under the development environment; performed extensive testing on new product functionality such as the UTF-8 data conversion
- Modified the “Dup pidms” process in Banner to remove Social Security numbers, birthdates, and all other sensitive data from reports that are e-mailed
- Identified Social Security numbers inside Banner’s lastname field for removal
- Coordinated the establishment of a centralized web application hosting environment for Enterprise Systems
- Transitioned the budget tuition application from General team to Finance team.
- Transitioned the VT Instant Messaging service from CTU to Network Infrastructure and Services
- Transitioned the Central Authentication Service from CTU to Middleware

Database and Application Administration

Database and Application Administration (DBAA) provides the necessary controls, oversight, performance monitoring, and 24 x 7 on-call responses to ensure a stable and auditable production environment for critical enterprise information technology services.

New application software

- DBAA assisted with the definition and installation of the Luminus environment.
- DBAA assumed support of the GIS Oracle databases.
- DBAA installed and implemented the content management system (CMS) application.

Application software upgrades and migrations

The Banner system was upgraded to new releases of Banner 7 during the year. The upgrades were applied to six Banner databases and four Banner foundation databases to support the Banner environment.

DBAA systems monitoring software was enhanced to include additional alerts, added application software, and hardware. This application is currently being migrated to use the Nagios open source software.

We enhanced software which allows tracking and scheduling of production updates for better security and functionality.

DBAA worked extensively with the Noli Imaging System and vendor to test new releases, modifications, security, and functionality.

SQR was upgraded to new release providing additional functionality and compliance with Oracle and operation system.

DBAA worked with Educational Technologies migrating the Blackboard application to a new release and hardware upgrades.

System software migrations

More than 24 Oracle database were migrated to new releases of 10g during the year. These databases support a host of administrative system throughout the university.

Two new databases were defined to support the geographic information systems application.

Web Hosting and Filebox

The Web Hosting service provides significant support to academic and administrative areas that take advantage of the services. They maintain a secure and stable infrastructure that supports over 1000 web sites including the www.vt.edu, and support for many registered student organizations. Each website potentially represents a Web server that does not have to be maintained by faculty members, graduate students, or staff members. As an enterprise service, this service achieves efficiencies for the university and ensures a more secure environment.

Highlights over the past year include the continued reconstructing of the environment with load balancing resulting in improved performance, reliability, and stability. In addition, server software was upgraded to new releases and front-end security software implemented.

Filebox provides individual web sites for over 25,000 faculty and staff members, and students. It is also used by the faculty for class projects.

Document Management Systems

Document Management Systems (DMS) provides information technology support to the university in the area of secure electronic document and information routing and storage. DMS provides access, management, configuration, coordination, enhancement and maintenance support for the following services:

- Enterprise imaging services
 - Nolij Web Document Imaging from Nolij Corporation
 - Banner Document Management Suite from Sungard Higher Education
- Web content management–Rhythmyx from Percussion Software
- Enterprise wiki service–Confluence from Atlassian
- Bug and issue tracking service–Jira from Atlassian
- Workflow–Banner workflow from Sungard Higher Education
- Information Technology Acquisitions support
 - Computer Purchasing Office
 - Departmental Software Office
 - Student Software Distribution Office
 - Laptop Leasing Program.

Document Management Systems is a new department formed by bringing personnel from the Application Information System Finance Team and Enterprise Systems Support Team, and the Integration and Portal Team together. The support, administration, and enhancement for the Nolij Web imaging system, Ensemble Web Content Management System, Information Technology Acquisitions systems support, and the Confluence Enterprise Wiki Server represent the major focus of efforts for DMS over the last year.

Web content management system

Ensemble is a Web content management system (CMS) provided by Enterprise Systems in collaboration with University Relations. The system uses the Rhythmyx Web Content Management by Percussion software (www.percussion.com/), which was chosen by the CMS selection committee in early 2007. Faculty Development Institute (FDI) courses were provided to train users on system usage. University Relations currently provides and maintains system templates to control the look and feel of websites published from the CMS.

The CMS application was upgraded from version 6.5.0 to 6.5.2 in early March 2008. Since that time, five patches have been applied to the application in order to fix critical and non-critical

issues. In order to avert future issues, Virginia Tech has offered to be a beta tester for future releases of Rhythmyx. Percussion Technical Support has been very responsive to our needs.

There are currently 49 websites managed in the production CMS application server. Of those 49 web sites, 13 are publicly available via the delivery tier:

- Virginia Tech homepage—www.vt.edu
- Human Resources—www.hr.vt.edu
- April 16th Remembrance—www.remembrance.vt.edu
- College of Science—www.science.vt.edu

In the coming months, several others will be launched, including:

- Department of Dairy Science—www.dasc.vt.edu;
- Department of Chemistry—www.chem.vt.edu;
- Arts Institute—www.artsinitiative.vt.edu.

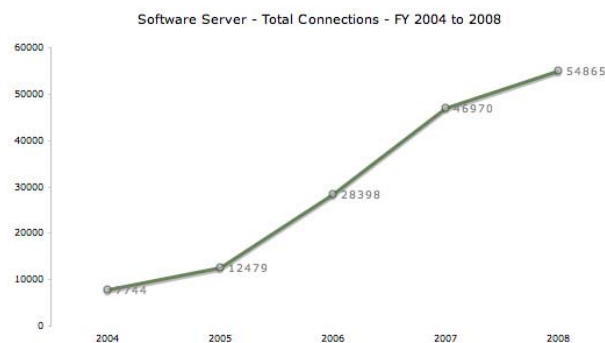
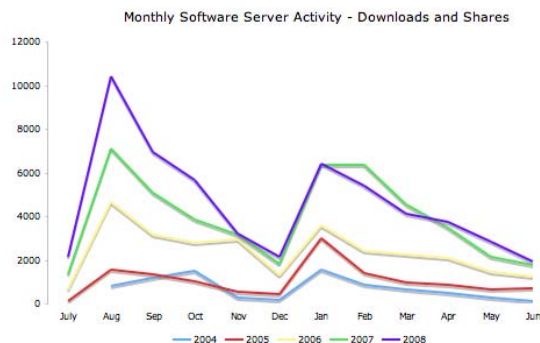
In the immediate future, areas of increased emphasis will be:

- Virginia Cooperative Extension—www.ext.vt.edu;
- VT News—www.vtnews.vt.edu;
- SACS review website—www.sacs.vt.edu.

A custom login module was written for the Virginia Tech implementation of Percussion. The CMS is now fully integrated with the Virginia Tech LDAP for authentication as well as using LDAP groups to manage authorization roles. Planned enhancements include the implementation of Server Name Indication to enable SSL support for CMS managed websites, integration between the creation and management of LDAP groups and CMS roles, upgrade to version 6.6 (not yet released), and expanded training to support additional websites.

Enterprise Systems Support

Information Technology Acquisitions (ITA) provides computer purchasing services and Enterprise Systems Support supplies technical support to these through application development and system maintenance. Application changes required by a recent ITA internal audit brought about significant updates to the departmental software system during the past year with regard to federal fund sales. The student software sales system was modified in 2008 to provide private software sales to Virginia Tech employees. Campus use of the network software server continued to grow with 71 new software titles added since July 2007 and 54,000 connections recorded in the last fiscal year.



Highlights of Enterprise Systems Support support activities from the last year are shown below for each ITA department.

Support for Departmental Software

Automated distribution of license keys for distributed software. A new feature was added to the Departmental Software System to manage software license keys provided to the campus for commercial software. This enhancement allows license keys associated with a product to be batch loaded and then distributed by e-mail at the time of sale to the PID e-mail provided.

FDI distribution and integration for 2008. The Faculty Development Institute distributes hardware and software to 400 class participants each year. The team provided assistance to ITA and the FDI team through Web-based applications that enabled electronic sign-off for the 2008 software license agreements and recorded software license assignments in ITA's database.

Developed tools to allow the ITA staff to manage application roles. This tool will eliminate the need for the Enterprise Systems Support staff to change roles manually for ITA applications.

Federal funds. We added functionality to determine if a product could be purchased with federal funds and, if so, to calculate the appropriate product price. This update was needed to comply with requirements from a 2008 ITA audit. The group worked closely with the ITA staff on a product-by-product review and then batch loaded new product information into the application.

Student Software Sales

LabView apps for license code creation and distribution. DMS worked with ITA and National Instruments personnel in 2007 and 2008 to develop facilitate campus-wide deployment of LabView student licenses. Applications were written to capture student machine information, create a unique license key, and send this key to the student.

Auralog automated e-mail. Auralog, a new product offering by Student Software, required a daily notice to the campus administrator to facilitate access. A script was written to automate this process.

Added employee sales capability to the Student Sales System. ITA was given authority to sell software for personal use to Virginia Tech employees in 2008. The student software application was modified to handle faculty and staff sales.

Bridge. We updated the Bridge application used at check in to clean up old table dependencies.

Compliance. DMS staff in Enterprise Systems Support modified student sales to require all products to use product eligibility rules for sale. This ensures sales always comply with contracts and sale prerequisites.

Serial numbers. We added a "serial number required" trait in the Student Sales systems to avoid selling products without serial numbers.

Matlab licensing. The team worked with ITA on a major update to student Matlab licensing. Because of problems and concerns surrounding this program, Mathworks and ITA came to an agreement in July 2008 to not implement this licensing procedure.

Computer Purchasing

Automated e-mail of purchasing activity to ITA administration. An automated e-mail containing HokieMart and purchasing office orders in a spreadsheet was completed in the past year. The report runs automatically once a week.

Migrated the purchasing staff to Windows platforms and setup webdav shares. DMS assisted ITA in moving all purchasing staff from Macintosh to a Windows platform. Fileserver links for purchasing documents were changed from NFS to WebDAV.

Hokie Mart. The team participated in meetings to discuss integration of Hokie Mart and Department Software.

Contracts. We updated the course management software contract information with 2008–2009 contracts. This system is designed to manage and provide access to course management software contracts for the other Virginia state agencies.

Network software server

Rule code. We reworked the Java rule code framework for easier integration into other Java-based applications.

User web interface. A new user web interface was designed in the past year to arrange products in submenus by vendor. Because the number of software packages available on the software servers continues to grow, the current interface is unwieldy. This interface change also incorporates layout and design from the new university pages.

Installed Samba updates. DMS staff installed Samba updates (3.0.30) on all software servers.

Additional titles. Since July of last year, 71 new software titles were introduced to the site.

Campus Agreement. The team added new enrollments to Campus Agreement rulesets. A total of 119 departments are included in the current CA rule access.

Other

ITA web edits and reports. DMS maintains pages on the ITA website and provides *ad hoc* reports for ITA throughout the year.

Moved Twiki to Confluence. Documentation for ITA support was moved from a TWIKI server running on an ITA server to the Confluence pages during the past year.

Reports. The group responded to audit requests from ITA, and worked with Internal Auditor and ITA to provide needed reports for ITA's audit.

Major server hardware upgrades and associated application testing. DMS worked with Systems Support in the past year in the upgrade of ITA's production servers to new hardware.

LabView. We submitted a summary of our work involving LabView licensing to National Instruments as a case study for publishing on NI's website.

Imaging

Xtender. The Banner Document Management System (XTender product) continues to serve as the Document Management System for the Office of University Scholarships & Financial Aid.

Nolij Web. This fiscal year saw the first full year that Nolij Web provided document management for the Office of the Controller to store university accounts payable invoices. During the year, they averaged 15,000 new images per month.

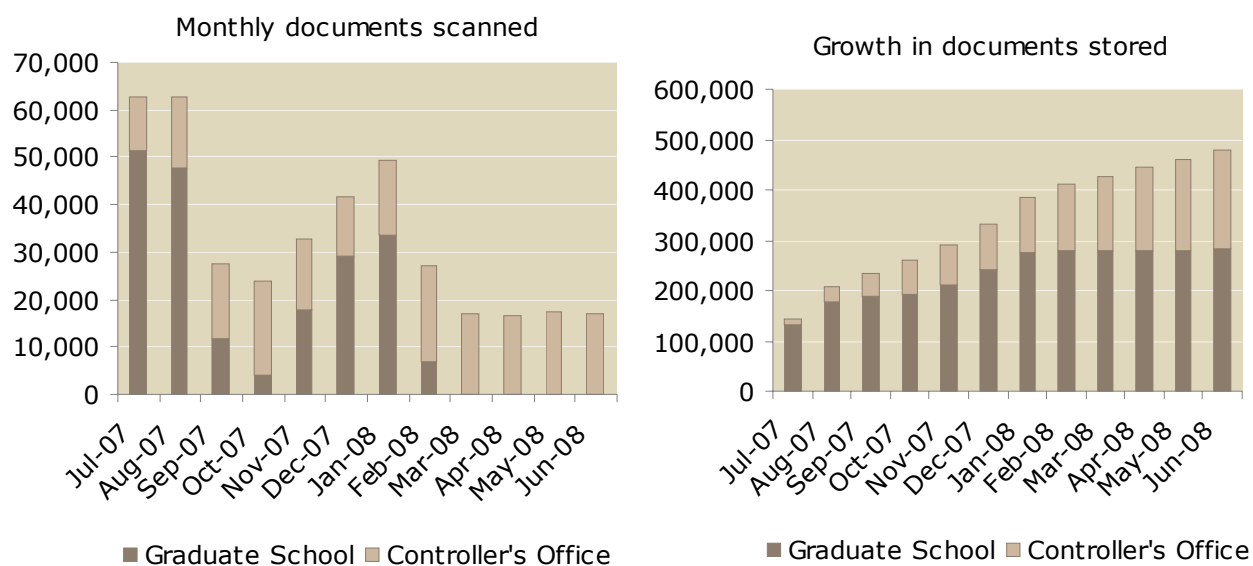
A major upgrade to the Nolij Web software was applied this year. Version 5 of Nolij Web is a new systems architecture that eliminates the need for desktop software and moves the major functionality of the product to a web environment. All clients were converted to the Web version in February of 2008, eliminating many of the security issues inherent in a desktop tool. Because of those concerns, Nolij Web had previously been deployed as a Citrix application. Eliminating Citrix as a requirement to run Nolij Web reduced the support infrastructure needed and greatly improved the performance of the product decreasing document scan delays and increasing the number of images that users could index each day.

During this past year, the Nolij Web image store was drastically rearranged with images relocated and indexes updated to improve the space usage and efficiency of the system. This enhancement also improved the performance of the system.

The Graduate School continues to use Nolij Web as the document management tool for the graduate admissions process and the international student check in process. DMS provided consulting and coordination for the Graduate School in an effort to improve the readability of images scanned from safety paper and other documents printed on paper with backgrounds. Ultimately, they converted to doing color scanning in order to insure the effectiveness of their documents.

DMS continued collaboration with the Nolij Corporation on the enhancement of the security of the Nolij Web system as well as adding improvements to the functionality and usability of the system.

Nolij Web Document Management System activity



Confluence Wiki service. Responsibility for the maintenance and administration of the Confluence Wiki Service was transferred from Learning Technologies to Enterprise Systems this year. The Database and Application Administration team provided the resources to transfer to Enterprise Systems servers and DMS took on responsibility for the administration of the system. DMS drafted new usage guidelines governing the use of the system. Database and Application Administration provided the resources to help DMS upgrade the software to the most current version.

Information Technology Acquisitions

The mission of Information Technology Acquisitions (ITA) is twofold. First, ITA seeks to acquire technology goods and services for the university using best value concepts. Second, ITA makes every effort to acquire and distribute relevant software to the university community at the best possible terms. To accomplish this mission, the department is organized into three major operational entities: Computer Purchasing, Software Distribution (Departmental and Student) and Contract Management, Licensing and Billing.

Software Distribution

Departmental Software Distribution

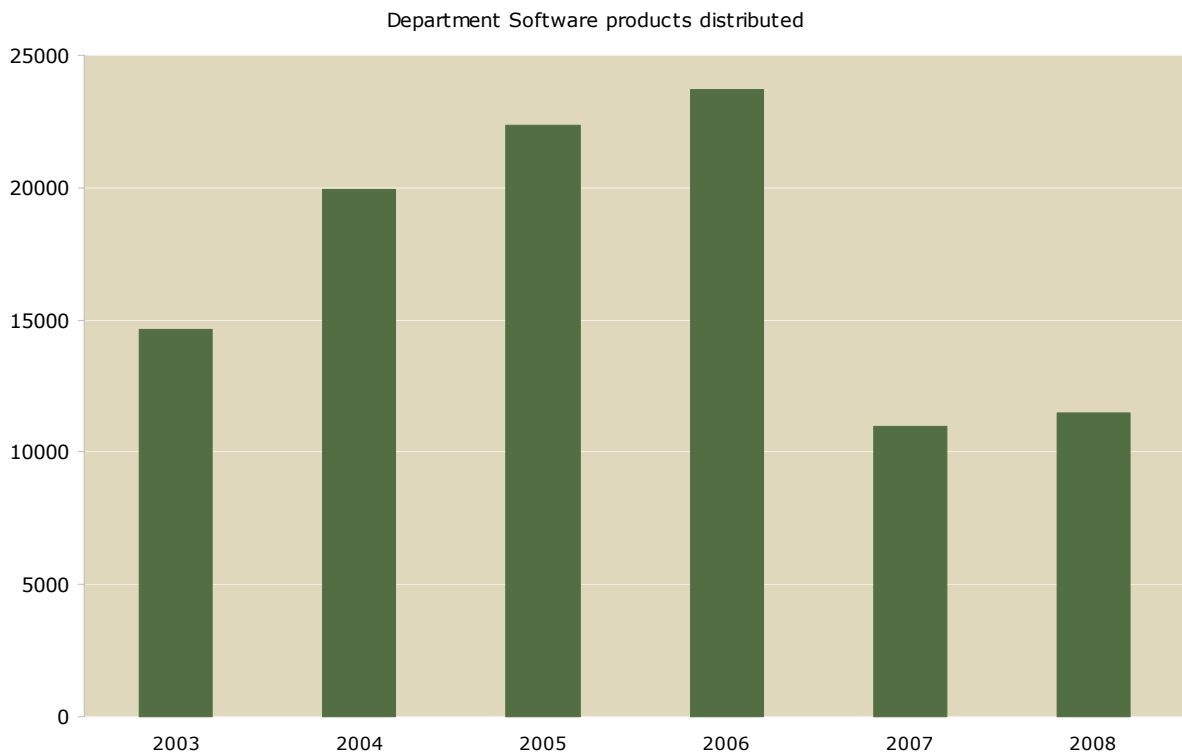
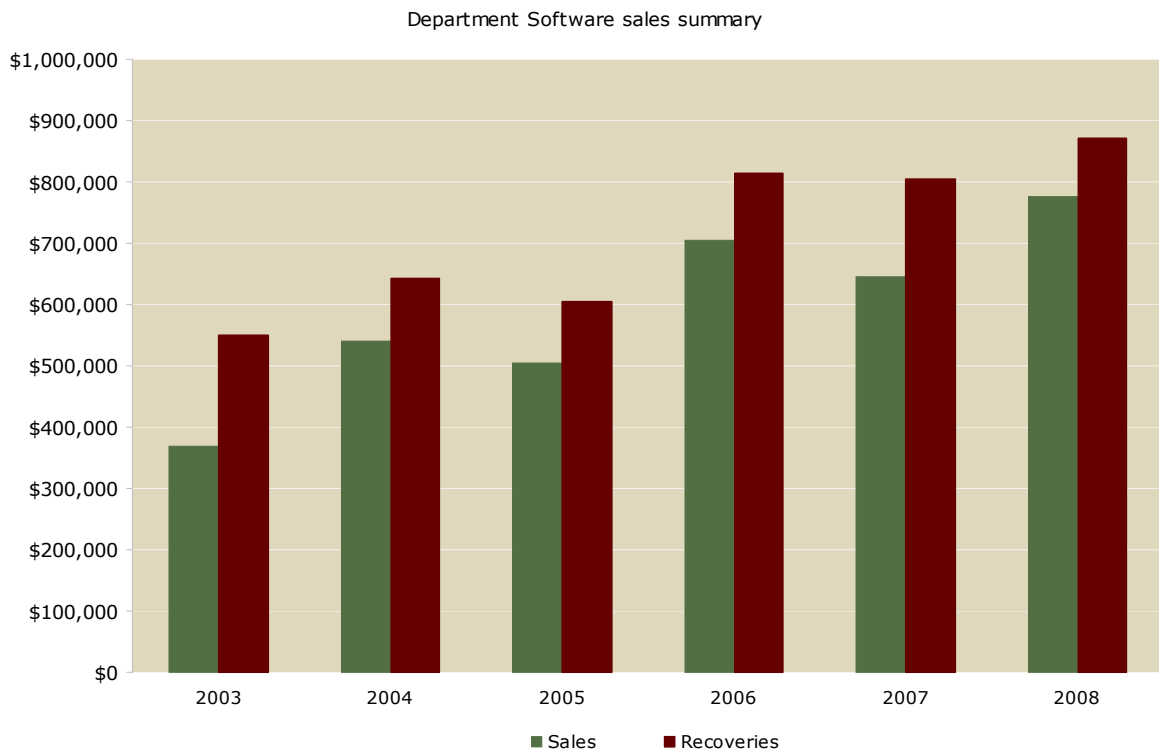
Departmental Software Distribution is a part of the Office of Software Distribution and is organized on a partial cost-recovery basis. Departmental Software Distribution provides software at discounted prices, and occasionally at no cost to departments, with limited support for faculty and staff of Virginia Tech. Software distributed by Departmental Software Distribution includes software purchased through major contracts or site licenses (e.g., Adobe, Microsoft Select, and Campus Agreement contracts) and any software that can be obtained at quantity discounts for which there is a demand by departments. Departmental Software Distribution also offers a limited number of laptops for short-term lease to departments. The only form of payment Departmental Software Distribution accepts internal to the university is payment using an interdepartmental service request (ISR). Total recoveries include billings to other universities for their share of the Virginia statewide ESRI education license that we manage.

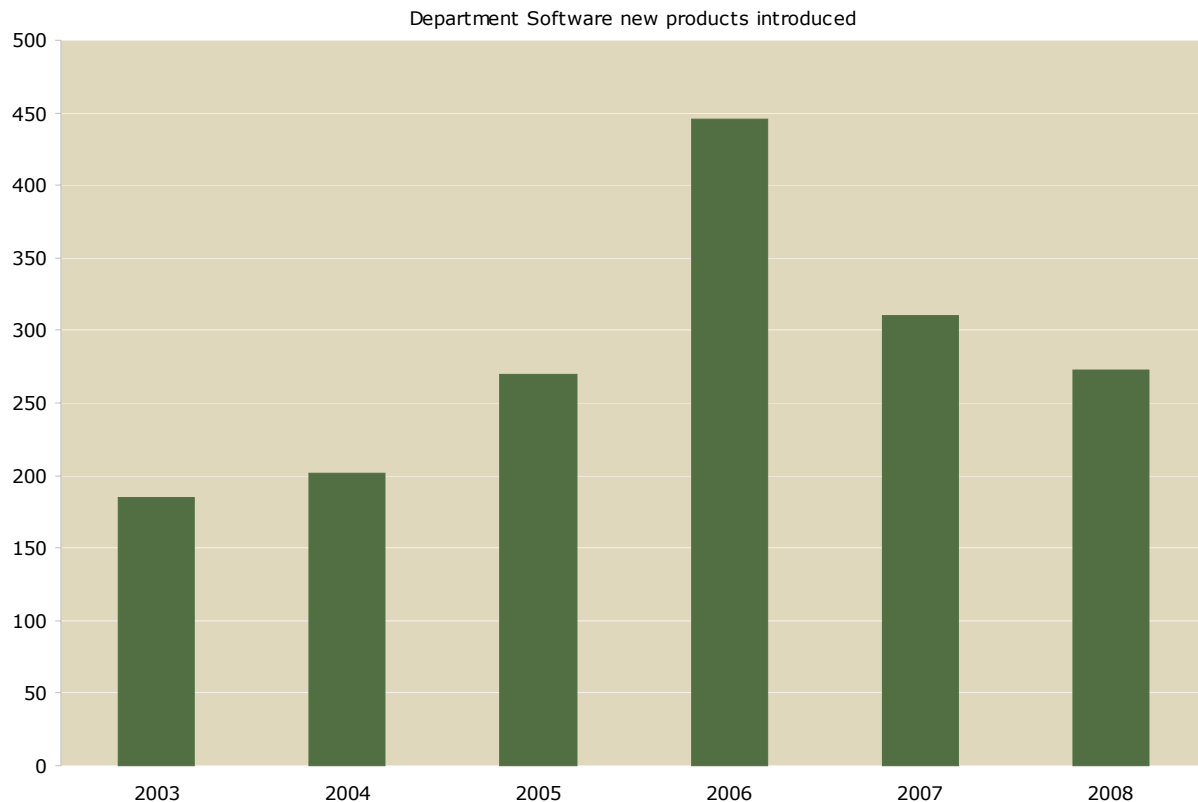
Over the last year, Departmental Software Distribution expanded its capabilities in support of the academic missions of the university community by serving as a resource for departments that were in need of specialized software but did not have the numbers to purchase the software at reduced rates. Through our initiatives, we were able to add many departments to Microsoft's Campus Agreement. New additions include Human Resources, Systems Engineering and Administration, Alumni Relations, the Microsoft Implementation Group, Critical Technologies, eProvisioning, Secure Enterprise Technology Initiatives (SETI) management, and SETI Test and Deployment. Again this year, we concentrated on obtaining training in new software applications. In December 2007, in cooperation with representatives from Adobe, we sponsored "Adobe Day." This was an open event and provided hands-on training on the new releases of Adobe Acrobat and Creative Suites. Additionally, ITA provided support for the Auralog

TELL-ME-MORE training initiatives that were sponsored by the Department of Foreign Languages and Literature and by the English Language Institute. This software provides a more comprehensive approach for faculty who teach Spanish, Chinese, and Arabic foreign languages. The photos below illustrate how the Auralog TELL-ME-MORE software was integrated into classrooms across the university.



The following graphs show totals per fiscal year of ISRs processed, total items distributed, new products added, and distribution of software by server. Sales billings to departments vary each year based on the mix of products that are purchased by departments. Fiscal year 2003 was down due to an Information Technology security initiative to provide Microsoft Window XP and Office products at no charge to reduce the number of vulnerable systems. The sales drop in fiscal year 2005 resulted from a change in product mix and a drop in price for Adobe, Macromedia, and Mathworks products. The increases in fiscal years 2006 and 2007 reflected both volume increases and the addition of the Department of Education to the ESRI statewide education license. Sales include all ISRs processed for departments. Total recoveries are higher because of ESRI billings to other colleges and universities in the state. In this fiscal year, we saw an increase in overall revenue as well as an increase in products distributed. Much of this increase came in the form of new releases from Microsoft and Adobe, new Campus Agreement subscriptions, and from new titles that were added to our distribution list such as SNAP Surveys, NVIVO, Diffpack, and Spaceclaim.





Individual products distributed include licenses, departmental licenses, and additional CDs and DVDs purchased. Distribution numbers do not include numbers related to site licenses distributed through the network software installation service. The decrease seen between fiscal years 2006 and 2007 is due in large part to a redesign of the naming convention of many of our products in 2006 and a significant increase in the distribution of Microsoft products on our network server in 2007. The decrease in new product offering has come about as departments establish base product staples within their programs, changes in the way products were distributed (for example,. conversion of several CDs to one DVD), discontinuation of back releases, and a change in product naming conventions such as an annual releases instead of individual product descriptions. Additionally, in 2006 Adobe purchased Macromedia and began clustering their product sets in an effort to encourage the suite purchase of Adobe products. As in previous years, the clustering of products continued in 2008 as companies such as Adobe made it more difficult for departments to purchase individual products due to price hikes. This past year, the Faculty Development Institute could only provide Adobe Dreamweaver to half of the faculty machines they distribute due to Adobe's effort to push Creative Suites 3.

In 2008, we continued to see an increase in software that is being distributed by downloads, compared to 2007. Several departments were added to Campus Agreement last year, and the satisfaction with the program has been impressive. The technology and those that maintain the system have made the just-in-time program successful. To date, we are serving more that 3800 faculty and staff full time equivalents (FTE). As more departments become familiar with the

benefits associated with Campus Agreement, we expect the FTE count to continue to increase over the next several years. In 2008, we added several new product offerings. These included SNAP Surveys, Diffpack, and Spaceclaim.

Student Software

Student Software Distribution is a part of the Office of Software Distribution and is organized as an auxiliary. Student Software Distribution was organized to provide software for the engineering freshman software bundle. It now handles bundle requirements for seven academic areas. Student Software also distributes software to other students, primarily Microsoft Office and Adobe releases. It handles only software that is requested specifically to support an academic program, such as the freshman engineering bundle; or is only available as an add-on to a current university contract. The software must be priced for students significantly lower than otherwise available.

The next graphs show total sales by fiscal year and total products distributed through those sales. The sales drop in 2005 was due primarily to the decrease in price of the engineering freshman software bundle. Since 2002, the price of the bundle has dropped from nearly \$500 to \$280 in 2008. This reduction was accomplished through better pricing obtained on the components of the bundle. The sales increase in 2006 primarily came from an increase in the number of engineering bundles, the new architecture bundle, and brisk sales of Adobe Creative Suites. Total units distributed have continued to rise because of the factors noted above and an increase in the number of free upgrade trade-ins processed. The decrease in distribution shown in 2007 reflects a significant delay between our ability to acquire Microsoft's new release of Office and the last date to purchase the previous version. In 2008, we see considerable growth in sales than in previous years. Some of this growth can be attributed to the significant increase in sales of the upperclassman business and engineering bundles as well as Microsoft's new release of Office 2008.

The software server connections graph shows the explosive growth we have experienced in distributing software to students and departments via downloads or virtual mounts. We now offer 23 software titles encompassing more than 54 GB the network software server. We continue to invest in new hardware and software to stay ahead of this demand.

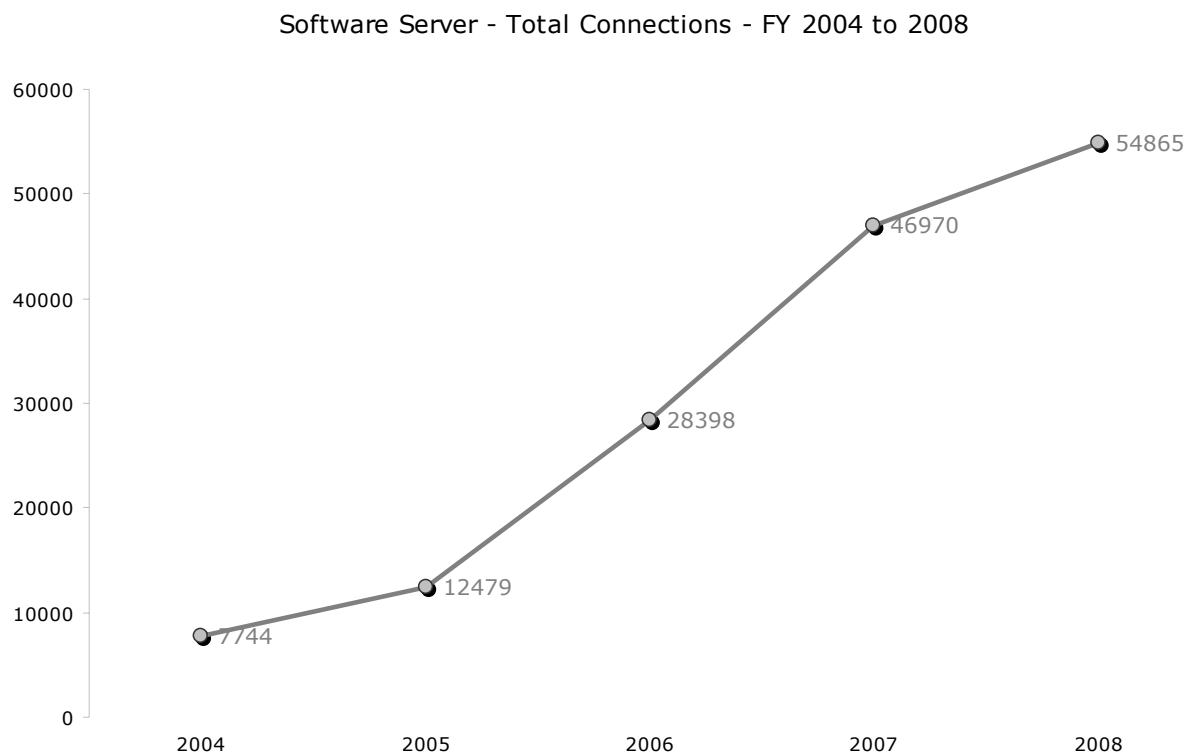
As licensing and activation methodologies continue to change in an effort to combat piracy, processes had to be developed that not only met the needs of the vendors, but would also fit into the way ITA ensures contractual compliance. In 2007, ITA was informed that Mathworks had changed their licensing scheme. With the release of Matlab 2008A, individual machine activations would require a separate code that would be controlled through the Mathworks licensing center. In previous years, the university was provided with a single personal license password (PLP) that allowed our customers to activate their licenses. Several hundred hours were spent between the technical teams of ITA and Mathworks to resolve the mass distribution issues that were foreseen by the ITA team. Due to the efforts of our technical team and their ability to provide testing data to Mathworks, ITA was able to acquire a student total academic

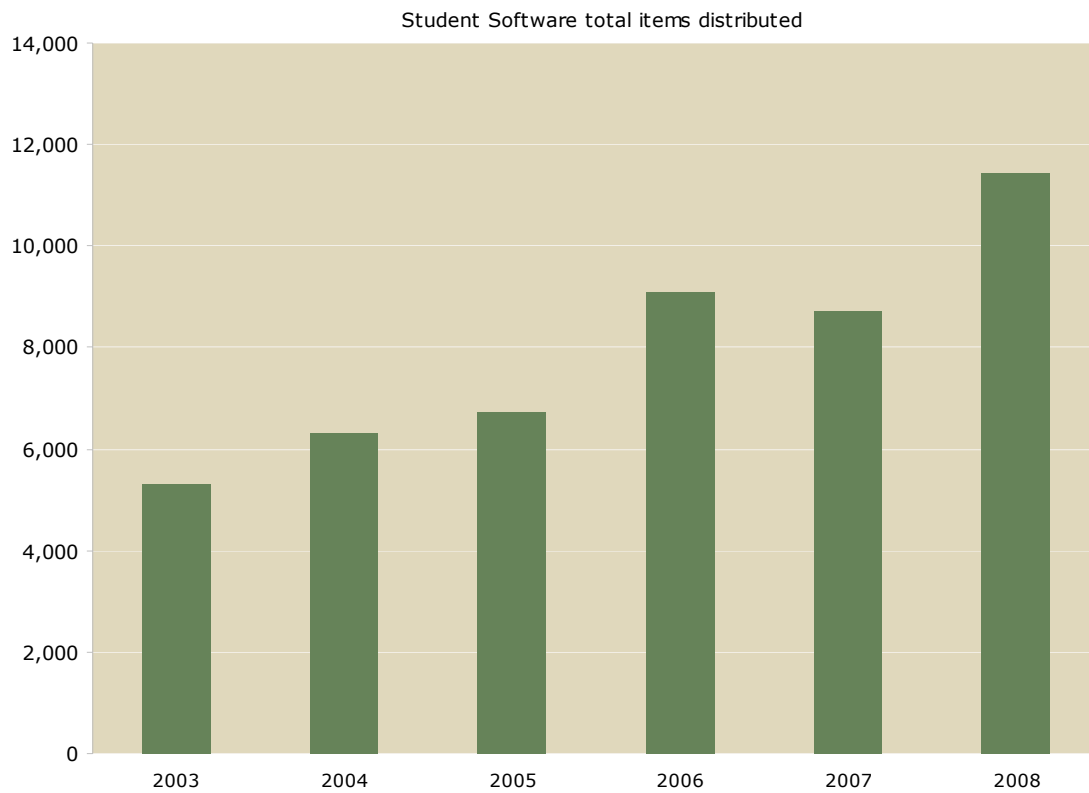
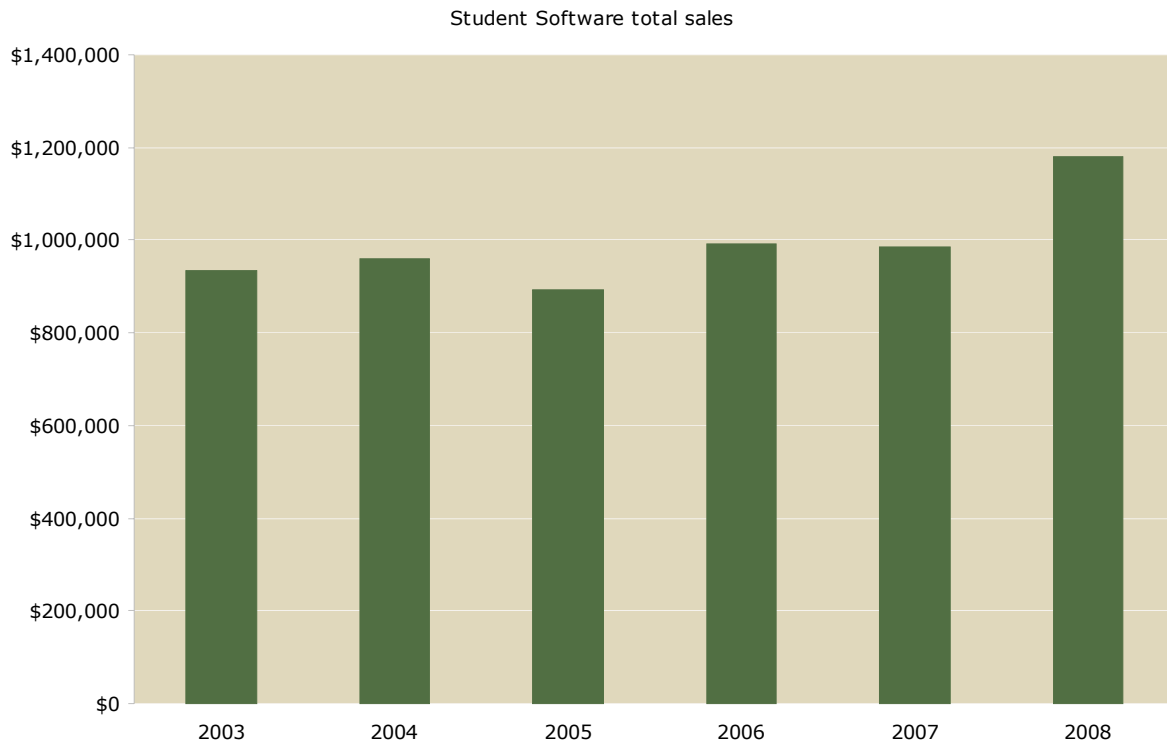
headcount (TAH) activation methodology for the university at a reasonable price. The TAH is similar in practice to the PLP where there is only one code that covers the student population. However, unlike previous years, students must establish Mathworks accounts prior to activating their licenses on their machines. Additionally, ITA has ensured an avenue to revert our Matlab licenses to the Mathworks standard activation model should the student TAH not work for the university.

This year brought about several new product releases. Adobe released new versions of Acrobat and Creative Suites. PDF Annotator, SAS, ESRI, and Microsoft also released new versions of their software.

The fall 2008 student pre-semester check-in set records for the department. This year, we set a daily record (1029 sales), and a five-day total record (3560 sales) while the average wait time was 6 minutes. To date, we have sales totaling over 7800 units. This year, vendor participation in the associated “VT, I.T., and You” was up with the inclusion of National Instruments, Apple, Microsoft, Mathworks, CDW, and Adobe.

Once again in 2008, ITA served as a valuable resource to departments that were in need of product negotiation with vendors. Products such as SNAP Surveys were acquired at a much discounted price from the original quote due to our efforts. As we move forward, colleges and departments that are in need of specialized software for their students have begun to call the Software Distribution office to make their requests.





Contract Management, Licensing and Billing

The Contract Management, Licensing and Billing section of ITA has responsibility for managing the various contracts and licenses that are used for distributing software to the university and the state of Virginia. Virginia Tech continues to hold the Virginia Association of State Colleges and University Purchasing Professionals (known as VASCUPP) contracts for ESRI's geographic information system software, a contract that now includes all middle and high schools in the commonwealth, and for Blackboard and Angel (learning management systems). Billing for both Student Software and Departmental Software is handled by Contract Management, Licensing and Billing. This section also manages most of the technical aspects related to software distribution with regard to the following activities:

Developing various software distribution methods. Students and faculty members are able to access software via direct download of ISO images, as well as through the creation of virtual mounted drives.

Creating and managing license codes. For example, we create yearly Matlab activation keys that terminate on a specific date to manage our licenses.

Manage license servers. In addition to managing and hosting the license manager for LabVIEW and Diffpack, we also access the license managers hosted by MathWorks and Minitab to generate license files.

Troubleshooting. We are responsible for troubleshooting various software installation and activation problems.

Departmental liaison. The section acts as a liaison to departments regarding access to software and services specified in contracts. These include Microsoft download products and volume license keys.

This year the Contract Management, Licensing and Billing section of ITA spent several hundred hours making sure that the new Mathworks Matlab licensing methodology was going to work and scale to our needs.

Computer Purchasing

Computer Purchasing manages the fulfillment of campus-wide requirements for information technology, including computers, software, systems, storage, maintenance, service, and negotiation of end-user license agreements. The office establishes new competitive contracts,

utilizes existing internal and external contracts, and solicits competitive quotes to achieve the most effective and efficient procurement process, meet end-user requirements, and assure compliance with university and state policies and procedures and legal requirements.

Growth trends in information technology continue at a rapid pace. On the hardware side, more server and storage space is needed to meet user demand, and the rate of obsolescence is compressing. On the software side, specialized software is sought, licenses are more complex, companies are merging, and security issues require frequent updates. These growth trends increase the complexity, cost, and volume of information technology acquisitions.

Computer Purchasing achieved numerous advancements and implemented novel approaches for increased effectiveness and efficiency in fiscal year 2008. Several key advancements include:

Incentives. The first incentivized contract was negotiated and issued this year. This new approach supports critical delivery milestones by defining ranges of delivery dates and adding or subtracting percentages of the milestone payment based on actual delivery date of conforming goods and services.

Intellectual property. The first two-stage competitive procurement was completed to accommodate confidentiality of Virginia Tech intellectual property while remaining open for competitive procurement.

New contracts. Several competitive procurements were awarded with others in process, a detailed, multi-phased process spanning many months. Some contracts are open for state-wide use, while others are specific to Virginia Tech.

Streamlining. Contract use was expanded to include competitively awarded cooperative information technology contracts through the Government Services Administration for new options to streamline procurement processes.

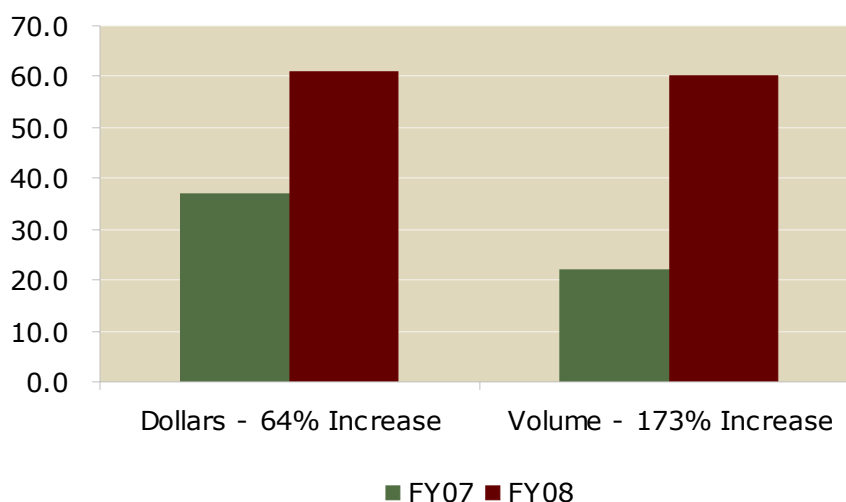
Evolving. To best meet evolving procurement demands in the complex and rapidly advancing field of IT, several transitions in responsibility were made. Staff skills and experience allowed a redefinition of the half-time staff position to assist with small-dollar purchase orders, the support staff position to maintain license records, the senior buyer to focus on large/complex orders, and the contract officer to focus on requests for proposals (RFPs) and large/complex orders.

After a progressive transition the latter part of last year, this year was the first full year of HokieMart implementation, HokieMart is now the university's single point of entry for procurement. This system enables the Offices of Purchasing and of Computer Purchasing to manage increased volume by automatically generating smaller dollar and contract purchase orders (POs). The system's punchout sites expedite the order process for end-user purchasing by providing a controlled list of contract commodities and services.

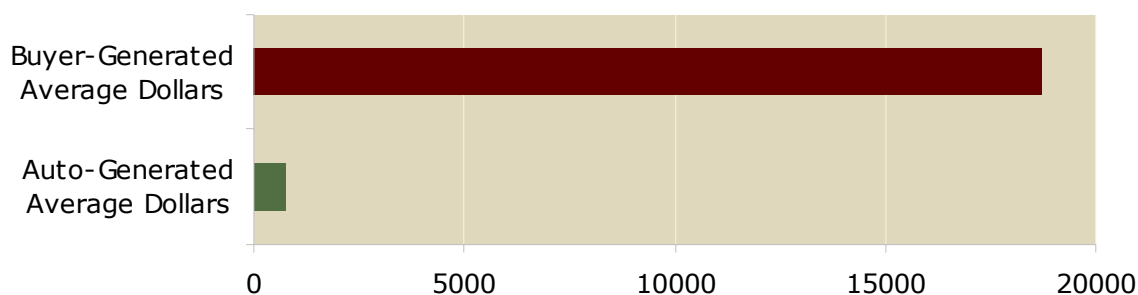
Two new ITA punchout sites were added to HokieMart. Computer Purchasing worked with Technology Integration Group, a Department of Minority Business Enterprise-certified minority-owned business, and CDW-G, to add their products and services to their new punchout sites.

These additional sites further streamlined university-wide procurement processes by allowing HokieMart to auto-generate a larger volume of contract POs.

The graph below reflects the immense growth in information technology acquisitions for combined buyer-generated and auto-generated orders. Order dollars increased by \$23.7 million, a 64% jump, and order volume increased by \$38 thousand, a 173% rise. Computer Purchasing continues to provide quality, value-added service, particularly for the larger, more complex procurements. This year's full implementation of HokieMart helped Computer Purchasing keep pace with rapid growth.



There is a wide variance in average order dollars for buyer-generated orders, averaging \$18,734, compared with auto-generated orders, averaging \$776. Computer Purchasing buyers issue POs that are larger dollar amounts, require quotes, require negotiation of license terms, request special processes, or involve competitive bids or proposals.

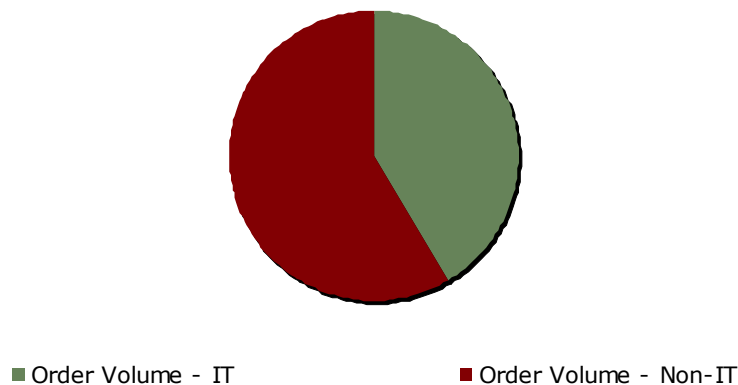


The type of procurements shifted this year to include five RFPs this year, more than any prior year. The department also consulted with several departments to plan for future RFPs. RFPs are the most complex procurement process and involve an average of four to eight months of

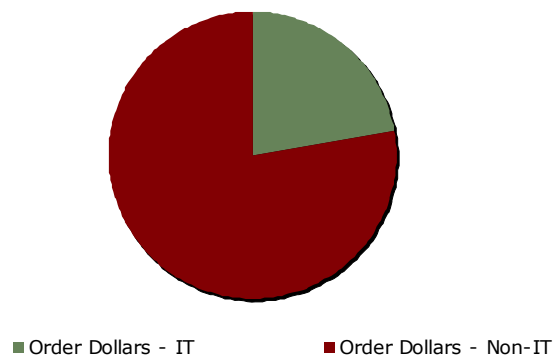
preparation, open solicitation, proposal evaluation, negotiation, contract writing, and legal review. The range of time depends on complexity, participant availability, and negotiations. RFPs are the appropriate procurement method for orders that have more complexity, have requirements that are more outcomes based than narrowly defined, and have multiple evaluation criteria beyond price for best value to the university.

The following graphs compare auto-generated information technology orders with auto-generated non- information technology orders. The data indicate that full implementation of HokieMart affected information technology-related auto-generated orders by increasing order volume compared over the previous year.

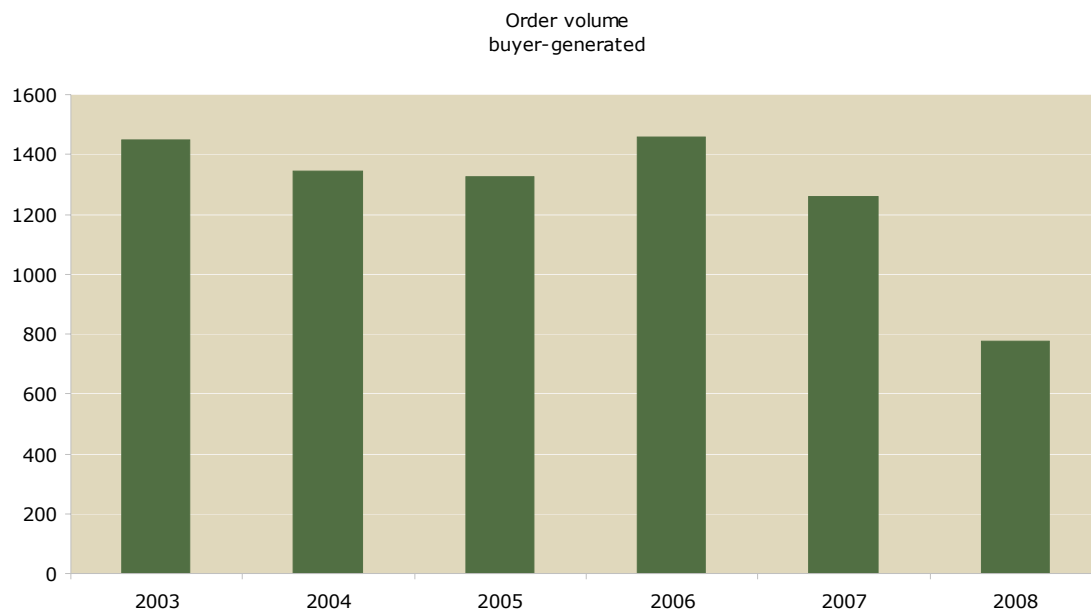
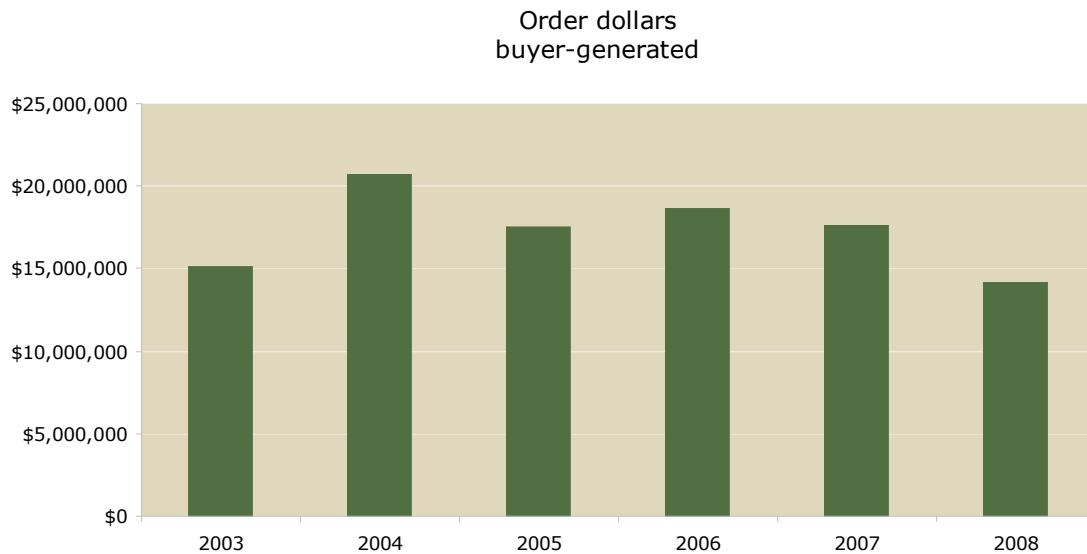
Order volume--auto-generated
Information technology /non-information technology



Order Dollars - Auto-Generated
Information technology/non-information technology

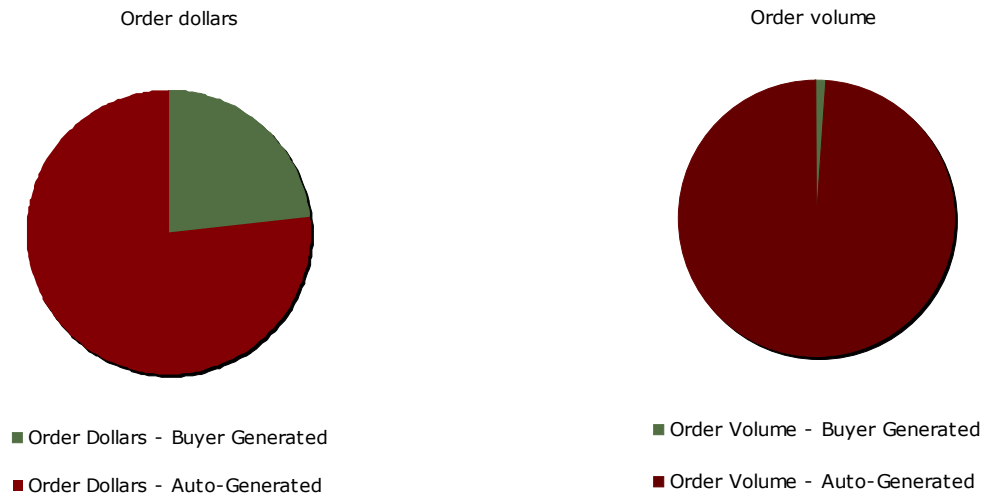


The order dollars and order volume buyer-generated graphs reflect the impact of this first full year of HokieMart implementation. HokieMart enabled Computer Purchasing to manage increased volume by automatically generating smaller dollar and contract purchase orders, resulting in a reduction of buyer-generated order dollars and volume.



HokieMart absorbed the 64% growth in dollars and 173% growth in volume. Larger, more complex orders were completed by the Computer Purchasing buyers. The average dollar amount of Computer Purchasing POs was \$18,734, compared with the average HokieMart auto-generated POs of only \$776. The large number of auto-generated orders along with the

significant increase in information technology-related dollar amount point to the advantages that HokieMart has provided to departments. Departments can purchase more frequently on an as-needed basis. Computer Purchasing continues to provide quality, value-added service, particularly for the larger, more complex procurements.



Information Technology Security Office

The Information Technology Security Office has three operating entities—the Information Technology Security Office, the Information Technology Security Lab, and Information Resource Management.

The Information Technology Security Office (IT Security Office) provides technology tools and services, education, awareness, and guidance necessary for all users to work towards a safe and secure information technology environment for teaching and learning, research, outreach and the conduct of university business. The office is also responsible for the Information Technology Security Lab and Information Resource Management.

The goals and objects of the IT Security Office are to:

- work with university management to ensure educational and promotional programs are made available to the entire university community;
- design, develop, and implement training materials and classes, in-person and online, for the general user community;
- work with departments on and off-campus to increase their security awareness, and ensure that developed and purchased software meets minimum security standards;
- incorporate various awareness programs into daily user activities;
- assist in providing technical training with the Information Technology Security Lab;
- work closely with the Office of the Vice President for Information Technology to ensure opportunities to enhance the technology security environment are considered and incorporated into plans as appropriate;
- ensure departments under the Vice President for Information Technology annually complete a continuity of operation plan;
- incorporate the continuity of operation plans into an appropriate structure for a disaster recovery plan(s), and ensure each plan is up-to-date with contact information and organizational changes;
- maintain a central security web site that can be used as an informational tool and provide university users with access to security-related policies/procedures, informational/educational resources, critical notices, and security-based tools for use at the departmental and individual levels;
- work with other university security personnel to evaluate current policy and procedures, and recommend updates and define areas needing new policy and/or procedures;

- follow-up on Internal Audit reports that deal with technology issues, ensure the college/department understands what needs to be corrected, and offer assistance as needed to satisfy audit comments;
- coordinate and manage the Virginia Tech Computer Incident Response Team, and coordinate and maintain the Virginia Higher Education Computer Incident Response Team mailing list;
- function as the Root Certificate Authority for Virginia Tech in the area of digital signatures;
- provide a technology security review service to all departments on campus and at remote locations to ensure they are operating in a secure and safe technology environment, including:
 - performing daily system scans to identify potential exposures and take appropriate actions to correct;
 - providing tools to identify sensitive data, to remove and/or protect, and to ensure individual machines are meeting the minimum security standards;
 - working closely with Internal Audit and the Office of the Controller to identify critical areas that need security reviews;
- provide Information Technology departments with goals and guidance in ensuring that computer and network security is designed and integrated into the development and implementation of information technology applications;
- provide leadership and direction for the Information Resource Management and the Information Technology Security Lab, securing appropriate funds and assisting them in planning efforts and obtaining their goals.

Major accomplishments and ongoing activities for the year are categorized into several topical areas.

Education and awareness

- The year saw an extension of our aggressive stance to educating the university community to technology security issues, policies, and initiatives.
- The IT Security Office was involved in over 100 presentations, training sessions, and informative talks throughout the year, reaching a large number of people:
 - Approximately 400 faculty members through the Faculty Development Institute
 - Approximately 200 staff members through Human Resources training
 - Over 4000 students in academic classes
 - An additional 100 faculty and staff members in departmental presentations
 - Faculty and student organizations
 - Other presentations to off-campus university groups and to non-university groups
- Staff members of the IT Security Office participated in all Faculty Development Institute sessions during the spring and summer and in selected groups during the past months.
- The staff also provided technology security awareness to orientation sessions:
 - The IT Security Office assisted orientation leaders in developing appropriate presentation for the incoming student orientation held during the summer.

- Staff members presented security session at several other student orientations—international students, new graduate teaching assistants, graduate student orientation fair, College of Engineering freshman orientation.
- We worked with other areas to present to new faculty members during their orientation.
- We participated as part of classified employee orientation on a weekly basis.
- The IT Security Office maintained and improved the security website to provide users with easy access to security tools and references for the latest security news.
- Staff members assisted in hosting professional security-related programs on campus for both technical and non-technical personnel (see details on technical classes in later section).
- We used publications, both locally and on the national level, to promote security issues within higher education:
 - The IT Security Office staff created and published the *IT Security Quarterly Hot Sheet* newsletter to keep the university abreast of news related to the IT Security Office.
 - We provided materials for the ITELL monthly newsletter.
 - The staff prepared a section on technology security for the Information Technology fall reference guide.
- We participated in programs where visitors were hosted by other departments by sharing our technology security programs.
- Student interns worked in the IT Security Office to reach out to the student population using technologies commonly used by those users, and developing other methods such as posters and tent cards to reach students.
- New initiatives for the Fall 2008 academic year included:
 - a series of four posters for distribution to resident advisors and staff members;
 - creating Virginia Tech IT Security mouse pads for distribution during National Cybersecurity Month (October);
 - an information technology security video to be used in Human Resources training for new staff members.

State and federal interactions

- The IT Security Office continued active participation in the Virginia Alliance for Secure Computing and Networking (VA SCAN, www.vascan.org).
- We assisted in planning the VA SCAN 2007 annual conference held at Virginia Commonwealth University, and will host the VA SCAN conference in October 2008.
- Staff members worked with the SANS Institute on educational opportunities for higher education, and with the Center for Internet Security on tools and possible training programs, including assisting in providing video broadcasting for one- and two-day sessions.
- Staff members were active with EDUCAUSE, particularly with various security initiatives.
- We worked with state agencies through VA SCAN to provide technology security presentations at various agency locations around the commonwealth, including presenting to all security offices for the Virginia Community College System.

- Staff members attended a major security conference for higher education in Washington, D.C., and participated in committee work to improve offerings to institutions.

Continuity of operations plans, business impact analysis, and risk assessment

- The IT Security Office oversaw the process for the Information Technology organizations to develop individual continuity of operations plans (COOP).
 - We reviewed the COOP structure to see if risk assessments can be incorporated into the current format, and we will meet with COOP and Internal Audit personnel to see if these COOP activities might be combined with business impact analysis and risk assessment for university departments.
- We worked with Internal Audit and campus departments to ensure departments have an updated assessment with necessary information.
- We made minor modifications to the risk analysis forms and updated them on the security website.

Disaster recovery plan

- The COOP structure was incorporated into disaster recovery planning and development, eliminating redundant data between two documents, and redefining the “teams” in the disaster recovery plan.
- Staff members worked with other Information Technology units to ensure each recovery plan interacts in the proper manner.
- We worked with Network Infrastructure and Services to ensure their plan reflected organizational changes and COOP efforts.

Security review program

- The IT Security Office provided resources and direction for the security review program that has been implemented university-wide and secured necessary funding.
 - We developed procedure to use available scanning tools to daily identify potential risks for the university.
- We secured the funding required to expand tools used in daily efforts to identify vulnerable areas within the university community.
- The staff worked closely with the Office of the Controller and Internal Audit to identify critical areas for review.
- We worked with staff members to define ways to identify areas within the university that might be a high risk.

Enterprise Directory initiative

- In providing sponsorship for the Enterprise Directory (ED) initiative, we recommended that the ED Advisory Group meet only as needed, supplemented with e-mail contacts for implementation efforts.

- We worked closely with Secure Enterprise Technology Initiatives and with Information Resource Management to ensure that releases of ED updates are done in an orderly and timely manner.
- The IT Security Office ensured that Information Resource Management has the necessary resources to assume production responsibilities.

Information Resource Management

- The IT Security Office worked closely with Information Resource Management (IRM) to ensure they have necessary resources for backup personnel.
- We assisted the director of IRM in looking at processes that can be automated to provide a more efficient and auditable environment.
- The office also worked with the IRM to become more involved in areas that impact access to systems—Enterprise Systems, various directories, and data stewards.

Virginia Alliance for Secure Computing and Networking

- The IT Security Office actively represents Virginia Tech to VA SCAN, participating monthly in a conference call or on-site meeting.
- The office provides materials and information for the VA SCAN website so they may be available for other institutions and for the public.
- The office is an available resource to provide security awareness training to other Virginia public/private schools as requested.
- The next annual meeting, VA SCAN 2008, will be hosted by Virginia Tech in Blacksburg in October.

Staff professional development

- Nick Pachis obtained the GCIH Gold Certification, and received the GIAC PCI STAR award. His certification paper can be found at www.sans.org/reading_room/whitepapers/incident/32819.php.
- Staff members attended Educause Security Conference, local SANS classes, the VA SCAN conference, and local professional meetings/training.
- The Security Officer represented Virginia Tech at local, state, and national meetings.

Information Technology Security Lab

The Information Technology Security Lab (IT Security Lab) exists to actively design, develop and implement computer and network security tools, training materials, and classes—in-person and online—for university technical and general users. The lab also is responsible for the security review process that works to identify vulnerable systems and to make recommendations. It will test computer hardware and software for security vulnerabilities under the direction of the IT Security Office. The lab will act as a testing facility for cooperative research project between

the IT Security Office and academic researchers, and provide testing services to external entities according to a fee schedule.

The goals and objectives of the lab are to:

- develop and provide technical education related to technology security concerns for system and network administrators within the university, by
 - coordinating training opportunities with distance learning initiatives at the academic and continuing education levels;
 - providing similar offerings outside the university through professional organization, conferences and various state and federal agencies;
- support the IT Security Office in providing general awareness training for groups associated with the university including the faculty and staff, students, and guests;
- direct efforts to provide a technology security review for university departments to help ensure a secure and safe operating environment, and prevent potential data disclosures,
 - placing special emphasis on sensitive data issues and providing tools for user community;
 - using scanning tools and work with the Controller's Office and Internal Audit to identify critical and vulnerable areas at the university;
 - responding as appropriate to requests received directly from departments and/or other areas;
- assist the IT Security Office as a key member of the Virginia Tech Computer Incident Response Team by providing necessary technical assistance, and defining guidelines and procedures for the six phases of computer incident response: preparation, detection, containment, eradication, recovery and follow-up;
- maintain and continually improve a lab environment that will support academic and research efforts for the institution, through
 - course offerings dealing with technology security and course materials as needed for both undergraduate and graduate classes;
 - research in the IT Security Office and also other departments on campus that have significant interest in cybersecurity areas;
- maintain a security testing and certification lab environment that can be used internally for testing network capable devices, and can be contracted with for certification of compliance of vendor security software with Center for Internet Security benchmarks, utilizing a teaching hospital model that will also support the academic/research efforts;
- develop and maintain a "Security Operations Center" that will provide detailed, up-to-date information on possible intrusions, and provide a toolset for the user community in doing more self-evaluations on machines and traffic;
- provide forensics support for detail analysis when requested by appropriate authority within the university;
- be active in professional associations at the local, state, regional, national and international level on computer security issues.

Major accomplishments and ongoing activities for the year reflect the instructional and research missions of the unit.

Technical education and awareness:

- The lab was responsible for hosting the 2007 SANS-EDU program at Virginia Tech.
 - Topics taught were PCI Security Standards (AUD 521), Windows Command Line Kung-Fu (SEC 531), Reverse Engineering Malware (SEC601), Advanced Network Worm and Bot Analysis (SEC 514).
 - There were 159 attendees from US, Canada, and New Zealand.
- We hosted the 2007 SANS-EDU one-day course on Windows Vista Security that used interactive video conferencing to allow 15 institutions with 252 students to connect to the Virginia Tech site for the class.
- We set up a video classroom to allow Information Technology staff members to remotely attend 2007 SANS-EDU 2-day course on Web Application Security (SEC 519) hosted at Purdue University, part of the 225 students from 13 institutions around the country who attended the class remotely.
- The lab hosted the 2008 SANS-EDU two-day course on Mac OSX Security Essentials, with 150 students from 10 institutions attending remotely.
- We will host the Web Application Security Essentials course (SEC422) in January 2009.
- SANS has adopted the interactive video conferencing classroom format that was pioneered at Virginia Tech (www.sans.org/partnership).
- The IT Security Lab provided basic awareness training to undergraduate classes, graduate classes, various orientations, and specific university personnel.
- The staff spearheaded technical awareness sessions for various groups at the university.
- Staff members also provided professional presentations outside the Virginia Tech community.

Technology security reviews

- The staff conducted security reviews for colleges, individual departments, compliance requirements, and administrative areas.
- We utilized scanning technology to identify potential problem areas that need immediate action to either correct or take off-line.
- The sensitive data initiative within the lab developed major tool for use in protecting data from potential exposures.
 - A staff member developed the Find_SSN tool that scans computer files for social security numbers and credit card numbers.
 - Several classes have been held on the Virginia Tech campus to promote and demonstrate the Find_SSN tool.
 - Find_SSN has been peer-reviewed and rated as one of the top available sensitive data search tools.
 - The Find_SSN tool has been downloaded by commercial, governmental, and educational sites around the world.
 - Over 15,000 executions of Find_SSN have been recorded since February 2008.
- Payment card industry (PCI) reviews were completed for all departments listed by the controller's office as handling credit card transactions, and we worked with the controller's office to hire an external vulnerability scanning service to fulfill a PCI security standard requirement.

- Additional compliance reviews were completed in several areas to ensure they were in line with industry standards; for example, we worked with the Office of the University Bursar to ensure compliance with Gramm-Leach-Bliley, and with Schiffert Health Center to ensure technical compliance with the Health Insurance Portability and Accountability Act.
- The lab purchased additional Rapid7 software licenses that allow the IT Security Office to create accounts for departmental managers so they can monitor their information technology security, with results stored for review by the department, the IT Security Office, or Internal Audit.
- Staff members attended a session on project management to better schedule and manage security reviews.
- We worked with the Office of the Controller and with Internal Audit to identify areas requiring reviews, and received Internal Audit reports from the IT Security Officer in order to offer assistance.
- The lab assisted departments in a consultant role to correct any shortcomings and to improve security environments.

Incident response team members

- Staff members in the IT Security Lab serve as members of the Virginia Tech Computer Incident Response Team.
- We provided leadership in preparing and maintaining three documents associated with this effort:
 - “Defense-in-Depth Security Architecture”
 - “Sensitive Data Exposure Incident Handling Checklist”
 - “Computer Incident Response Procedure Checklist”

Academic support

- The lab provided full classroom support for the following classes:
 - Electrical and Computing Engineering 4560–Computer and Network Security Fundamentals
 - Electrical and Computing Engineering 5984–IT Security and Trust I
 - Accounting and Information Systems 4024–Information Systems Audit and Control
 - Accounting and Information Systems 5424–IT Audit

Research support

- The SANS Institute donated \$18,000 to support a graduate student in the lab.
- Facilities are available for masters-level and doctoral research in cybersecurity.
- Current research projects are:
 - “Secure Programming Taxonomy,” 2009, Computer Science;
 - “Bluetooth Attack and Defense Methodology,” 2010, Computer Science.
- The lab provides workspace and systems for graduate student research.
- A student “pipeline” has been established with Electrical and Computing Engineering, Computer Science, and Accounting and Information Systems.

- The director of the IT Security Lab serves as a member of a graduate student's committee.

Setup for "Teaching Hospital Model"

- The lab is configured to allow faculty members and students to observe, treat, and immunize systems in a real world setting, allowing cybersecurity experiments to be run in a controlled environment.
- The lab is using virtualization software (VMWARE) to create a virtual network for use in an information technology audit class.
 - Lab graduate students created an information technology audit toolkit consisting of virtual machines configured with various vulnerabilities, an auditor system running Backtrack.
 - Students in Accounting and Information Systems 4024 and 5424 used the virtual network to gain hands-on experience using information technology audit tools to evaluate systems security and compliance with a test set of business objectives.
 - Students taking Electrical and Computing Engineering 4560 used the IT Audit toolkit CD to run the VM systems on their laptops.
- The lab is using VMWARE to create virtual systems that can connect to the real Internet, allowing students to observe and defend against live attacks without compromising real systems.
 - Students in Electrical and Computing Engineering 4560 and 5984 use these virtual systems to gain live experience in network offense and defense.
- The student "pipeline" continues from several university academic departments, filling several positions:
 - Graduate research assistant position
 - One student graduated with a master's degree in electrical engineering.
 - The 2007 graduate student intern migrated to this position for 2008–2009.
 - Graduate student intern position
 - A first-year graduate student assumed this position in 2008.
 - An M.B.A. student with concentration in Information Assurance student participated in Spring Semester 2008.
 - Two additional master's students start their research activities in Fall Semester 2008.
 - One Ph.D. student is scheduled to defend his research in Fall Semester 2008.
 - Graduate students presented approximately ten papers at various international and national academic and research conferences in 2008 that discussed research conducted in the lab.
 - Students designed, built, and are maintaining the IT Security Office vulnerability-scanning site (www.ids.cirt.vt.edu).
 - Students designed, built, and are maintaining the vulnerability scan engines that are the core of the www.ids.cirt.vt.edu site.
 - Students designed, built, and are maintaining an SQL database of vulnerabilities discovered by the scanners.

Other projects:

- Vulnerability scanning
 - Checknet-style scan engines
 - Scan tools for Social Security numbers and credit card numbers
 - Intrusion prevention system installation and management, and collection of metrics
 - www.ids.cirt.vt.edu
 - www.security.vt.edu
 - Security metrics project

Security Operations Center

- The IT Security Lab is building a Security Operations Center (SOC) that will be the focal point for the various Intrusion Detection Systems (IDS) managed by the IT Security Office.
- SOC components include the following:
 - The campus Dshield system collects firewall logs from university systems and displays them in a manner that gives an overview of intrusion activity (<http://dshield.cirt.vt.edu>).
 - The ISS Proventia Intrusion Prevention System (IPS) is currently monitoring all inbound and outbound network traffic to the Internet from the Virginia Tech network, examining packets for attack signatures.
 - ISS-to-Remedy Trouble Ticket Submission tool extracts attack records from the IPS and creates a trouble ticket to the Remedy trouble ticket system (http://candi4.cirt.vt.edu/iss_to_remedy).
 - SNORT sensor systems monitor networks activity and can be used by departmental sysadmins (<http://candi1.cirt.vt.edu/base>).
 - Self-scan vulnerability scanners (www.ids.cirt.vt.edu) allow individual users to scan their systems for well-known critical vulnerabilities.
 - Security Log Lookup Utility is a tool that can be used to access data (<http://candi1.cirt.vt.edu/ids/GetInfo.php>) that will help track the source of an attack.
 - HAWK-I Asset and Risk Management System is an inventory tracking system that can be used to maintain features for risk analysis and recovery (<http://candi3.cirt.vt.edu:8500>).
 - Virginia Tech Server Counter (<http://candi4.cirt.vt.edu/netscan>) provides daily counts of the number of servers on the campus network organized by server type (e.g., MySQL server, Oracle Server, SSH servers, HTTP servers).

Computer forensic support

- The lab staff assisted three Internal Audit investigations that required forensic copying of computer disks.
- The lab staff used forensic tools to gain access to an Information Technology worker's computer after she was killed in an accident.
- The lab staff used forensic tools to gain access to April 16 victims' computers as requested by proper authorities.

National Security Agency Center for Academic Excellence in cybersecurity research

- Virginia Tech was named a National Security Agency Center for Academic Excellence (CAE) in fall 2004.
- This designation allows Virginia Tech to apply for cybersecurity research grants in multidisciplinary curricula in areas such as Electrical and Computer Engineering, Computer Science, business, Masters of Information Technology.
- The IT Security Lab is the teaching hospital for the CAE (<http://research.cs.vt.edu/infosec>).

Staff professional development

- Philip Kobezak has certificates in GCIH, GSEC, GCFA, and GCIA (the last coming in October 2007).
- Randy Marchany has certificates in SANS GIAC GSEC, GCIH, and GCIA.
- Brad Tilley has the GIAC Certified Forensics Analyst (GCFA) certification, and the STAR—the payment card industry certificate.
- Staff members attended Educause Security Conference, local SANS classes, VA SCAN conference, and local professional meetings/training.

Professional presentations, classes, initiatives

- Guest lectures were given in the following settings: IS Audit class; College of Business Information Technology class; Internet law class; College of Engineering freshman orientation; Virginia Tech Outreach; Faculty Development Institute; 4HELP staff, Get Connected staff; Air Force ROTC orientation, Schiffert Health Center staff orientation, graduate student orientation, international graduate student orientation.
- Conference talks:
 - SUNY Security Technology Conference, Rochester, New York
 - UTK-FBI Cybersecurity Summit, Knoxville, Tennessee
 - SANS Institute classes/presentations: Singapore, China; Tysons Corner, Virginia; Ohio State University, Columbus, Ohio; Virginia Commonwealth University, Richmond, Virginia; University of Nebraska, Lincoln, Nebraska; Virginia Beach, Virginia; Washington, D.C.
 - College and University Business Officers (CACUBO) Midwest, St. Louis, Missouri; CACUBO National, Chicago, Illinois; Institute of Internal Auditors, Roanoke, Virginia; College and University Auditors of Virginia (CUAV), Richmond, Virginia; Information Systems Audit and Control Association (ISACA) Richmond Chapter, Richmond, Virginia; New Jersey Chapter of ISACA, New Jersey
 - VA Society of CPA's, Richmond, Virginia
 - Security Awareness Day, East Carolina University, Greenville, North Carolina
 - VA SCAN Conference, Virginia Commonwealth University, Richmond, Virginia
 - EDUCAUSE Security Conference, Crystal City, Virginia
 - Information Assurance Workshop, United States Military Academy, West Point, New York
 - NCTC, Roanoke, Virginia

- Local presentations were given to the following:
 - Faculty Development Institute lunch seminars
 - Virginia Tech Business Practices Seminar
 - Undergraduate Admissions security presentation
 - Virginia Tech Athletics security presentation
 - Virginia Tech Cybersecurity Research Seminar
 - Administrative Staff Professional Network
 - DCSS, the Information Technology Departmental Computer Support Symposium
 - Virginia Tech Institutional Research
 - Virginia Tech Graduate School: international students, graduate teaching assistants, and general graduate students
 - Electrical and Computer Engineering Graduate Student Seminar
 - Commission on Staff Affairs
 - Various users groups

Information Resource Management

Under the direction of the IT Security Office, Information Resource Management (IRM) provides the university community with policies, procedures, and support for secure access to information resources to complement its teaching, learning, research, and outreach as well as to support administrative operations.

The goals and objectives of IRM are to:

- provide a support structure for administering authorization, authentication and security access controls to information technology resources to the university community;
- facilitate the review of security and access processes to improve the effectiveness and efficiency of services provided to the university community;
- make authorization rules and access information accessible for review to appropriate levels of management within the university community for decision making and strategic planning;
- continually research and provide information technology solutions and standards for administrative operations;
- identify management issues to address for future implementation;
- establish a long-term strategic plan for investigating emerging-technologies that will affect security and access control issues related to information systems and computing;
- inform the university community of security procedures through open communication.

Major accomplishments and ongoing activities are categorized below by project or production activities.

IRM office

- The office is recognized as a production office responsible for electronic user identities at Virginia Tech, overseeing all aspects of the production environment.
- IRM continued to have the goals listed above and will be involved in defining access and enforcing rules for Virginia Tech resources.

Enterprise Directory project

- IRM continues to sponsor the Enterprise Directory (ED) project and define requirements for implementations, as well as providing database programming support for the project.
- IRM wrote the functional specifications and helped develop the Enterprise Directory Group Tools that will allow for delegated management of ED groups.
- The director of IRM leads a weekly meeting of an ED technical group and also a weekly meeting of an ED policy group.
- IRM has created 30 production services that use ED-ID for authentication and authorization.
- IRM has created 192 ED groups for use in authorization.

Public key infrastructure

The IT Security Office and associated entities including IRM are involved in the production environment for the certificate authority (CA) service that provides digital certificates to securely sign documents, secure transactions, and protect identities. The service is the main component of the university's public key infrastructure (PKI), a system of digital keys assigned to computer users to verify identity; as PKI is deployed, it will increase security and make it possible to use digital signatures in situations where a written signature is required today.

- IRM staff members served as both Registration Authority Administrators and CA Administrators for the Class 1 Server CA and the Middleware CA, and IRM serves as the role manager for the Virginia Tech User CA.
- IRM developed and maintains a workflow process to support digital signing of leave reports.

Virginia College of Osteopathic Medicine

Approximately 150 incoming students of the Virginia College of Osteopathic Medicine (VCOM) are successfully loaded into Virginia Tech's identity management repository each year using the workflow and load process that IRM developed. The interactive process that IRM developed to allow VCOM to update identity information on their faculty and staff members and students continues to be heavily used, saving VCOM time and effort.

Consultation

One of the important responsibilities for IRM is to provide consultation to other groups, both within Information Technology and beyond, regarding user access issues. IRM has provided

consultation during the past with Banner and other administrative applications, as well as with those defined above.

Daily support and production work

- The IRM staff worked closely with application areas to define requirements for any applications dealing with identity and access.
- We maintained and provided access capability for these Virginia Tech systems:
 - PIDs (approximately 128,000 active PID accounts)
 - UNIX
 - Banner/Oracle access (approximately 4000 production accounts)
 - Virginia Information Technologies Agencies (VITA) access
 - Distance Learning access
 - Active Directory (Hokies domain)
 - Other special needs
- The staff responded to over 5600 Remedy trouble tickets for “access” issues.
- The self-service PID generation application that IRM developed has been used to successfully generate over 13,000 PIDs in the past year.
- The underlying architecture of the application will be utilized in the upcoming year to include self-service password resets and reactivation of dormant accounts.
- IRM staff wrote functional specifications and provided technical leadership for the university electronic guest access system, now in production, that will initially be used to allow students to grant parents online access to view the student’s financial aid information, and that will extend to other applications now in the planning stages.
- We deactivated approximately 30,000 dormant PID accounts.
- IRM facilitated the Auditor of Public Accounts audit review of Banner access in the Office of the Controller, the Office of the University Bursar, Human Resources, University Scholarships and Financial Aid, Office of the University Registrar, Graduate School, and IRM will be responsible for overseeing this annual review.
- IRM currently maintains and enforces most access policies and procedures.

Professional activities

- IRM staff members attended the following professional meetings: Sungard Summit 2007, Educause Security and Identity Management Camp.
- The director of IRM leads the Enterprise Directory Policy and Technical Issues meeting each week and the Enterprise Directory Project Planning meeting each week.
- The director of IRM is a member of both the Educause and Sungard SCT Identity Management groups.
- The director of IRM is also a member of the ED Advisory Board, the ED Liaison Group, and the Data Security Committee of the Security Task Force.

Learning Technologies

Learning Technologies is a multi-faceted organization dedicated to supporting the tripartite mission of the university: learning, discovery, and engagement. Learning Technologies provides a teaching and learning infrastructure that meets modern needs for integrating technology across content areas. We seek to create and support robust environments for learning, discovery, and engagement for the faculty and staff, and for students that are grounded in sound principles of learning and in a thorough knowledge of integrating technology for effectiveness and efficiency of effort. We seek these aims

- through comprehensive development programs and training activities in the appropriate use of emerging technologies;
- through systematic application of appropriate resources to designing, developing, implementing, and evaluating technology-assisted instruction; and
- by providing highly responsive services that advance and support technology-assisted learning, discovery, and engagement.

Building on its record of achievements as demonstrated by several national awards received over the past few years, Learning Technologies continues to have a significant impact on the instructional mission of the university. Major activities include

- the Faculty Development Institute, a model program recognized at the national level, is a continuously improving effort designed to have a long-term effect on the integration of instructional technology as a critical, enabling component of the university's mission;
- Open source software development, participating in national initiatives for course management systems and e-portfolios;
- The Graduate Education Development Institute, a partnership with the Graduate School that increases graduate students' opportunities for professional development.

Other work is conducted through the units of Learning Technologies:

- Technology support for faculty and students at the New Media Center, now InnovationSpace
- Technical expertise, leadership, and coordination for disability accommodations from Assistive Technologies
- High quality scanning services for the library and the faculty from Digital Imaging and Repository Initiatives
- Opscan processing for exams and other data gathering by Test Scoring Services

- Community engagement programs which assist K–12 students from economically depressed regions of the commonwealth
- Support for computer-integrated classrooms and ongoing research on pervasive computing

Major operational programs and functions

Faculty Development Institute

The Faculty Development Institute (FDI) provides the pedagogy, knowledge, skills, and tools needed by faculty teaching in a 21st century university. This nationally recognized program has had a transformative impact on the university's instructional program by ensuring that the faculty has opportunities to provide the most efficient and effective learning environment for students. There continues to be a clear demand across campus for our training and development offerings, which suggest that adopting sound principles of learning as part of our curricular objectives resonates with the university community.

During the spring and summer of 2008, 556 faculty participated in short courses and workshops in the third year of the fourth cycle (2006–2009) bringing the total of all participants to nearly 6000 since 1993.

In 2007–2008, our overall aim was to strengthen the program's value to the faculty by providing a wider range of content, including topics that are consistent with the university's renewed emphasis on research. New FDI short courses and workshops were also developed and refined to create awareness and readiness for several important technologies that continue to mature, such as tablet PCs, Scholar (Virginia Tech's version of Sakai), and electronic portfolios.

The FDI staff meets regularly with faculty members from all colleges to provide direction for the program. Additionally, as part of each workshop's evaluation process, participants are asked to provide suggestions for future FDI workshops. The information gathered from those participants has enabled us to ensure that our offerings continue to stay relevant and timely, allowing us to continue to contribute to the diversification and growth of Virginia Tech's applications of technology in research and instruction.

Growth in FDI workshops and
short course sessions and attendance

Semester	Activity	Sessions	Participants
Fall 2007	Short courses	139	1,756
Fall Blitz 2007	Short courses	9	77
Spring 2008	Short courses	191	2,398
Spring 2008	Spring tracks	10	168
Summer 2008	3-day tracks	23	388
Summer Blitz 2008	Short courses	7	67
Total			4854

FDI track offerings

Track topic	Spring or Summer	Number of participants
Track A–New Faculty Computing	Summer	64
Track B–Teaching with a Tablet PC to Engage Students in the Learning Process	Summer	35
Track C–Using the Web for Instruction with Blackboard and Other Tools	Spring & Summer	103
Track D–New Strategies and Tools for Teaching with Technology	Spring & Summer	74
Track E–Creating and Utilizing Media Content for Instruction	Spring	19
Track F–Developing and Delivering Online Instruction at a Distance	Summer	22
Track G–(Northern Virginia Track): New Strategies and Tools for Teaching with Technology	Summer	12
Track H–Student Learning Outcomes: Identifying, Teaching, and Assessing What Matters Most	Summer	9
Track J–Fostering Student Engagement, Learning, and Development	Summer	23
Track L–Community of Practice: A Development Opportunity for Librarians	Spring	8
Track M–Faculty Inquiry Group: Tablet PCs and the 21st Century University	Spring	12
Track N–Faculty Inquiry Group: Learner–Centered Teaching and Technology	Spring	9
Track O–Faculty Inquiry Group: The Art of the Question	Spring	12
Track P–Statistics: Statistical Data Exploration, ANOVA, and Regression using JMP	Summer	25
Track Q–Advanced Statistics: Design and Analysis of Experiments using JMP	Summer	15
Track R–Using LabVIEW	Summer	6
Track S–Life Cycle of a Sponsored Project: Research Administration	Spring	7
Track T–The New Age of Interdisciplinary Projects: More Bang for the Buck	Summer	22
Track U–Creating Database–driven Web Sites with PHP and MySQL	Summer	12
Track V–Parallel Programming	Summer	12
Track W–Visualization and Research Computing: Deep Media for Research and Education	Spring	7
Track X–Independent Study / Project Development	Spring	20
Track Z–Survey of Essential Summer 2008 FDI Content	Summer	28
Total participants		556

The following table summarizes the distribution of computers for spring and summer of 2008.

FDI computer distribution

	Apple	Dell	Fujitsu	HP	Total	Percentage
Desktops	60	89	0	0	149	30%
Laptops	140	83	0	17	240	48%
Tablets	0	0	111	1	112	22%
Total	200	172	111	18	501	
Percentage	40%	34%	22%	4%		

Online Course Systems

Serving as Learning Technologies' public face for online services, Online Course Systems (OCS) provides

- learning systems user support through the Support Desk, help pages, Web support, application documentation;
- learning systems training—user training through FDI, online documentation, handout materials, tutorials, videos, resource development;
- product evaluation and quality assurance through usability and functionality testing, quality analysis and documentation, product design, and new services.

Enterprise-level academic services include Scholar, Blackboard, Electronic Portfolios, DyKnow, Course Evaluation, Courseware, and Element K.

Scholar. Scholar is Virginia Tech's next-generation learning, research and collaboration management system based on Sakai, a community-source software development project that involves over 120 universities, colleges, and commercial partners worldwide. During 2007–2008, Scholar (<https://scholar.vt.edu>) emerged from a pilot to a full-scale production system. Over 800 project sites are active, of which 417 were added in 2007–2008. These sites are used for a variety of faculty and administrative needs such as committees, taskforces, and research projects. Sixty-three course sites were created or modified as well, for a total of 7,000 Scholar logins and 7,500 accounts in 2007–2008.

During 2007–2008, the Electronic Portfolio tool was integrated with Sakai and released to the university. Additional tools, functionality, skins, and documentation from rSmart.com were also deployed to better meet the expressed needs of faculty members, students, and staff members. System support advice, bug fixes, and customized solutions are also provided by rSmart.

In 2008–2009, we will place a major emphasis on positioning Scholar as a powerful course management system as well as a collaboration environment for projects and research facilitation. By 2010–2011, we envision a Scholar system that will touch virtually all faculty members,

students, and staff members, providing an enhanced environment for learning, discovery, and engagement across the university.

Blackboard. Blackboard is Virginia Tech's legacy enterprise learning management system that the majority of the faculty use for course management. This past year, we upgraded Blackboard from version 7.1 to version 8.0 to add new functionality and correct several deficiencies. Before the start of the Fall 2008 term, we applied three service packs and many small bug fixes to the system to ensure its security and stability. The most notable area of the upgrade was to the Grade Center, which got a complete overhaul to include a much more interactive set of functions for the faculty.

Active Blackboard courses, faculty, and students per term

	Summer II 2007	Spring 2007	Fall 2007	Spring 2008	Summer I 2008	Total
Course sections	223	2664	2497	2665	350	8399
Faculty & GTAs	433	1890	2407	2458	606	7794
Students	4,117	28,501	30,801	29,307	6,737	99,463

Electronic portfolios. The old stand-alone electronic portfolio application (version 1.5) will be phased out in during the fall 2008, with all new portfolio activities using the Scholar 2.5 ePortfolio suite of tools, which was integrated with Scholar. New features assist with student assessment, departmental self-studies, and accreditation processes.

The director of Electronic Portfolio Initiatives, Marc Zaldivar, was hired in January 2008 to extend the use of ePortfolios to meet the university's growing need to demonstrate direct evidence of student learning.

Eleven new academic programs adopted ePortfolios between Fall 2007 and Summer 2008: Agricultural and Extension Education, Computer Science, English, graduate music education, the English Language Institute, the Graduate Education Diversity Initiative, the Office of Sponsored Programs, the dietetics program, Materials Science Engineering, secondary English education, Geography. Seven other programs have expressed interest and will be developing materials during 2008–2009.

For 2007–2008, there were 625 shared portfolios in ePortfolio 1.5 and about 600 users. The pilot Scholar/OSP 2.2 had about 550 users.

DyKnow Vision. DyKnow is a Web-based tool used to foster interaction through collaborative note taking, student response tools, content replay and more, using tablet PCs in the classroom or lab. It is especially popular for integrating tablet PCs into instruction. The OCS staff provided helpdesk, user account administration, and in-classroom assistance for DyKnow Vision to support faculty members as they teach with DyKnow. We are in the early stages of implementing a more robust support plan that covers network and server issues as well as the ability to get into the classroom to troubleshoot issues as they occur. This plan will be in place for Fall 2008. In 2007–2008, there were 62 DyKnow courses created and 5,600 users.

OCS Helpdesk. Last fall, OCS Helpdesk migrated to the Remedy queue system employed by other help systems on campus, allowing requests for assistance to be easily transferred to the appropriate Virginia Tech help desk. Remedy also facilitates better data tracking to help pinpoint areas that require the most assistance.

OCS Helpdesk questions

	Fall 2007	Spring 2008
Questions answered	613	963
Submitted by:		
Instructors	414	662
Undergrads	99	120
Grads	19	43
GTAs	81	138

Problem tickets resolved

Total problem tickets resolved	1,941
Blackboard 7	1,520
Course Evaluation	89
Courseware	23
DyKnow	111
Element K	7
ePortfolio	18
ITunes U	1
Scholar	157

OCS training. OCS staff members played an active instruction and supporting role in FDI, reaching hundreds of faculty members who use the systems supported by OCS. The staff also paid visits to several classrooms and faculty groups to do hands-on training for ePortfolio and Scholar. In conjunction with the recent upgrade of Blackboard to version 8, OCS revised its curricular approach in FDI to provide more variety and depth, while also targeting specific themes and functionality. A focused branch of the training is on using Scholar in academic, research, and portfolio situations with emphasis on actual uses and examples rather than what buttons to push.

OCS is also responsible for the creation and delivery of training materials as part of the Blackboard upgrade project and in response to other documentation needs. The technical writer undergraduate intern program has been a valuable addition to OCS, providing updates to the OCS website and new handouts.

Evaluation system. In 2004, we collaborated with Columbia University to modify and extend an online course evaluation system. The Virginia Tech-centric system developed out of that effort continues in pilot mode and is integrated with the legacy paper evaluation system so that all results from both systems are stored in a secure database. The system prevents multiple responses from students and is designed with safeguards for confidentiality and authentication of responses. The online system offers many advantages, including the following:

- Easy addition of questions
- Flexibility to administer mid-term and end-of-term evaluations
- Improved efficiency through elimination of paper handling
- Saving valuable class time
- Improved turnaround of results
- Student comments more thoughtful, in-depth
- All students have opportunity to respond
- Improved reporting system (administrators and faculty)
- Improved security

Pilot testing expanded this year to include several entire departments, with over 34,000 students responding to online questionnaires during the 2007–2008 academic year.

The experience with online rating systems at other universities has shown that there is initially a lower response rate. At Virginia Tech, however, the use of e-mail reminders, among other factors, produced response rates of more than 80 percent, comparable to the response for the paper-based system.

During the upcoming academic year, the legacy evaluation system will continue in pilot mode. There will also be evaluation conducted on the Sakai Course Evaluation Tool as well as a vendor solution used by several major universities. The advantage of the vendor solution is that the evaluation results would automatically be integrated into a planned faculty activity reporting system from the same vendor.

Course evaluations

	Summer 2 2007	Fall 2007	Spring 2008	Total
Courses assigned	25	595	753	1,373
Course approved	15	501	594	1,110
Number of students	319	19,437	21,543	41,299
Completions	171	16,593	17,326	34,090
Completion percentage	53.61%	85.37%	80.43%	

Courseware. Courseware is a legacy Web-based file sharing service designed to allow faculty members to store course materials for student access. The current system is nearing its end-of-life. During 2008–2009, the few remaining faculty users will be offered assistance to move their courses to Scholar.

New Media Center. The New Media Center (NMC) provides a central campus facility that supports the integration of technology in teaching and provides the opportunity for students to use technology in support of learning. The table below displays total New Media Center use for a variety of services for July 2007–June 2008. The number of users has increased significantly from previous years, with last year's total being 6,185.

	Faculty	Staff	Graduate	Undergraduate	Public	Total
3D	0	0	1	0	0	1
Audio	50	31	35	468	6	590
Authoring	5	31	10	27	5	78
Blackboard	15	0	3	13	1	32
CD/DVD burn	7	9	4	36	2	58
Desktop publishing	21	11	33	178	19	262
ElementK	0	0	0	5	1	6
Equipment loan	131	106	77	436	31	781
ETD	1	0	2	0	0	3
Flatbed scanning	95	29	304	595	26	1049
Graphics	86	31	114	1476	61	1768
Maintenance	0	89	1	6	0	96
PowerPoint	7	0	2	33	2	44
Slide scanning	39	31	66	74	14	224
Video	207	152	240	2043	42	2684
Web development	34	12	104	433	16	599
Total	698	532	996	5823	226	8275

The New Media Center staff manages and schedules three classrooms used by FDI, New Horizons (staff training), faculty members, and other groups. There were 652 class sessions in these rooms in the past year, filling 9,565 seats, putting the average class size at just under 15 participants.

Faculty Development classroom usage

Classrooms	FDI Sessions	Other sessions	Total events	Total users
1120, 3060, 3080	416	236	652	9,565

Projects

Projects are undertaken in order to assist faculty members with their teaching mission and to further the strategic plan of the university. Within Learning Technologies, the applications development team, systems integrators, and OCS collaborate on many projects throughout the year.

Application Development projects

Open source projects allow Learning Technologies to enlarge the scope of applications and services available to faculty members and to students, and to ensure that the products available meet diverse user needs.

Sakai Electronic Notebook for Research and Groupwork (SENRG). Learning Technologies received a Mellon Award for Technology Collaboration to fund the design and development of a new open source tool, an electronic notebook called SENRG. It will facilitate research and scholarship activities by providing a searchable, indexed, collaborative log of research notes, journal entries, comments, self-reflection and feedback, artifacts and links (text, images, files, etc.), witness statements, and the like. Potential users of the system include students, instructors, researchers, and lab managers.

In the past year, two cycles of design, implementation, and usability testing of the SENRG tool were completed. The tool's core functionality is in place, with students able to create and maintain notebooks. Professors and graders in the students' courses can review the students' notebooks and provide feedback. The usability-testing phase of the most recent development cycle took the form of a field study, in which evaluators observed the tool's use in two academic courses in the spring of 2008. The results were positive, and will help to inform future development.

SENRG was demonstrated at the annual Sakai Conference in Paris this summer, where several schools expressed interest in either using the tool in the future or potentially contributing to its development. Suggestions and feedback from the global Sakai community will be considered during the next design phase.

Scholar/Sakai collaboration and learning environment development. Scholar (<https://scholar.vt.edu/>) is the Virginia Tech version of Sakai, a community source software development effort to design, build, and deploy a new collaboration and learning environment for higher education and research. Application Development works directly with universities including the University of Cambridge, the University of Texas-Austin, the University of Maryland, the University of Michigan and others to enable use of the system at Virginia Tech and develop needed tools.

Recent development has focused on a new integration suite for Sakai 2.5, which provides user, course, and enrollment data, and automates the course creation process.

ePortfolio/Open Source Portfolio development. Development projects focused on customizing the Open Source Portfolio (OSP) data structures for each specific program's needs—namely, wizards, matrices, XSD-based forms, and XML-based templates. For example, one project needed a matrix that would hold student work, a customized reflection form to gather student reflections at the end of their graduate work, and a portfolio template that would draw items out of the matrix and display them in a Web-friendly and sharable format. Another project required customized forms that could be cumulatively added together to make a growing portfolio presentation for students.

In Summer I 2008, work began on a full replacement for the features of the ePortfolio 1.5 system. Specifically, using a project begun with the University of Michigan's Sakai development team, a student-centered template was created that offers a variety of design options with flexible, yet guided prompts to assist students putting together a professional-looking electronic

portfolio of their work. This template will be finalized and offered to the students in the Fall Semester 2008.

Evaluation system development. Recent development of the evaluation system focused on addressing support issues. The evaluation copying mechanism was altered so that copies of an evaluation can be given to any user of the system, eliminating the need for the support staff to create copies manually and greatly reducing the support burden.

FDI administrative system development. The FDI tracking system is used to manage program participant activity, workshop registration, webpages, and computer selection, delivery and inventory. During the reporting period, a series of refinements, modifications, bug fixes, and expansions were accomplished. The most significant improvement was integration of Banner user data into the system, eliminating the need for users to maintain their own biographical and contact information on the site. This integration also makes the site easier to administer, as conflicts between Banner user information and FDI user information are eliminated. Departmental administrators now have the ability to view the enrollment history of users in their department, which aids them in suggesting and/or selecting courses for users. A new attendance report, previously generated by hand, is incorporated into the system. There have also been improvements in the automated wait list and data tables in the administrative portion of the site. These changes allow more courses and events to be managed by the same number of staffers.

Software Skills Gateway development. The Software Skills Gateway (<https://gateway.edtech.vt.edu/>) provides a way for end-users to link to ElementK software tutorials using a PID and password without having to know a custom username and password. This year, the Gateway was updated to work with the current Virginia Tech ElementK subscription.

Training and tool support for project development. Application Development and Systems Integration work together to improve internal Web-based services. Highlights from the reporting period include the following:

- Maintained an enterprise level wiki (<https://content.cc.vt.edu/>) for use by Learning Technologies and other groups in Information Technology
<https://content.cc.vt.edu/confluence/display/DEV/Confluence>
- Maintained enterprise level issue tracking system
(<https://content.cc.vt.edu/confluence/display/DEV/JIRA>) and source code repository
(<https://content.cc.vt.edu/confluence/display/DEV/Subversion>).
- Piloted continuous integration testing and build server, Continuum
(<http://continuum.apache.org/>)

Systems Support and Integration projects

The Systems Support and Integration team handles all aspects of server application administration from design and deployment to daily maintenance and monitoring for enterprise academic applications including Scholar, DyKnow, and Blackboard.

Application upgrades. The Systems Support team led two major application upgrades in Summer 2008. The Blackboard learning management system was upgraded to version 8.0 in May, and the Scholar collaboration and learning environment was upgraded through three major versions of Sakai to 2.5 in June. As part of the Scholar upgrade, development environments were also created for the Electronic Portfolio Initiative, Application Development, and Systems Support teams.

New application deployment. The DyKnow classroom collaboration server software and its associated Windows Server and Microsoft SQL Server environment were originally deployed in July 2007 as version 5.0 with an upgrade to version 5.1 in June 2008. The Apreso classroom recording system, along with supporting Flash Server and MySQL, were deployed in August 2007. All were installed in a fully virtualized environment.

Server virtualization and consolidation. To improve flexibility and efficiency in using systems resources and to speed deployment of new systems, Learning Technologies has begun deploying new systems to a virtualized server environment running on VMware Server. The new DyKnow, Apreso, SQL Server, MySQL, and Flash Server systems, as well as several non-production and development support servers, have all been deployed as virtual servers.

Systems Support collaborated with the Systems Support group in NI&S to develop a virtual server template that can be copied and reconfigured as a new server in less than an hour. Over the next year, eight existing applications running on nine physical servers will be consolidated into this virtual environment.

Standardization and automation. As new applications create larger demands on the Systems Support team, the need for consistent standards for application deployment and automation of maintenance processes increases. Over the past year, the Systems Support team has made great progress towards meeting this need through a shared network storage area containing a large repository of shared tools and data, including a number of scripts that automate and standardize installation and upgrades of tools and utilities that previously had to be built and managed by hand.

New Media Center

Classes. The New Media Center (NMC) offered tours of the center, overviews of the center's capabilities, and short instructional sessions to over a dozen classes. One example is SOC 2024—"Group Minority Relations," where the center staff provided a short instructional session for the

entire class, and then class groups used the center equipment to create and edit their own videos with assistance from the center student staff. The staff also served as judges for the videos once complete.

WordPress MU. The Podcast Test Server was changed to an alternate technology to meet changing needs. This server was created, maintained, supported, and customized by the NMC.

Faculty production support. In cooperation with FDI, the NMC continues to assist numerous faculty members and departments with the development and creation of various media projects to support instruction directly. Support ranges from general assistance and consultation to the actual creation of digital objects. NMC handled eight projects this year.

Faculty course media development support. The NMC continued to work directly with students as part of their class experience. Faculty members in several departments have established on-going relationships with the NMC to help enrich classroom experiences and train their students to work easily with the multimedia demands of the 21st century. Over the course of the year, the NMC provided instruction and assistance to several hundred students on topics including illustration and presentation programs, video and audio recording for web, video, and podcasting.

FDI: “Creating Media Content” and “Tablet PC” tracks. The NMC staff supported for two FDI tracks, acting as facilitators, instructors, and consultants. The Creating Media Track is directly supported through the center and the Tablet Track is supported through the setup and maintenance of two Fujitsu tablet carts with 46 tablet PCs.

Outreach programs. The NMC provides facilities, equipment, and/or instruction to programs outside of the Virginia Tech numbered courses.

Upward Bound. The center provided instruction and assistance to 10 high school students over the course of a 5-week program. The students were taught how to work with a variety of multimedia equipment and software from video and audio recording and editing, to website development and designing for print.

The Multimedia Music Dictionary. We provided technical support for media object development, primarily video and audio illustrations and some assistance with Flash animations.

Student media organization support. NMC served as host for group functions and offered special equipment loans to media-oriented student organizations such as the Mac User's Group and the Association of Movie Producers.

VT STARS. We provided support for the VT STARS program through facilities and direct support of their multimedia development.

4 Minute Film Festival. NMC provided video equipment and computers for the local film festival. The lab was made available for the 24 continuous hours of the contest.

Progeny Film Festival. The center provided support and some prizes for the festival this year.

Digital Media Sandbox Consortium. We partnered with the consortium at Tennessee State University. Several podcasts from Virginia Tech were entered in the competition.

Swiss International Teacher's Program. Hosted at Virginia Tech for the first time, this program will likely remain at Virginia Tech for several years. The group of 30 teachers from around the world were provided with an overview of the technology at Virginia Tech and given access to the New Media Center for use after hours.

Department projects. The New Media Center explores emerging technologies and inventive applications of existing ones. Highlights from this past year include the departmental wiki, open source content management system, classroom calendar, and the dual-boot classroom.

Departmental wiki. Work continued on the migration of the center's information and documents into the Confluence wiki, providing wider access to the information and better staff collaboration. The site has been redesigned, and will be used on a regular basis by the staff and by student lab assistants.

Open source content management system. NMC is using an open-source content management system (CMS) and university templates to generate its website, in preparation for moving to the university CMS in the near future.

Classroom calendar. NMC created an online calendar, using PHPiCal to replace the MeetingMaker calendar that was failing to meet our needs. This calendar shows the use of all three classrooms. <http://calendar.is.vt.edu/>

Dual-boot classrooms. All classrooms have Intel-based iMacs and laptops. Network speeds were increased to a gigabit and printers and screens were updated.

The Graduate Education Development Institute

This year the Graduate Education Development Institute (GEDI) course, "Pedagogical Practices in Contemporary Contexts," enrolled 110 graduate students: 70 students in two sections in the fall and another 40 students in the spring. In addition, the director worked individually with seven graduate students in GRAD 5974, focusing on discipline-specific technology-enriched teaching strategies, in order for them to complete the requirements of the Future Professoriate Graduate Certificate. We also added a significant curricular component to the pedagogy course, asking GEDI participants to develop case studies in multidisciplinary groups, explore best practices for integrating technology into their case study assignments, and present their cases to the rest of the participants. The GEDI Fellows also taught over 300 graduate students throughout the fall semester in Blackboard workshops as part of our support of the Graduate School's graduate teaching assistant orientation course, GRAD 5004. During the spring, we revised the GEDI website www.gedi.vt.edu, worked on creating a database for longitudinal contact with

former GEDIs, and began developing a pilot teaching practicum course. The pilot, “21st century Strategic Pedagogies Practicum,” will be offered for the first time in Fall Semester 2008.

Assessment data

Assessment data for the GEDI pedagogy course continues to suggest that the program is fulfilling the need to help graduate students explore technology-enriched pedagogy, playing a vital role in their professional development as educators.

Question: To what extent did this course improve your awareness of the teaching and technology resources available to you?

Response	Fall 07-1 (n=32)	Fall 07-2 (n=38)	Spring 08 (n=40)
Extensively	23	20	21
Moderately	9	15	18
Minimally	0	3	1
Not at all	0	0	0

Sample qualitative responses

What technologies are you likely to employ in your teaching?

I will always incorporate a course website and use blackboard more thoroughly in the future. I will be less worried about cramming in curriculum and more concerned about creating a productive learning environment for students.

I plan to use Discussion Boards whether in Bb or in another CMS and I would like to use ePortfolios.

I am looking forward to using Blackboard (or another Course Management System), IM (AOL IM, or other), wikis, Discussion Board (in Bb or elsewhere), ePortfolio, Chat tools (in Bb or elsewhere), and tablet PCs in the classroom.

I have learned far more than I ever thought about speaking in front of a class, the ways to approach a class, and the ways in which to incorporate technology into a class. Most were new concepts and all were valuable.

The Tablet PC was great and I liked learning about Blackboard, but even the part about moving around in class was new to me. I've been using Blackboard for a while, but I was definitely unaware of all of the tools associated with it, and I am looking forward to using more interactive tech. tools with my students.

What impact has the GEDI course had on your development as a teacher?

This class has enhanced my knowledge base on pedagogical practices especially in regard to working with students in undergraduate programs of today and the future. I have learned many strategies that I will incorporate into my classes.

This course has definitely opened my eyes to a discipline that I had never had exposure to before. I had always evaluated myself as a teacher based on feedback from my students in terms of how well they enjoyed the course and how well they liked me. I'm very aware now that I should be evaluating myself on how effective my teaching is (based on how effective the student learning is). I am now focusing on setting clear learning objectives and improving the assessment of learning outcomes. This course has made me realize that I actually knew very little about effective teaching.

The primary benefit of this course for me was the introduction of several technology tools. Most I had at least heard of, but the course provided me with more familiarity, hands-on experience, and dialogue about things to consider for choosing what tool for what purpose, all of which greatly improved my comfort level in implementing them into the classroom.

The concept of learner-centered teaching was immensely useful; before taking this class, I was unaware of the learner-centered teaching concept and how to engage students in their own learning, but through the classroom activities as well as assignments and reading, I have really enhanced my teaching skills.

The course gave me a very good solid beginning to start applying new teaching practices to the way my classroom is run. There were many things about teaching that I was previously unaware of and this class did an excellent job of shedding light on educational research that I was not aware existed. After taking this class, I now feel I have the skill sets necessary to research new pedagogical approaches on my own and implement them with more confidence.

This course was helpful from an interdisciplinary perspective, as well as being exposed to new knowledge and practices for teaching. I enjoyed the content that I could directly apply to my class I am teaching this semester.

This course in conjunction with the PFP course has definitely transformed the way I not only approach courses I teach but the courses I take. These courses have really helped me to realize that I may just be an adequate teacher and that there may be slight changes I can make via the ideas we have discussed in class that will not only let me be a great teacher, but be a great teacher with 21st-century learners, who need to be aware of themselves in a much broader and complex social context. I hope to be able to help them learn within our own discipline but in applied ways across disciplines, too.

As this was my first class in pedagogy, my knowledge and understanding of pedagogical practices has increased exponentially. I talk a new talk. I understand ideas about teaching contemporary students that I didn't know existed. My thoughts about 21st-century learning and education have changed based on my new knowledge and understanding.

Actually, prior to taking this class, I didn't have any idea what my teaching philosophy might be. This class provided me with the opportunity to begin seriously thinking about what I want my future students to learn and what are the best ways to facilitate their learning processes. Especially as an engineering graduate student, our discussions and readings on pedagogies that integrate technology were very important to me.

Contact information: Shelli Fowler, shfowler@vt.edu

Classroom Technology Integration

A university-wide classroom improvement project was completed last year as part of the first phase of the classroom master plan. Eight centrally scheduled classrooms received extensive renovations, which completed the first phase of the master plan. These renovations included new infrastructure, acoustical and lighting improvements, and the installation of the latest technology for the enhancement of teaching and learning. All of the technology upgrades are a collaborative effort with Video/Broadcast Services and Classroom Audio Visual Services.

Fifteen classrooms in Pamplin Hall received upgrades this year, all equipped with the Extron Media Link control and new projectors. Nine new classrooms in the Surge Building were installed and equipped with presentation technology including full Crestron control systems.

In addition to major renovations, an ongoing computing technology refresh program continued this year, to systematically replace existing technology supporting presentations in the classroom. A concerted effort is made to ensure that high capacity auditoriums are kept up to date.

Over the past several years, more than 154 classrooms have been upgraded with presentation technology systems designed to assist faculty members and students in teaching and learning. This represents 85 percent of all centrally scheduled classrooms on campus. Seventy-four classrooms are equipped with full Creston units and 25 additional classrooms have been equipped with Extron Media Links. These facilities provide the ability to display a wide array of computer-generated presentations including scientific visualization and other complex graphic displays. All of the stations have a network connection, which provides access to the Internet for downloading information during class sessions. These classrooms continue to be in high demand by faculty members across all colleges and departments.

Contact information: Bruce Rakes, Bruce.Rakes@vt.edu

Computer-Integrated Classroom Support

Computer-Integrated Classroom Support (CICS) provides support for all computer-integrated classrooms on campus, including approximately 1000 computers. Services include the following:

- Provide software and hardware installation, maintenance, and troubleshooting
- Train faculty and staff members on the use of computer teaching stations and audio/visual equipment
- Provide consultation and support to other departments on request
- Provide laptops for check-out by students, or by faculty or staff members from the TechConnect Lab in Torgersen 3250
- Provide administration and training for the TimeClock System
- Support for the president's conference room in Burruss 325
- Manage and maintain 17 computer-integrated classrooms with 663 computers running Mac OS and 345 running Windows

PACE/PDM collaborative course support. CICS also provides an essential support and development role for Dr. Jan Helge Bøhn in Mechanical Engineering. Dr. Bøhn has been the driving force behind the creation of several collaborative Product Data Management courses involving other PACE Institutions around the world. CICS provides the administration of the Teamcenter Engineering application and database servers, Teamcenter Community web and database servers, as well as consultation with the other institutions on installation and setup of their clients to interface with our systems.

Pay-for-print service. CICS maintains printers in 29 rooms. Last year's statistics show

61,000 jobs
230,000 pages
\$25,000 gross income

These numbers reflect an 8 to 20 percent increase in pages and jobs over last year, with a 22 percent increase in gross income.

Contact information: Rob Dickert, rdickert@vt.edu

Digital Imaging and Repository Initiatives

Digital Imaging supports the research and instructional activities of the university by providing

- a comprehensive range of scanning services in support of image archiving, research, and course development projects;
- assistance for the University Library's Image Database Initiative;
- support for preparation of instructional materials through the online E-Reserve.

Service is provided to individuals or departments at Virginia Tech who are interested in converting collections of original materials to digital formats suitable for research or instruction, which require a high degree of image scanning precision and network accessibility. Since July 2003, 763,484 scans have been made representing 78 distinct projects.

Standards used by Digital Imaging represent best practices for digital file construction and preservation. One goal, established through the use of standards for digital files, is to create a baseline for master file development, providing both a preservation strategy and broadening the range of media applications for the digital files we create. Providing archival masters also creates a potential starting point for developing repository projects without the need to rescan the original material. Master images also provide a capability for use in multiple media applications, while also providing excellent detail for learner discovery.

For the fiscal year represented in this report, Digital Imaging scanned 269,725 individual items associated with 18 distinct projects.

E-reserve	1,209 journal pages	86 documents
Reserve annex	718 journal pages	59 documents
Theses/dissertations	225,785 manuscript pages	1,076 documents
Collections—pictures	18,767 assorted images	
Collections—bound books	19,822 page images	

During the past fiscal year, 10 separate collections were completed. These collections represent 8,486 individual images represented by slides, 3D models, photography, and printed pages. A description of those collections is provided below.

Completed projects: 2007–2008

Orthodontic Dentrifice	4	3D models	Graduate Research
Civil War Documents	1,277	book pages	Industrial Arts
Speculative Fiction Covers	81	Book covers	Special Collections
University Relations Archive	2,777	images	Special Collections
Insect Systems	67	35mm slides	Biological Sciences
Plant Disease	236	35mm slides	PPWS
Wine Production Methods	638	slides	Food Science
Forests of North America	723	book pages	Digital Library Archives
Plant Pathology	1920	35mm slides	PPWS
Historic Maps	777	illustrations	Special Collections
Surface Mining Record	53	photographs	Digital Library Archives
Robotic Head	2	3D models	Graduate Research

In addition to these completed projects, Digital Imaging continues to provide scanning support for numerous projects originating from the University Library's Special Collections and Digital Library and Archives as well as course material for the library's Electronic Reserve.

The 1,927 pages scanned represent 145 new individual supplemental readings made available to students online through links established in Blackboard and on the University Library electronic reserve website.

Technology improvements

Central to providing superior archival scanning services are professional-level equipment and personnel dedicated to consistency and quality. In fiscal year 2007–2008, we enhanced our scanning operations, consolidated our processes, and prepared for the future by updating equipment, refocusing on primary services, and planning for redundancy and improved efficiency.

Fujitsu document scanners and PCs updated this year equip us for higher quality, faster throughput, and the capacity for increased scanning volume. These additions also allow us the opportunity to maintain reserve equipment and assemble backup workstations that are necessary for uninterrupted workflow in case of breakdowns or events that prevent normal onsite operations.

A production-level Spartan paper cutter that was added this year streamlines the workflow in one of our primary services, digitizing bound dissertations. This device improves the speed in converting these documents from being a book on a shelf to a file online and network accessible to interested researchers.

New software and equipment facilitated modifications to our work environment and processes during the past year. These improvements enabled us to position workstations and devices in a way that maximizes our available space and project workflow. Also, a variety of previously

acquired scanners and digitization devices that augment our capabilities were incorporated into our improved workflow during this fiscal year.

In fiscal year 2007–2008, technology improvements continued to strengthen the foundation for all of our work, which is a commitment to the quality of our product. Quality control enhancements in the form of cross-platform software and equipment aid in maintaining the consistency necessary to provide high-quality archival material that can be used now and that will help to assure continued access for the generations of students and researchers to come.

Planning and acquisition of new local area networking and an updated server were a major focus for fiscal year 2007–2008. Increased storage and improved file access are key elements in our current scanning services, while increased capacity is critical to our ability to meet a growing demand for digitization and image repository services in the future.

In working to promote the development of a digital repository for the university, we acquired the VTLS Vital software module as a preliminary step toward the development of a more robust repository support offering. Further development of the repository project is scheduled for the next fiscal year including a pilot project to support the Center for Civil War Studies.

Contact information: Gary M. Worley, gworley@vt.edu

Test Scoring Services

Test Scoring Services supports the collection of data by Virginia Tech faculty and staff members by processing optical mark reader forms, providing analysis of the data, and promoting and supporting innovative technologies that improve data handling efficiency.

Primary uses of opscan forms at Virginia Tech are exams, course evaluations, and collection of research data. Volume varies slightly from year to year, but shows no consistent direction of change. Statistics for the 2007–2008 academic year show the following:

Number of different clients served	765
Jobs processed	6,100
Exams	5,200
Final exams	1,100
Course evaluations	500
Research data capture jobs	500
Total sheets processed	740,000

While opscans remain a popular, cost-effective information gathering method for many applications, the office also provides support for other methods using new technologies. Test Scoring continues to work with other units in Learning Technologies to assure the new online course evaluation system is compatible with current policies and supports provision and merging of data gathered via opscans.

Assistive Technologies

Assistive Technologies (AT) serves students, employees, and the public by ensuring that individuals with disabilities have the appropriate technologies needed to access programs and services of the university. AT serves in a leadership role for university accessibility standards, promotes AT related research, supports AT software and services, provisions accessibility testing software, and provides training and consulting services for technology-based disability accommodations used at Virginia Tech. The AT department works to increase the awareness of accessibility issues and the benefits of AT for people with disabilities by classroom instruction, hands-on demonstration of assistive technologies, and public presentations at a variety of outreach events. AT is also responsible for the AT Research Lab in Torgersen Hall and Special Services, located in Newman Library.

AT Research Lab

The AT Research Lab (AT Lab) is a multidisciplinary research lab and teaching facility used to create or improve assistive technologies for persons with disabilities and to advance emerging technologies and research applications useful for all individuals. Research and teaching activities of the lab include collaborating and supporting research programs in the university community needing AT expertise or services of the AT Lab; working to obtain grants or sponsored funding from government, industry, or the private sector for AT related research and for the dissemination of AT research results through outreach activities and publications; and providing assistive technologies expertise and services of the AT Lab for independent research studies and teaching/learning research projects.

Innovative Flexible Experimental Environment for Learning SCIENCE (I Feel SCIENCE).

The primary goal of this grant is to integrate haptic feedback (sense of touch) into an interactive learning environment. Student researchers from multiple disciplines worked in the AT Lab to identify relevant tools, experiment with new document-analysis systems, and discover ways to improve an existing prototype engine for translating mathematical formulas into Math ML.

Proposals under development

- Science and Mathematics Inclusive Learning and Engagement (SMILE), providing home science kits in support of informal learning
- Community Living Connection, helping people with acquired brain injuries in rural settings to live within their community and home environment

- Smart Dorm Rooms for College Students with Disabilities ,designing smart devices for dormitory rooms to create prosthetic living space supporting the needs of college students with disabilities

Special Services

Special Services provides individualized training for faculty and staff members and for students on the software, hardware, or equipment requested as a disability accommodation. We also serve the regional On-Campus Transition Program, which gives high school students with disabilities the opportunity to try a variety of vocational work experiences on-campus and/or the opportunity to attend college classes.

In addition to individualized training, Special Services provides the following services.

Assistive technologies for library patrons. AT procured a new accessible computing workstation with an electrically adjustable table, dual-boot computer (Mac OSX and Windows) and software, document scanner for conversion to alternative formats, and separate video magnification for non-electronic documents and objects.

E-text provisioning and alternative media formats. Special Services added a higher-capacity scanner for students seeking textbooks in an alternative format as well as a scanner with an automatic document feeder so students can quickly scan multiple pages for assistive reading using synthetic speech.

Student referrals. Services for Students with Disabilities within the Division of Student Affairs is now introducing the AT staff to new students being referred. This process has increased student AT training and decreased the number of students who delay using Special Services assistance. Specialized accommodations requiring remote videoconferencing and video taping services, as well as some unique one-time accommodations in university computer labs were provided to students.

University employee referrals. University ADA Services, a program within Human Resources, continues to refer a significant number of university employees for assistive technologies that will help them perform their job duties.

AT central services

Assistive Technologies, working with Computer-Integrated Classroom Support, helps coordinate AT software support for computer workstations in approximately 25 locations across campus including university and departmental computer labs, administrative facilities, and satellite locations. Changing customer demand, assistive technologies equipment, operating systems

(Windows, OS X), and assistive technologies software makes this a continuous and challenging effort.

Accessibility Standards Committee. The AT department chairs the committee, provides software and training materials for accessible web design, and offers software to verify and monitor websites for compliance to university accessibility standards, coordinating with major university web initiatives.

Teaching and outreach

AT classroom instruction. AT participates in a wide range of one-time instruction and lectures. This teaching includes lab demonstrations and lectures designed to raise accessibility design issues and disability awareness for computer science, education, and other university disciplines and departments. Last year 3 sessions were offered.

AT outreach activities. AT served about 500 individuals in outreach programs last year:

- College Bound "Preparing students with disabilities for a collegiate experience"
- Real World Day—students transitioning from high school
- Taken' the Next Step—targeting the middle school
- High School/High Tech—employing a Montgomery County Public School HS/HT student for the summer to provide him with work experiences in a technology field.
- Youth Leadership Forum (YLF–VA) "Empowering Young Leaders for the 21st Century"—a four-day conference
- C-Tech² "Computers and Technology at Virginia Tech"—Engineering program for high school girls
- AgrAbility Virginia—monthly meetings and annual events designed for those with disabilities in agriculture
- Equal Opportunities Officers' Networking Forum of Virginia toured the AT Lab
- Longwood University Distance Learning faculty and staff presentation
- AT Open House for Disabilities Awareness Week
- AT Open House for Family Day
- CommonHealth and Benefits Fair

Contact Information: Bill Holbach, holbach@vt.edu

Pervasive Computing Laboratory

The Learning Technologies Pervasive Computing Laboratory serves as a convening point for collaborative research activities between Learning Technologies, Information Technologies, and

the university research community. This lab supports undergraduate research projects and basic and applied graduate research initiatives with university partners. Past undergraduate research projects include a classroom monitoring system based on wireless sensor networks (motes), and a context-based access control mechanism for physical lab spaces using RFID technology.

Contact information: Bill Plymale, *plymale@vt.edu*

Summer Training Academy for Rising Students

Summer 2007 marked the completion of the third summer residency for the Summer Training Academy for Rising Students (VT STARS) funded by the US Department of Education grant funded phase (2005–2007) of the program. This phase included an attempt to shift the program to a year-round focus. A project no-cost extension was approved to extend the project closeout to October.

An effort was made to continue program funding via an additional congressional grant, and via direct solicitation to the Danville Community Foundation. Sustainability options were also explored with several university partners, Fralin Biotechnology Institute, the College of Science Diversity Committee, and the Materials Science Department. These explorations resulted in varying interest to continue program collaboration and involvement as the program evolves for sustainability.

The College of Science Diversity Committee prepared a plan to develop a similar initiative for fiscal year 2009. The exact nature of such an initiative is uncertain.

Additionally, a request was made to use remaining Jessie Ball duPont funds to support individual science fair project development, and transportation to Blacksburg for periodic laboratory activity, in conjunction with research faculty mentoring. A detailed final project report to the duPont fund is planned for September.

In spring 2008, a series of meetings were held with the Dean of the Graduate School to explore connecting the program to academic programs at the Institute for Advanced Learning and Research in Danville. Further discussion was postponed pending the hire of a new executive director at the Institute, but did result in a series of demonstration visits to campus by middle and high school students from the Southside region to explore the feasibility of redefining the program's structure, and to strengthen the working relationship with the Institute's outreach staff.

Planning continues to develop the program into a regional model for a pipeline approach to minority under-representation in science and technology sectors of the emerging knowledge economy. This effort is coordinated with the University Development Office, for ongoing solicitation of national and regional funding.

The knowledge gained from the VT STARS program will be used to develop a community engagement initiative focused on career pathways in Information and Communications

Technology. This proposed initiative is in the pre-implementation planning stage. Sponsors and partners are being defined as part of a work plan.

Contact information: Ed McPherson, *ejay@vt.edu*

Professional activities

Teaching, workshops, publications, presentations, and outreach

Courses taught

GRAD 5114, Pedagogical Practices in Contemporary Contexts, two sections; 70 enrollments, Fall 2007, S. Fowler

GRAD 5974, Independent Study: Integrating Technology into Teaching, for the FP graduate certificate, 2 and 3 credits, 4 enrollments, Fall 2007, S. Fowler

UNIV 2984, MOSAIC: Diversity and Social Justice, co-taught with Ennis McCrery; 10 enrollments, Fall 2007, S. Fowler

GRAD 5114, Pedagogical Practices in Contemporary Contexts, one section; 40 enrollments, Spring 2008, S. Fowler

GRAD 5974, Independent Study: Integrating Technology into Teaching, for the FP graduate certificate, 2 and 3 credits, 3 enrollments, Spring 2008, S. Fowler

CS 1706, Introduction to Object Oriented Programming, Fall 2007, David McPherson

CS 2606, Data Structures and Object Oriented Development, Fall 2007, David McPherson

CS 1054, Introduction to Programming in Java, Fall 2007, David McPherson

IDST 3114, Special Topics in Interdisciplinary Studies: On Becoming an Agent of Change; 21 enrollments, Spring 2008, C. E. Watson

ECE 4994, Application of Pervasive Computing Concepts to Teaching and Learning, Fall 2007, Spring, 2008, and Summer I 2008, W. O. Plymale

Workshops taught

Evans, A. D. Workshop leader, Faculty Development Institute, Fall 2007 and Spring 2008; workshops taught: Web Design, Emerging Technologies, Web 2.0, Pedagogy workshops, and Technology Planning and Evaluation

Evans, A. D. Workshop facilitator, Faculty Development Institute Summer Tracks. Facilitated 4 summer tracks about Blackboard CMS and pedagogy training, with enrollments in excess of 66 faculty and staff members at Virginia Tech (Summer 2008)

McPherson, David. Workshop leader, Faculty Development Institute, Spring and Summer 2008; workshops taught: DyKnow: Utilizing PCs to Increase Student Engagement and Organization, Blackboard 7: Content Management, Blackboard 7: Communication Tools, Blackboard 7: Assignment and Test Creation, Blackboard 7: Student Performance Assessment (The Gradebook and Performance Dashboard), What's New in Blackboard 7? Wikis in Higher Education

Schwartz, Ed. Workshop leader, Faculty Development Institute. Fall 2007 and Spring 2008, 29 short courses

Schwartz, Ed. Summer Veterinary Student Research Program, May 2008, short courses on computer-based graphics, reports and presentations

Zaldivar, Marc. Workshop coordinator, Track B: An Introduction to Blackboard. Faculty Development Institute, Summer 2007, with three iterations of the track over the summer

Zaldivar, Marc. Workshop leader, Faculty Development Institute. Fall 2007 and Spring 2008, workshops taught: Blackboard 7: Assignment and Test Creation, Blackboard 7: Communication Tools, Blackboard 7: Content Management, Blackboard 7: Student Performance Assessment, Blackboard for New Users, DyKnow: Utilizing Tablet PCs to Increase Student Engagement and Organization, Scholar for Administrators and Researchers, Scholar for Instructors, What's New in Blackboard 7?, ePortfolio: Virginia Tech's ePortfolio System within Scholar, Online Student Ratings of Instruction Tool: Departmental Administrator Overview

Zaldivar, Marc. Workshop leader, Office of Academic Assessment. Spring 2008, workshops taught: Measuring and Analyzing Student Outcomes, Program Assessment Using ePortfolios

Dissertation committees

Moore, A.H. Two dissertation committees: Environmental Design and Planning, and Planning, Governance and Globalization

Fowler, S. Dissertation committees in Marriage and Family Therapy and in Educational Research and Evaluation; two preliminary exams and orals; one Master's committee (English) and thesis defense

Awards

Mid-Cycle ICTAS Research Awards 2007–2008, “Smart Laboratories: Computer-Ready, Immediate Environments for the 21st Century Science,” T. Kaur, VMRCVM; J. Singh, VMRCVM; B. Schubert, College of Architecture and Urban Studies; R. Dunay, CAUS; N. King, CAUS; C. Clark, CAUS; C. Vorster and M. Gardener, CNS; B. Plymale, Learning Technologies; W. Feng, CS

Watson, C.E. received Virginia Tech's Xcaliber Award for Exemplary Teaching with Technology Project (Team Award) for the Digital History Reader, September 2007

Publications

Cole, R., and Schwartz, E., editors, Virginia Tech Multimedia Music Dictionary, www.music.vt.edu/musicdictionary/

Diaz, V., Garrett, P.B., Kinley, E.R., Moore, J.F., Schwartz, C., and Kohrman, P., “Faculty Development for the 21st Century Faculty Member,” accepted for publication in *Educause Quarterly*

Evans, A. D. and Lockee, B. B. (2007), “AT A DISTANCE: A model for distance Education,” in M. Simonson (Ed.) *Association for Educational Communication and Technology 2007 Annual International Convention Proceedings: On the Practice of Educational Communications and Technology*, 2(144–149), North Miami Beach, FL.

- Fowler, S. "Active Learning and Technology: Development Designing Change for Faculty, Students, and Institutions," co-authored with Anne H. Moore and C. Edward Watson for *Educause Review*, September/October 2007; ranked as the second most popular *Educause Review* article for 2007
- Fowler, S. "Learners 2.0? IT and 21st-century Learners in Higher Education," co-authored with Anne H. Moore, Brent K. Jesiek, John F. Moore, and C. Edward Watson, *ECAR*, Vol. 2008, Issue 7, April 1, 2008
- Lusk, D. L., Evans, A. D., Jeffrey, T. R., Palmer, K. R., Wikstrom, C. S., and Doolittle, P. E. (in press), "Multimedia learning and individual differences: mediating the effects of working memory capacity with segmentation," *British Journal of Educational Technology*
- Moore, A.H., "Learners 2.0?: IT and 21st Century Learners in Higher Education," *ECAR Research Bulletin* Vol. 2008, Issue 7, April 1, 2008, with Shelli B. Fowler, Brent K. Jesiek, John F. Moore, C. Edward Watson
- Moore, A.H., "Framing Assessments of Technology-Assisted Learning Outcomes To Benefit Students In The 21st Century," in Patricia Rogers *et al.* (eds.) *Encyclopedia of Distance and Online Learning*, in press
- Moore, A.H., "Fluency in Information Technology (FIT): Are We There Yet?" *WCET Frontiers*, Vol. 1, No. 2, October 2007, with Louis Fox
- Moore, A.H., "Active Learning and Technology: Designing Change for Faculty, Students, and Institutions," *Educause Review* September/October 2007, with Shelli B. Fowler and C. Edward Watson
- Moore, A.H., "The New Economy, Technology, and Learning Outcomes Assessment." *Educause Quarterly*, Vol. 30, No. 3, July–September 2007
- Moore, A.H., Fowler, S.B., Jesiek, B., Moore, J.F., and Watson, C.E., April 2008, "Learners 2.0? IT and 21st-Century Learners in Higher Education," *ECAR Bulletin*
- Moore, A.H., Fowler, S.B., and Watson, C.E., "Active learning and technology: Designing change for faculty, students, and institutions," *Educause Review*, 42(5), 43–60, 2007
- Plymale, W.O., Research publication: Co-Principal Investigator, NSF Proposal 0828815 "Interdisciplinary Student Projects: Smart Dorm Rooms for College Students with Disabilities"
- Watson, C.E., 2008, *Self-efficacy and diffusion theory: Implications for faculty development*, Saarbrücken: VDM Verlag

Presentations

- Evans, A. D., Adams, I. S., Sunha, K., Richmond, J. A., Spruill, N. R. (2008, February), "The transition experience of tenure-track faculty at a research one institution," paper presentation at the 31st Annual Eastern Educational Research Association Conference, Hilton Head, SC
- Evans, A. D., Adams, I. S., Richmond, J. A., Spruill, N. R. (2008, February), "The voices of tenure-track faculty: Their transitional experiences," poster presentation at the 3rd Annual School of Education Student Association Research Conference, Blacksburg, VA
- Evans, A. D. and Lockee, B. B., "AT A DISTANCE: A model for distance education," paper presentation at the 30th Annual Association for Educational Communication and Technology International Convention, Anaheim, CA, October 2007

Fowler, S., "Pedagogies of Engagement," for the College of Engineering Conference, "'The Quiet Crisis' Intervention: Inventing the Future by Engaging Today's Students," the Inn and Skelton Conference Center, September 2007

Fowler, S., "Appropriate Pedagogical Responses in the post-4.16.07 classroom," with Dean DePauw for GTAs, September 2007

Fowler, S., "Identifying and Referring the Distressed Student," with Tom Brown and Chris Flynn, sponsored by the Office of the VP for Students Affairs, Cook Counseling Center, Dean of Students Office, and CEUT, September 2007

Fowler, S., "Contemporary Technology and Learning Communities for 21st-century Learners," guest lecture, Earth Sustainability course, September 2007

Fowler, S., "What is a curriculum vitae and what do I put on it?" guest panelist for a C.V. mentoring presentation for the English Department, November 2007

Fowler, S., "Contemporary Diversity Issues for Citizen-Scholars," guest lecture for CSE graduate seminar, February 2008

Fowler, S., "Dealing with Cultural Diversity," guest lecture for Earth Sustainability, February 2008

Fowler, S., "Freire and Feminist Pedagogy," guest lecture for Women's Studies graduate seminar, February 2008

Fowler, S., "Professional Identities: Can You Integrate the Personal and the Professional?" guest panelist for the LGBTA undergraduate group, March 2008

Gausepohl, Kim, Humphries, W., "VT SENRG: Applying the Usability Engineering Lifecycle in Tool Development," 8th International Sakai Conference, December 2007, Newport Beach, CA

Head, J.T., "Open Source Online Student Rating Systems," EDUCAUSE national conference, October 2007, Seattle, WA.

Humphries, W., "Evaluation Tool Demonstration," 8th International Sakai Conference, December 2007, Newport Beach, CA

Humphries, W., "Pilot Testing the SENRG Notebook," 9th International Sakai Conference, June 2008, Paris, France

Humphries, W., "Evaluation Tool Demonstration," 9th International Sakai Conference, June 2008, Paris France

Lusk, D. L., Evans, A. D., Jeffrey, T. R., Palmer, K. R., Wikstrom, C. S., and Doolittle, P. E., "Multimedia learning and individual differences: mediating the effects of working memory capacity with segmentation," paper presentation at the 31st Annual Eastern Educational Research Association Conference, Hilton Head, SC, 2008

Moore, A.H., "Learners 2.0?: IT and 21st-Century Learners in Higher Education, June 2008. ECAR Symposium, Boulder. CO

Moore, A.H., "What's New in Course Redesign: Redesigning the Social Sciences," March 2008. The Redesign Alliance Annual Conference, Orlando, FL, with John Broida, Brad Brubaker and Bill Williams

Moore, A.H., "New Learning and New Technologies: Who Will is FIT?" February 2008. Indiana State University, Terre Haute, IN

Moore, A.H., "A Need for Speed: Internet Bandwidth and Associated Computing Power," November 2007, WCET Annual Conference, Atlanta, GA, with Michael Abbiatti, Kathleen Gay, Helen Ware, Darlene Williams

Moore, A.H., "New Technologies and New Learning: Changing Faculty, Students, and Institutions," October 2007, National Institute for Multimedia Education International Conference, Tokyo, Japan

Moore, J.F., invited speaker, "Open Source Possibilities for Course Redesign," Learning by Design conference, Richmond, VA, State Council For Higher Education in Virginia, November 2007, with Gardner Campbell

Smith, J., Gunn, D., Watson, C.E., Kral, K., Keesler, S., Baron, J.D., Peet, M., "Developing and sustaining an OSP implementation on your campus. Paper presented at 8th Sakai Conference, Newport Beach, CA, December 2007

Watson, C.E., Baron, J.D., Peet, M., "ePortfolio for assessment, student learning, and career development: Open source portfolio applications," paper presented at Educause 2007, Seattle, WA, October 2007

Worley, G. M., Common Solutions Group meeting, "Digitizing University Collections: A Proposal for Extending Support," September 2007, MIT Campus, Boston, MA

Worley, G. M., 11th International Symposium on Electronic Theses and Dissertations, "Scanning Dissertations: What Have We Learned," June 2008, Aberdeen, Scotland

Zaldivar, Marc, "Balancing Departmental Assessment with Student Reflection," Making Connections: ePortfolios, Integrative Learning, and Assessment, Queens, NY. April 12, 2008

Zaldivar, Marc, "Developing a Student ePortfolio Group," Making Connections: ePortfolios, Integrative Learning, and Assessment, Queens, NY. April 12, 2008

Outreach

Brackett, H.J. and Holbach, W. Annual Planning and Consortium Member for College Bound and Real World Day, ongoing

Brackett, H.J. and Holbach, W. College Bound, (Preparing students with disabilities for a collegiate experience)

Brackett, H.J. and Holbach, W. Real World Day (Students transitioning from high school)

Brackett, H.J. and Holbach, W. Takin' the Next Step (Targeting the middle school)

Brackett, H.J. and Holbach, W. High School/High Tech (Employing a Montgomery County Public School HS/HT student for the summer to provide him with work experiences in a technology field)

Brackett, H.J. and Holbach, W. Youth Leadership Forum, "Empowering Young Leaders for the 21st Century" (A four-day conference)

Brackett, H.J. and Holbach, W. C-Tech² "Computers and Technology at Virginia Tech" (Engineering program for high school girls)

Brackett, H.J. and Holbach, W. AgrAbility Virginia (Monthly meetings and annual events designed for those with disabilities in agriculture)

Brackett, H.J. and Holbach, W. Longwood University (Distance learning faculty and staff presentation)

Dustin, J.C. Event planning and assistance for the Virginia Tech Four Minute Film Festival, September 2007

Dustin, J.C. Technical support for VT Engage kickoff event, October 2007

Dustin, J.C. Planning and instruction (Video Production Best Practices) for Upward Bound, June 2008

Fowler, S. Attended the Learning by Design SCHEV conference in Richmond with the ES faculty team, encouraging their interest in ES “redesign,” and in particular, encouraging their consideration of a more central integration of technology into any redesign

Moore, A.H. Development Team-Leadership Development Through the Arts, Urban Affairs and Planning, Theatre Arts, Southern Virginia Higher Education Center, 2003–

Moore, A.H. Oman University Development Team, October 2007–

Moore, A.H. VT Engage Steering Committee, IT/communications group, 2007–2008

Moore, J.F. Met regarding learning technology and FDI program with representatives from universities in Egypt, India, Japan, and Singapore

Moore, J.F. Member, Board of Directors, Christiansburg Institute

Schwartz, Ed. Invited Speaker, SITP Conference, "Innovative Computing at Virginia Tech", July 2007

Schwartz, Ed. Invited Speaker, VT Entomology Department ProSem. "New Technologies in Higher Education," September, 2007

Zaldivar, Marc. Demonstration of Sakai/OSP for representatives from Rikkyo University, Tokyo, Japan. April 2008

Zaldivar, Marc. Rainbow Riders’ Annual Scholarship and Tuition Auction. Computer-support. May 2008

University service

Brackett, H.J. and Holbach, W. Equal Opportunities Officers’ Networking Forum of Virginia (Toured the AT Lab)

Evans, A. D. Webmaster/CMS Coordinator, Instructional Technology Student Association at Virginia Tech

Evans, A. D. Judge, Institute for Distributed and Distance Learning Virtual Student Center competition

Fowler, S. FIG (Faculty Interest Group) co-facilitator, with Barb Bekken; focused on learner-centered pedagogy in general and specific learner-centered uses of CMS features and Ppt. presentations, specifically, with 12 faculty members over a four-week session. As an FDI that provided faculty with a brief “community” in which to explore new pedagogical approaches, I think the FIG format has tremendous potential to help foster pedagogical change across the disciplines

Fowler, S. Pedagogy consultant, “Earth Sustainability—Living in the 21st century,” a Curriculum for a Liberal Education Learning Community project, includes weekly meetings throughout the year and co-facilitation of an August orientation to learner-centered, technology-enriched pedagogy for the ES instructors

Fowler, S. Invited committee member and pedagogy consultant, College of Engineering Tablet PC Initiative Working Group, Fall 2006–Spring 2008. (Participating faculty on a CCLI NSF Grant, submitted by PI Joe Tront)

Fowler, S. Continued work on the ePFG (electronic Pedagogical Field Guide), supervising the development of an eGuide for technology-enriched learner-centered instruction at Virginia Tech

Fowler, S. GTA Orientation presentation on GEDI; scheduling of Bb and Technology Tools workshops for GRAD 5004 (1-credit GTA orientation course)—taught by GEDI Fellows

throughout the Fall semester for hands-on training for GTAs and “gateway” recruitment tool for GEDI

Fowler, S. Mentoring Committee Member for two junior faculty members—Dr. Sheila Carter-Tod and Dr. Gena Chandler, Department of English

Fowler, S. Academic advisor for Sean Kelly, MA student in English, Fall 2006–Spring 2008

Fowler, S. Ongoing advising (open-door policy) for numerous GEDI students who are teaching or about to teach here at Virginia Tech

Head, J.T. Member of the university Committee on Teaching and Learning, 2007–

Head, J.T. Participant, Candidate Interviews, for CEUT Director Position, June 2008

McPherson, David. Faculty Advisor, Virginia Tech ACM Chapter

McPherson, David. Faculty Advisor, Virginia Tech Game Club

McPherson, David. Faculty Advisor, Virginia Tech Free Culture Chapter

Moore, A.H. Human Resources Employee Advisory Committee, June 2007–May 2008

Moore, A.H. University Leadership and Professional Development Team, 2007–

Moore, A.H. Quality Enhancement Planning Team, Southern Association of Colleges and Schools, Commission on Colleges, accreditation reaffirmation process, 2006–2008

Moore, A.H. University Strategic Planning for the Arts Initiatives, Roanoke Art Museum and University Performing Arts Complex, 2006–

Moore, A.H. Advisory Committee, Center for Creative Technology in the Arts, 2008–

Moore, A.H. Affiliated Faculty, Virginia Tech Institute for Policy and Governance, 2005–

Moore, A.H. University Director, Center for Innovation in Learning; Coordinates annual XCaliber Award; Provides grants for technology-enriched learning development when funds are available. 1998–

Moore, J.F. Member, XCaliber Award Committee, Center for Innovations in Learning

Moore, J.F. Member, CEUT Director Performance Review Committee, Fall 2007

Moore, J.F. Participant, Candidate Interviews, for CEUT Director Position, June 2008

Moore, J.F. Member, Search Committee for IDDL Assistant Director position

Moore, J.F. Member, CEUT Internal Grants Committee

Moore, J.F. Member, Leadership and Training Committee, University Employee Development

Moore, J.F. Member, Search Committee, Organizational Effectiveness Consultant, University Employee Development

Moore, J.F. Member, University Computing Requirements Committee

Moore, J.F. Participant, Candidate Interviews, for CEUT Director Position, June 2008

Professional service

Moore, A.H. rSmart Innovators Program, Advisory Group, April 2008–

Moore, A.H. Pearson Strategic Advisory Board, November 2007–

Moore, A.H. Virginia Tech/OTE Oman University Project, Learning Technologies expert consultant, October 2007–

Moore, A.H. The National Center for Academic Transformation, Redesign Alliance Advisory Board, January 2007–

Moore, A.H. Joint Committee on Science and Technology, Open Education Resources Subcommittee, May 2007–November 2007

Moore, A.H. State Council for Higher Education In Virginia, Learning Technology Advisory Committee, November 2006–

Moore, A.H. Adobe Higher Education Leadership Advisory Board, 2006–

Moore, A.H. Research Channel Advisory Board, 2006–

Moore, A.H. WCET, the Cooperative advancing the effective use of technology in higher education, Elected to Executive Council, 2005–

Moore, A.H. Commons Solutions Group, 2005–

Moore, A.H. Sorensen Institute for Political Leadership, Regional Advisory Board, 2005–2008

Moore, A.H. EDUCAUSE Center for Applied Research, Institutional Representative to ECAR, 2003–

Moore, A.H. Electronic Campus of Virginia. Founding Chair. Virginia Tech Liaison to Steering Committee and Treasurer, 1999–

Moore, A.H. Virginia Institute for Government, Advisory Board Member, 1996–

Moore, J.F. Member, Learning Technology Advisory Committee, SCHEV

Moore, J.F. Peer reviewer, 2008 Virginia Outstanding Faculty Awards, Teaching with Technology category, SCHEV

Moore, J.F. Participant, rSmart Innovators Program, Sausalito, CA. With Anne Moore

Moore, J.F. Participant, EDUCAUSE seminar on Web 2.0 applications

Moore, J.F. and Watson, C.E. Participant, Sakai Client Focus Group, rSmart

Moore, J.F. Participant, Common Solutions Group fall meeting, Boston

Moore, J.F. Participant, Sakai winter conference, Newport Beach, CA

Moore, J.F. Participant, EDUCAUSE national conference, Seattle

Moore, J.F. EDUCAUSE Advisory Committee on Teaching and Learning

Moore, J.F. and Head, T. Participant and presenter, Learning Technology Consortium meetings, University of Pittsburgh and Wake Forest University

Watson, C.E. Co-Chaired International Teaching with Sakai Innovation Award Committee

Watson, C.E. Actively served on the Review Board of the International Journal of Teaching and Learning in Higher Education

Watson, C.E. Served on the proposal development committee for the Center for Peace Studies and Violence Prevention

Network Infrastructure and Services

Network Infrastructure & Services (NI&S) includes the following operational units:

- **Communications Network Services** is the telecommunications auxiliary.
- **Systems Support** and **Information Technology Support** have responsibility for the university's centralized information technology services.
- **Video/Broadcast Services** produces broadcast-quality, instructional video and advanced, multimedia, instructional materials.
- **Printing Services** and **Mail Services**, respectively, provide efficient and timely production and distribution of print information.
- Through the **Blacksburg Electronic Village** and **NetworkVirginia** and in collaboration with Information Technology's eCorridors program, NI&S reaches out to help expand opportunities and improve the quality of life for citizens across the commonwealth.

NI&S reports to Ms. Judy L. Lilly, Associate Vice President, 1770 Forecast Drive (0506), Blacksburg, VA 24061. The departmental website is www.cns.vt.edu, and Judy Lilly may be reached at 540/231-2599.

Overview

NI&S provides and manages the university's information technology infrastructure and related services by

- providing available, reliable, and secure networks, systems, and services;
- researching, testing, and advancing emerging technologies;
- developing and deploying technologies and services that directly support the learning, discovery, and engagement missions of the university;
- disseminating information obtained from research and development;
- embracing our role as a corporate citizen and partner in local, state, regional, and international communities; and
- practicing sound fiscal management.

Our role in learning, discovery, and engagement

Rapid advances in technology and the nature of broadband infrastructure are reflected in the constantly changing ways the university community must approach its work. Such change, in turn, drives increased demand for, and expectations of, technology and infrastructure and the benefits they provide. In response, NI&S continually invests in innovations and improvements that directly support university programs and enhance Virginia Tech's reputation as a research university in an increasingly competitive, global, and digital environment. Access to next-generation networks, protocols, services, and applications is critical if the university is to create a modern, technology-enriched, discovery and learning environment; fulfill its engagement mission; and improve the quality of life for citizens of the commonwealth.

Infrastructure and access

NI&S participates in and supports the deployment of wide-area, high-performance computing and communications to provide the university with ubiquitous and direct access to high-speed, national and international, research networks and facilities.

Whether the network is used for teaching, learning, research, administration, or community service and engagement, Virginia Tech has access to gigabit Ethernet, wireless local area networks, wired and wireless voice communications, video and related services, broadcast-quality teleconferencing, and a cable television system. New, Internet-based applications like IP videoconferencing and high-definition video provide greatly improved quality and performance for distance learning programs. In all cases, essential technical, security, and help desk support are integral to daily infrastructure operations.

Meanwhile, planning is underway for tomorrow's unified communications infrastructure. Based on a diverse, survivable, optical core with ubiquitous wireless and wired access, the enhanced network will provide a pervasive, leading-edge, technology infrastructure to support the vision and mission of the university well into the future.

Our business model: personnel, partnerships, and prudence

NI&S seeks to attract, develop, and retain quality employees who enhance the organization's effectiveness and contributions to the university. The highly skilled and talented workforce is committed to excellence; staff members work together to improve delivery of services and accelerate the deployment of new technologies.

Staffing by unit

Unit	2005	2006	2007	2008
Communications Network Services	110	113	114.5	114.5
Systems Support Services–Help Desk/4Help	21	21	16	21
Systems Support Services–Server Administration	12	11	12	12
Systems Support Services–E-Communications Clients	8	8	9	7
Video/Broadcast Services	14	14.5	14.5	15.5
University Printing and Digital Imaging	26	26	26	26
University Mail Services	19	18	18	19
Total	210	212.5	210	215

NI&S collaborates with Research Computing, Learning Technologies, Enterprise Systems, and the Information Technology Security Office to provide centralized network management, support, and services emphasizing security and reliability. Through collaborations with academic programs and external partners, NI&S helps enhance the university's reputation in advanced network research initiatives and learning environments.

NI&S is required to recover all operational costs as well as the expenses necessary to build, maintain, and continually upgrade the network. In so doing, the organization has always emphasized financial integrity and stability, administers a balanced budget, and ensures financial resources are available for reinvestment in new technologies. NI&S is able to use a variety of funding mechanisms to fulfill its mission. Various units are supported from a combination of auxiliary, education and general, and cost-center funds. Communications Network Services (CNS) can assume debt for capital expenditures related to infrastructure development. However, the majority of NI&S funding comes from revenues associated with the resale of services. In addition, the auxiliary portion of NI&S participates in funded sponsored projects and research.

Organization

Strategic Initiatives

Strategic Initiatives (SI), led by Jeff Crowder, directly supports Information Technology's executive administration in strategic programs and special projects to enhance Virginia's competitiveness through advanced broadband technology. By design, SI is broadly engaged technologically, geographically, and politically. For example, current SI involvements include the following:

Mid-Atlantic Terascale Partnership. At relatively low cost, the Mid-Atlantic Terascale Partnership (MATP) connects regional research and education members through an aggregation facility in McLean, Virginia, to high-capacity and global networks, including National LambdaRail (NLR) and the Internet. An SI representative serves as program director for MATP and as the mid-Atlantic administrative representative to NLR.

NetworkVirginia. Promoting equitable access to broadband, particularly in rural communities, NetworkVirginia serves an estimated 1.4 million Virginians through colleges, schools, government offices, municipalities, and other public and private entities. Under subcontracts from Verizon and Sprint, Virginia Tech provides multiple services to NetworkVirginia and its customers.

Mid-Atlantic Broadband Cooperative and LENOWISCO Fiber-optic Project. The Mid-Atlantic Broadband Cooperative (MBC) and LENOWISCO are regional infrastructure projects designed to connect to NLR and expand economic development and commercial innovation in far Southwest Virginia. Both projects are facilitated by SI with significant Virginia Tech investment.

Local Multipoint Distribution Service. Virginia Tech purchased regional Local Multipoint Distribution Service (LMDS) spectrum. SI is assisting with its deployment and integration with other networks through projects at the University of Virginia at Wise, the Institute for Advanced Learning and Research at Danville, and the City of Martinsville.

Network Engineering and Operations

Network Engineering and Operations, led by Carl Harris, includes Research and Development, Network Engineering, Switch Engineering, Telecommunications Facilities Management, Information Technology Support, Network Security, and Project Management.

Research and Development. Research and Development (R&D) engineers—diverse in educational backgrounds and professional experience—are nationally recognized and sought after for advice in areas including advanced networks and services, security, application architecture, design and development, and scientific/quantitative analysis. Their solutions are known not only for technical viability, but also for efficiency and effectiveness in implementation, maintenance, and total cost-of-ownership. R&D is led by Jeff Bevis.

R&D activities encompass three major areas:

Infrastructure planning and upgrades. Appropriate physical facilities, up-to-date cable plant, and constantly upgraded network systems are essential. R&D's planning is comprehensive and includes the re-engineering of pathways and building wiring as well as the design of upgrades to network architecture and support equipment.

Network services planning and implementation. Near-term new and upgraded services will address increasing demand for converged technologies and enable future services like distributed applications, mobile wireless networking, and pervasive computing.

Systems and applications development. R&D adapts and develops software of all kinds along with strategies and models for rapid deployment and large-scale management of UNIX/Linux servers, databases, and other components that provide the foundation for new network and application services.

In addition, R&D has a long history of involvement in open source software development that positions NI&S to contribute to higher education in general and enhances the university's visibility and national reputation.

Network Engineering. The university's network must serve the diverse and challenging needs of teachers, learners, researchers, and administrators. Reliability and security are paramount concerns given the university's critical dependence on computers and the sensitive nature of the data they contain. In addition, technology operations are highly dynamic and require us to plan and invest in technologies of tomorrow even as we operate and maintain those of today.

The Network Engineering team, led by Brian Jones, designs, implements, and operates the university network. Team members research network protocols, test new products, develop software, measure and analyze performance, constantly adjust configurations, and improve processes.

NI&S video engineers provide uplinks for the Virginia Satellite Educational Network for distance learning and to commercial television networks for university cable television service. In addition, they help the university and its departments broadcast special events. The team emphasizes rapid response and close collaboration with commercial providers to maintain a high level of availability and to enhance services.

Switch Engineering. Switch Engineering, led by Barry Linkous, provides telephone and voice messaging services for university locations statewide. In addition, the group oversees the emergency “blue light” telephones on the Blacksburg campus and provides appropriate support to law enforcement and service providers investigating telephone misuse.

Telecommunications Facilities Management. The Telecommunications Facilities Group, also led by Barry Linkous, helps plan, secure, and maintain telecommunications pathways, spaces, and systems. The group performs or schedules needed maintenance and repairs and serves as the primary contact for facilities-related failures.

Information Technology Support. Information Technology Support, led by Joyce Landreth, comprised of the Virginia Tech Operations Center and University Computing Support provides a single point-of-contact for computing and telecommunications services.

Virginia Tech Operations Center (VTOC). Operating 24x365, the VTOC integrates the call center, the computing help desk, and all network, video, and systems operations functions in one facility that proactively monitors all Information Technology networks, systems, and services. The VTOC receives trouble calls and opens problem tickets used to track the diagnosis, escalation, and resolution of reported problems.

University Computing Support. University Computing Support (UCS) is comprised of the help desk and the Content and Knowledge Management (CKM) group. The help desk consultants resolve escalated problem tickets and serve as a liaison, when needed, with other Virginia Tech Information Technology groups. CKM publishes and manages content for Information Technology products and services and maintains an extensive, publicly available, knowledge base (<http://answers.vt.edu>).

Network Security. The Network Security group, led by Phil Benchoff, registers and manages Internet protocol (IP) addresses and other activities critical to network security. Registry services are used by every network-attached device (host); are essential for network reliability, availability, and security; and help maintain accountability for network activities. Network Security staff provides consulting and engineering assistance in networking, security, systems administration, and support for special applications.

Network Registry services include the following:

IP address assignment. Every host (computer) in the Internet has an IP address. This unit manages the IP addresses assigned to Virginia Tech.

IP domain name service (DNS). DNS associates host names with IP addresses.

Dynamic host configuration protocol (DHCP) service. DHCP automatically configures network connections for registered hosts, which allows those hosts to be moved among networks without manual reconfiguration by a system administrator.

Design and development. The group develops systems and tools for efficient, effective, address registration and management.

Project Management (led by Carl Harris). Many NI&S projects to enhance campus communications services and infrastructure are lengthy and complex, involving significant financial and personnel resources. Project management uses tools and techniques to increase efficiency and ensure a project will be completed successfully, on schedule, and within budget.

Under the Restructured Higher Education Financial and Administrative Operations Act, Virginia Tech has been authorized to use a project management process for information technology projects different from the one provided by the Virginia Information Technology Agency. NI&S has used Virginia Tech's own policies, benchmarks, and guidelines to create a standard template to plot project tasks. Plans are available to team members in multiple formats (PDF and HTML). Complex projects may require tiered plans.

At periodic meetings, team members review timelines and deliverables, update pertinent details, and resolve problems that could interfere with success. At project completion, the team prepares a final status report to highlight lessons learned for the benefit of future projects.

Systems Support

Systems Support, led by William Dougherty, provides reliable and secure electronic communications and central computing facilities, in-depth service monitoring, trend analysis, and predictive capacity planning.

E-Communications Services and Windows Administration Services Team. The E-Communications Services and Windows Administration Services (ECS-WAS) Team, led by Ron Jarrell, provides support for all centralized messaging systems (e-mail, Instant Messaging/Chat services, mobile messaging, USENET news), and OS and hardware administration support for all non-UNIX-based centralized services. Other responsibilities of this group include the maintenance of LISTSERV, the Virginia Tech UNIX/Linux mirror site, responding to Internet abuse complaints and participation in the Computer Incident Response Team, and e-discovery in support of civil, criminal, and regulatory investigations.

Storage Management Team. The Storage Management Team (SMT), led by Wanda Baber, provides self-managed storage and backup facilities, administers the IBM Storage Area Network (SAN) for large, data-intensive applications, and the network-attached storage (NAS) devices that provide file-level storage for desktop/laptop users or departmental-level file-sharing. Eighty percent of all storage is used for academic and research purposes.

UNIX Administration Services. The UNIX Administration Services Team, led by Tim Rhodes, supports UNIX/Linux-based hardware and operating systems for administrative applications (such as Banner and the Information Warehouse), instructional applications (such as Blackboard), and research applications (such as those running on System X, Silicon Graphics Incorporated [SGI], and Sun-based hosts). Standardization across all systems enables a relatively small team to manage over 150 non-research systems and more than 1,000 research systems (including the Apple MAC OS X-based System X, Sun Microsystems' Solaris-based systems, and SGI IRIX and Linux-based systems) even as they provide systems administration support to 11 separate groups within Virginia Tech Information Technology.

Blacksburg Electronic Village

The Blacksburg Electronic Village (BEV), an outreach effort of Virginia Tech Information Technology in collaboration with the Town of Blacksburg, is led by William Sanders. Since its inception in 1993, BEV has supported and encouraged the use of technology to enhance social capital and to broaden educational and economic opportunity in Virginia communities.

BEV (www.bev.net) remains one of the longest operating and best-known community networks in the world. Its initial focus on building infrastructure and prototyping community connectivity has consistently expanded. Today, BEV is a Web-services resource of choice for many civic, social, and nonprofit organizations even as it serves as a real-world test bed for new technologies, applications, and funded research projects.

Video/Broadcast Services

Video/Broadcast Services (VBS), led by Mark Harden, produces multimedia-based, instructional materials and manages and schedules—on a statewide level—the interactive videoconferencing network and electronic classrooms required to deliver such materials to thousands of Virginians through distance education. VBS offers live and on-demand streaming media servers for classes, projects, and special events.

Business Administration and Operations

Network Infrastructure and Services is supported by several distinct business administration and operations units—Systems Development and Administration, Network Administration, Field Engineering, Safety, and Business Operations. These groups support the daily enterprise business activities and operations of the organization.

Systems Development and Administration. Systems Development and Administration (SDA), led by Morgan Allen, develops and maintains NI&S administrative information systems. ATLAS—the principal system—supports billing, accounts receivable, accounts payable, purchase order, budget management, work order, service management, and voice call detail record management as well as equipment, materials, and cable plant inventory. Customer On-Line Access (COLA), the Web-based customer portal for ATLAS, provides electronic bill delivery, account information, and service provisioning and management. Additionally, SDA develops and maintains Blacksburg Electronic Village systems.

System and security administration responsibilities include database servers, application servers, Web servers, and telecommunications management and infrastructure systems.

Network Administration. Network Administration, led by Richard Hach, provides administrative coordination among the diverse entities involved in delivering telecommunications services to the university. The group's duties include relationships with other government agencies and vendors, long-term planning, evaluation of new technologies and services, network design assistance, cost analysis, contract negotiation, communications with customers, and problem resolution.

In collaboration with other NI&S units, Network Administration coordinates the record-keeping, data analysis, and reporting necessary for accurate billing, fraud prevention, and audit compliance. When required, Network Administration provides information and assistance to proper university authorities and law enforcement.

Field Engineering. Field Engineering (FE), led by Doug Jones, plans, provisions, and provides telecommunications distribution systems (both inside and outside plant) designed to reliably and securely support current university needs and those of the next 10 to 15 years.

By working closely with Physical Plant, university architects, and project engineers, and through testing and evaluation of vendor products, FE ensures pathways, spaces, and equipment meet or exceed all required capacities, specifications, and standards. During construction and upgrades, FE helps assure work quality, proper documentation, smooth workflow, employee efficiency, and safety.

Safety. Because of its size, NI&S has its own Safety Coordinator, Steve Gordon, who works closely with the university's Facilities Department and Environmental, Health and Safety Services.

The coordinator's duties include providing information and training about health issues and Occupational Safety and Health Administration compliance, performing environmental investigations, coordinating personal protective equipment, reviewing construction sites, and raising employee awareness of safety-related issues. The result is a safer, more supportive, work environment for NI&S employees.

Business Operations. Business Operations, led by Roy Smith, includes Ordering and Provisioning, Business Services, and Public Relations. These groups serve the administrative and business needs of NI&S in keeping with university policies and procedures and consistent with industry best practices.

Ordering and Provisioning. Ordering and Provisioning (O&P) facilitates and fulfills customer requests for telecommunications equipment and services. In addition, O&P provides planning assistance for major telecommunications projects including new building construction.

Business Services. The Business Services group processes accounts payable (including vendor billing), accounts receivable, and payroll and maintains the Student Telecommunications Office.

Public Relations. Public Relations includes the university switchboard, the NI&S receptionists, and a Web/documentation group. The Public Relations staff provides information and assistance to NI&S customers and constituents.

University Printing Services

University Printing Services, led by Charles Tyree, manages a full-service print facility, the copy and digital print centers, contracts for leased copiers and printers, centralized mail services, and copyright clearance.

Printing Plant. The Printing Plant produces results of the highest quality in a timely manner. In light of rising demand as well as rapidly changing and increasingly digital technologies, the plant continually invests in new hardware, updated software, streamlined business processes, and a well-trained staff.

Copier Management Program. The Copier Management Program (CMP) serves as a central liaison with copier vendors for university-affiliated organizations and centrally manages all copier agreements. The program eliminates the need for additional devices by providing high-quality, network-attached devices that copy, print, fax, scan-to-fax, and scan-to-e-mail. Significant cost savings result from the program, and to date, no existing customer has opted out of the CMP.

Digital Print Centers. Demand for color printing and copying continues to increase. The Digital Print Centers have added high-capacity devices, coil binding, and upgraded software. With these additions, greater efficiency is achieved as a result of increased speed and complete finishing, which has eliminated the need to transport an unfinished product to another location for finishing. Receiving Web-submitted files and having student-dedicated print and copier areas have improved the ability of the Digital Print Centers to serve the needs of the university community and reduced operating costs.

Centralized Mail. Centralized Mail processes outgoing bulk mailings; sends internal mail to Deans, Directors, and Department Heads; and does labeling and presort bar-coding to achieve the lowest possible cost.

Mail Services

Mail Services, led by Virginia McCoy, has two divisions:

University Mail Services. University Mail Services (UMS) delivers and picks up mail for more than 300 university departments each day including satellite centers such as the College of Veterinary Medicine, the Math Emporium, and the Virginia Tech Corporate Research Center.

Residential Mail. Residential Mail Services (RMS) is responsible for delivering mail and distributing notices for packages to approximately 8,900 students living on campus. RMS serves students through the use of five staffed mailrooms and several non-staffed mailrooms on campus.

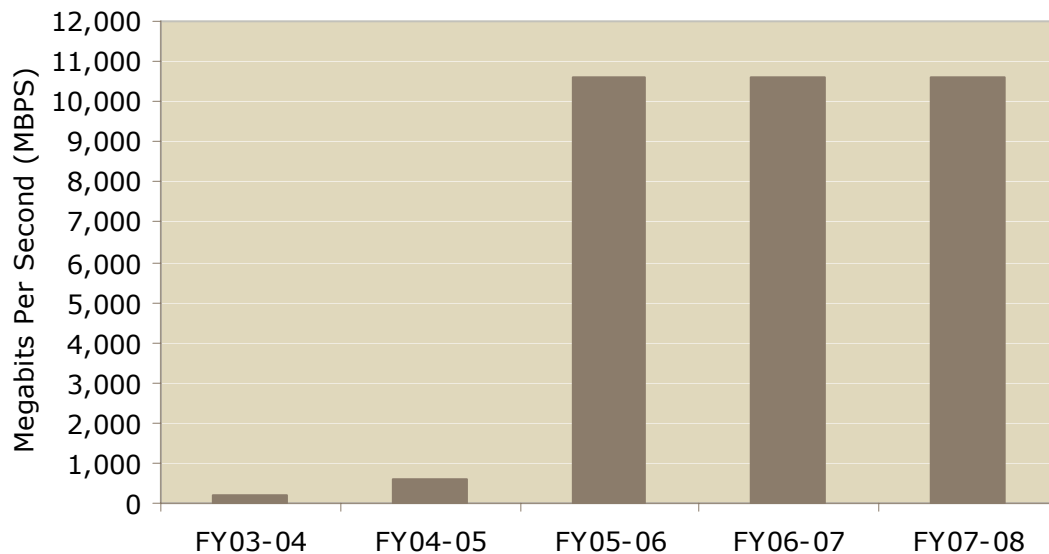
Mail Services only delivers and picks up mail from the United States Postal Service. UMS works with additional vendors, such as United Parcel Service and Advance Post, for outgoing mail.

More information about Mail Services can be found at its website, www.mailservices.vt.edu.

Performance and productivity metrics

Strategic Initiatives

Campus Capacity to Internet, Internet2, NetworkVirginia, and National LambdaRail

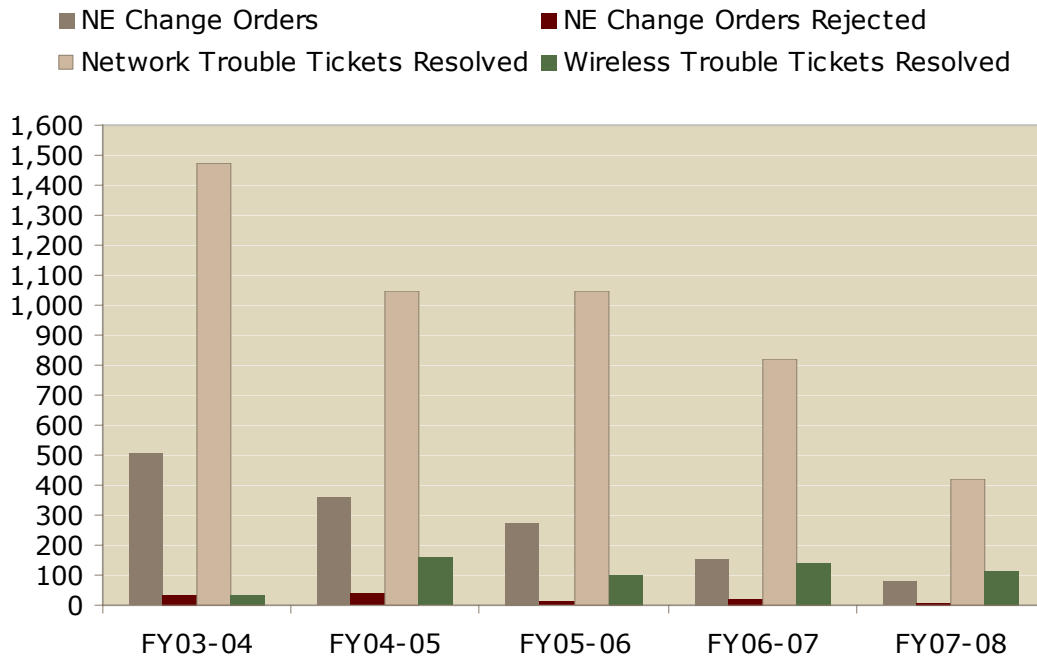


The campus capacity graph depicts the aggregate capacity of Virginia Tech's campus connections to the Internet and to national and global research and education networks. Capacity requirements have trended upward concurrent with increased utility of the Internet and the demand for related services. High-performance connectivity for computational research, coupled with increased requirements for visualization and collaborative tools, resulted in a dramatic increase in capacity requirements.

In 2006, the university implemented VORTEX, a new fiber-optic-based link between the campus in Blacksburg and the Northern Virginia Aggregation Facility which is operated by NI&S. VORTEX augmented Virginia Tech's connection to NetworkVirginia which was previously the highest capacity link operated by any Virginia university. While VORTEX is expected to provide adequate capacity for three to five years, Virginia Tech anticipates the need to add diversity for reliability and to continue to increase capacity tying the university to the global research community.

Network Engineering

Change Orders and Trouble Tickets



Network Engineering (NE) *change orders* are orders submitted to make changes to existing network configurations or to introduce new equipment and configurations into the network.

NE *change orders rejected* represents orders that were submitted but rejected by the Engineering Change Order Committee. Orders may be rejected for many reasons—the submitted change is deemed unnecessary; the submitted change has been superseded by another change order; the committee determined the submitted change would not result in the desired effect; the change was deemed too disruptive to be implemented due to other changes taking place or conflicts with the critical dates calendar, etc.

Network trouble tickets resolved is the number of opened network trouble tickets in the Remedy trouble ticketing system that were successfully resolved.

Wireless trouble tickets resolved is the number of opened wireless trouble tickets in the Remedy trouble ticketing system that were successfully resolved.

NE change orders have decreased in number over the last few years. Network hardware and software changes have been limited because no major upgrades have been implemented in

several years. The majority of network changes have resulted from security software patches and the replacement of failed/aging equipment to keep the network in operating order.

The number of network trouble tickets has also decreased as a result of the attention given to network management tools. These tools allow NI&S engineers to be proactive in responding to network anomalies before they are reported as failures.

Rejected engineering change orders have decreased in proportion to the NE change orders processed.

The number of wireless trouble tickets increased and then leveled out as the number of wireless access points installed increased over the last five years.

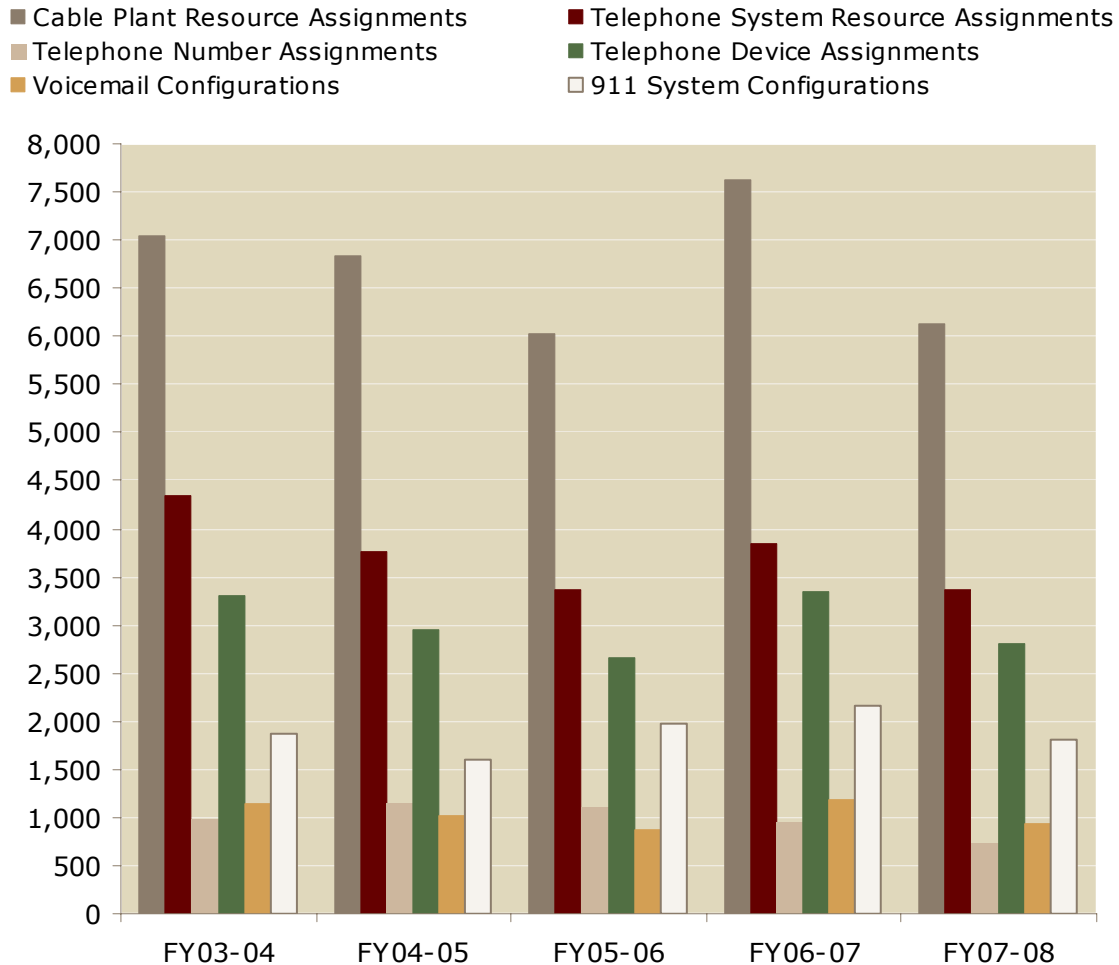
Network Engineering continues to improve Wireless local area network (LAN) coverage. In the past year, 14 academic and administrative facilities have received wireless LAN service. As building renovation projects continue to reshape our campus, access points are constantly removed from and returned to service to optimize coverage and capacity. Wireless utilization continues to grow, and the number of registered users climbs each semester as more faculty, staff, and students use the wireless LAN for mobility and convenience.

Wireless LAN service

	FY05– 06	FY06– 07	FY07–08
Number of on-campus buildings with wireless LAN Service	106	109	114
Number of off-campus buildings with wireless LAN Service	16	20	29
Total number of deployed wireless access points	1,179	1,248	1,359
Total number of wireless LAN registrations	23,167	26,358	29,885

Switch Engineering

Work Order Processing

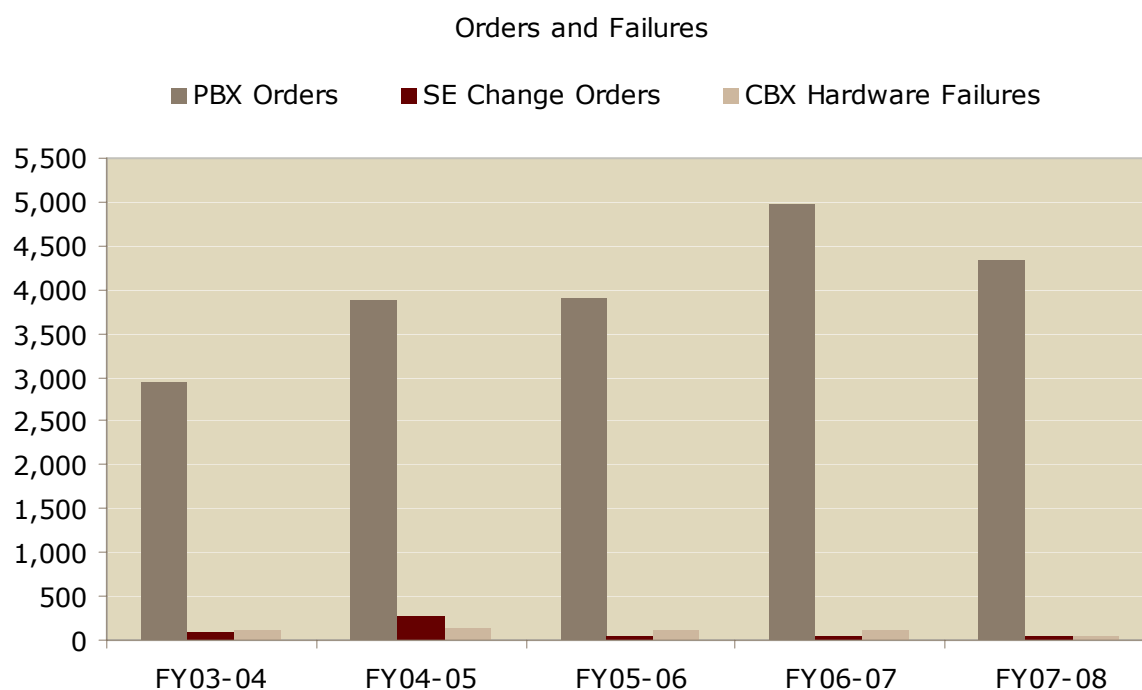


The graph above represents the total number of resource assignment transactions—cable plant, telephone number, telephone system, and telephone device assignments—required to support requests for new telephone and network services.

911 system configurations track software configuration and verification activities to ensure a telephone's location is accurately documented.

Voicemail configurations track the software activity to provision voicemail and call processing services.

The increase in *cable plant resource assignments* in the last fiscal year can be attributed to the service and support efforts in response to the events of April 16th. CNS was able to deploy new service and relocate existing services to meet the communications requirements of the university community and law enforcement agencies in the hours and days following the event.



In the graph above, *PBX order* statistics represent the total number of move, add, and change orders for telephone and/or voice messaging services. This statistic tracks hardware, software, and cable plant activity that, in most cases, affects a single telephone user.

Switch Engineering (SE) *change orders* represent changes to the campus telephone and/or voice messaging systems to add capacity or additional functionality. This statistic tracks hardware and/or software activity affecting large groups or, in some cases, all users of the telephone system.

CBX hardware failures represent the total number of electronic circuit packs replaced in response to service-impacting failures of the university's telephone system.

The large jump in the quantity of PBX Orders in the 2004–2005 fiscal year is associated with the orders required for the opening of The Inn at Virginia Tech, Skelton Conference Center, and Holtzman Alumni Center. The increase in the 2006–2007 fiscal year is related to the orders resulting from the events of April 16th.

Some of the reasons for increased Switch Engineering change orders in 2004–2005 were the work associated with the new telephone system for The Inn at Virginia Tech and the relocation of a voicemail node to the Northern Virginia Center.

The university's telephone system is aging but remains highly reliable. Therefore, the number of *CBX hardware failures* remains consistently low. As the CBX ages, it is more difficult to repair as dependable replacement parts are difficult to locate. The vendor has discontinued any upgrades that would involve system change orders and the possibility of initial failures related to those changes. As the system continues to age, routine card failures have diminished in numbers. However, if and when there is a system failure, the magnitude of the problem is much greater; there is a greater potential for user impact; and the time for problem resolution increases.

Telephone system operation and maintenance

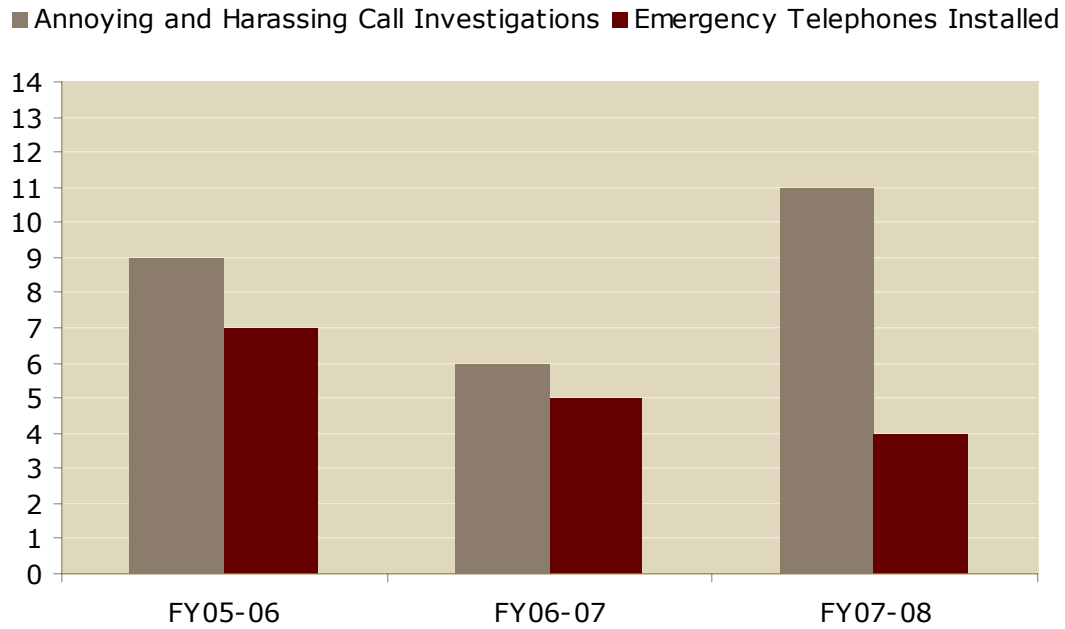
	FY05-06	FY06-07	FY07-08
System availability	99.999%	99.999%	99.999%
System hardware failures resolved	0	2	3
Operating system and application patches	0	0	0
User-reported failures resolved	756	591	412
Hardware architecture modification projects	2	2	4
Software architecture modification projects	46	49	41

Voicemail system operation and maintenance

	FY05-06	FY06-07	FY07-08
System availability	99.982%	99.999%	99.999%
System hardware failures resolved	3	2	1
Operating system and application patches	0	0	0
Hardware architecture modification projects	1	2	0
Software architecture modification projects	1	2	1

The campus telephone system was designed and is maintained to ensure a high level of service availability. The statistics in the preceding tables illustrate the effectiveness of engineering, maintenance, and monitoring efforts of the Switch Engineering group.

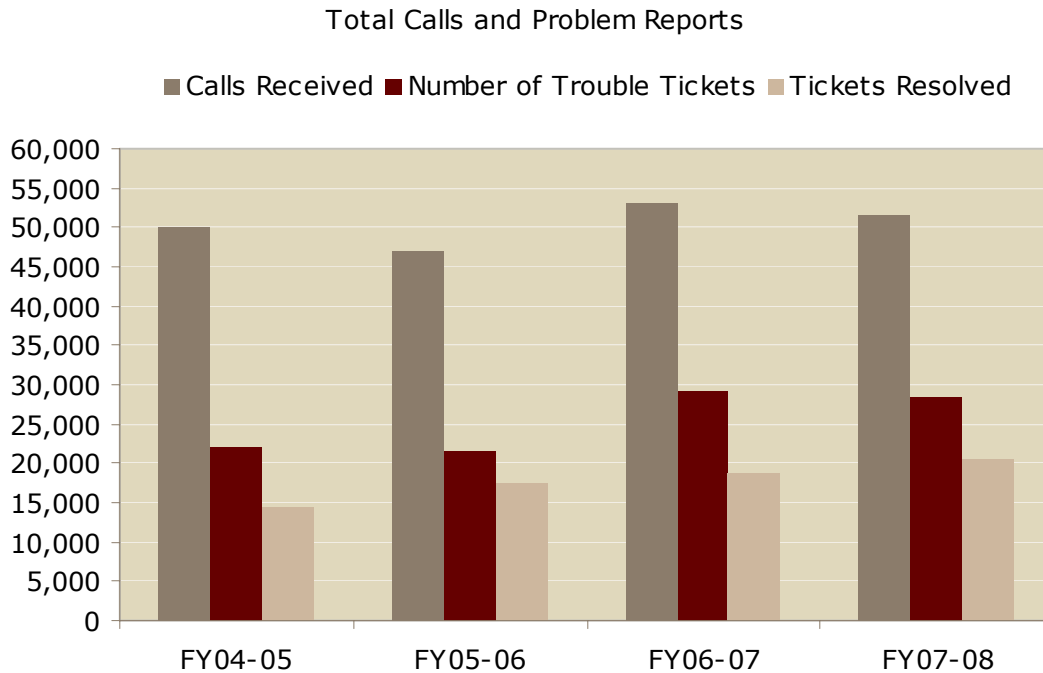
Public Safety and Regulatory Compliance



This graph shows the total number of requests by the Virginia Tech Police Department to have a telephone monitored for the purpose of identifying the source of malicious or harassing telephone calls.

Emergency telephones installed represents the number of blue-light emergency phones installed on the campus. Blue-light telephones are strategically positioned to provide fast access to emergency services to members of the university community.

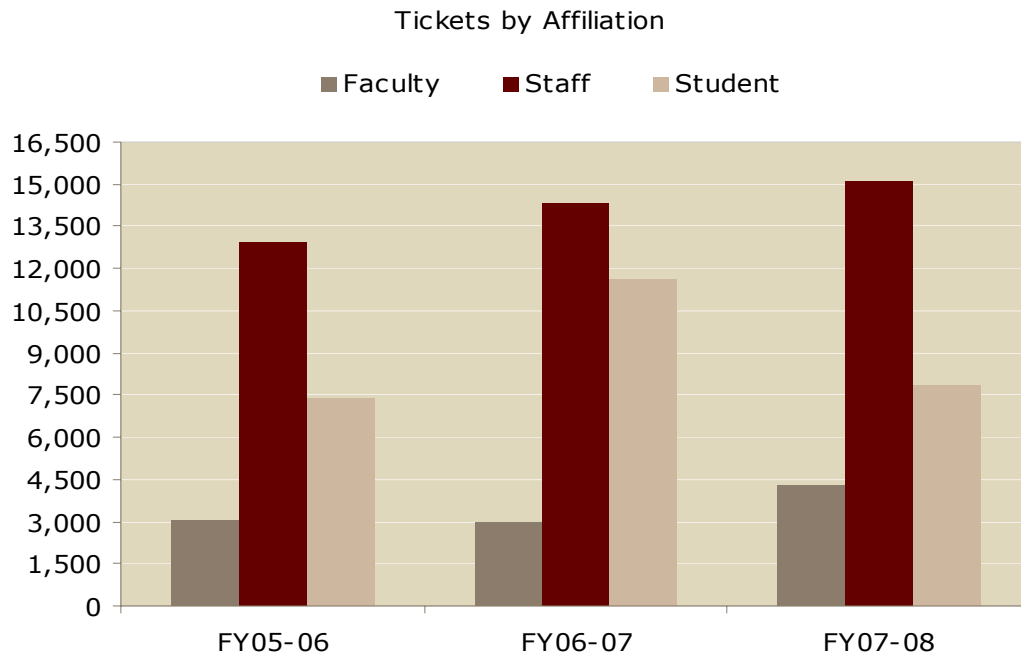
Virginia Tech Operations Center



The graph above shows the total number of *calls received* in the Virginia Tech Operations Center (excluding those for VBS), the number of Remedy *trouble tickets* created, and the number of *trouble tickets resolved* in the VTOC.

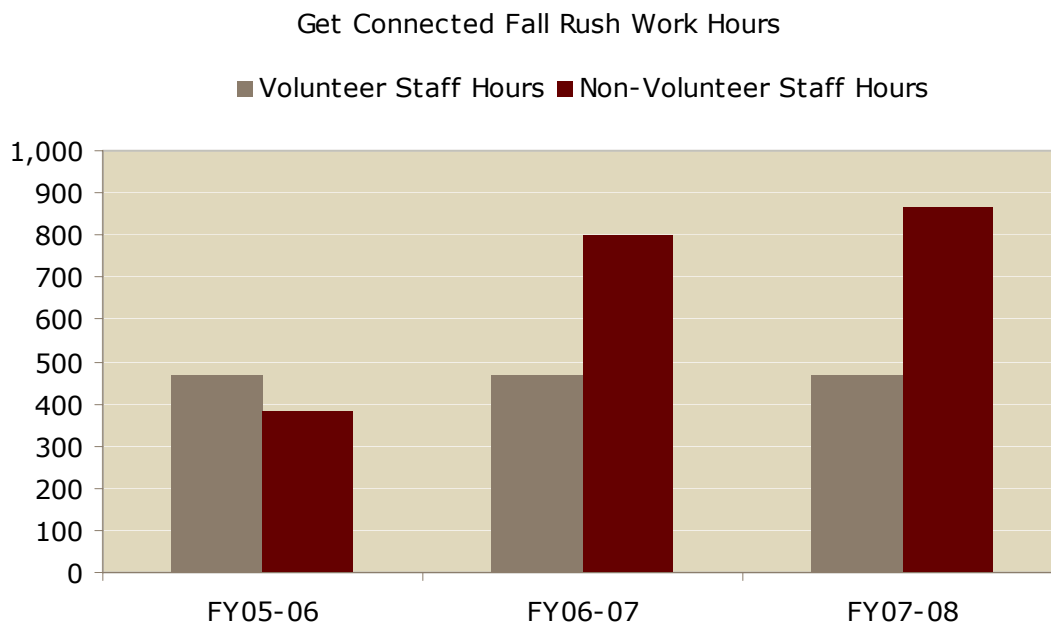
VTOC technicians receive questions and trouble reports from constituents and provide information and technical assistance as required. Trouble tickets are created, as necessary, and resolved if possible. If the problem cannot be resolved as a result of the need for additional data (e.g. financial records or accounts) or a higher level of technical expertise, the trouble ticket is escalated to the appropriate unit.

Total calls received have remained relatively constant. However, an emphasis on training has enabled the VTOC technicians to create and resolve an increasing number of trouble tickets.



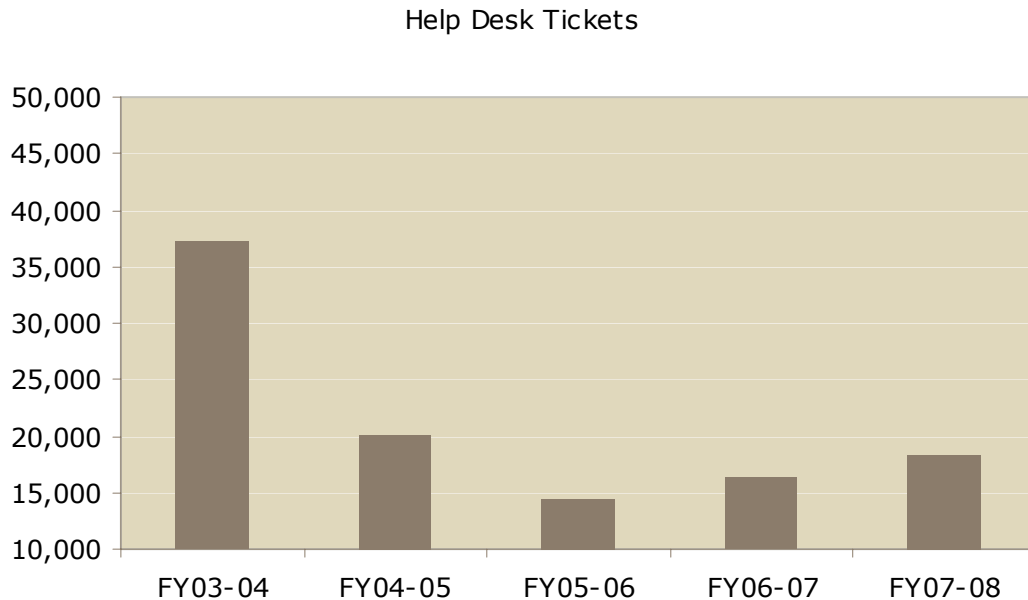
This graph shows the distribution of the majority of the problem tickets received in the VTOC by the affiliation of the caller. The quantities of calls from some affiliates—alumni, retirees, etc.—are not included here.

The spike in the number of student tickets during fiscal year 2006–2007 is most likely due to the introduction of the Microsoft Vista operating system.



Each year, the number of calls received in the VTOC at the beginning of the fall semester requires the addition of staff members from other Network Infrastructure and Services groups—“volunteers”—to handle them. This graph indicates the number of hours worked in the VTOC from the Thursday prior to the start of fall semester classes through the following two weeks.

NOTE: A portion of the substantial increase in the number of non-volunteer hours for FY06–07 and later is the result of the inclusion of the work hours of some staff members not previously counted for this purpose.

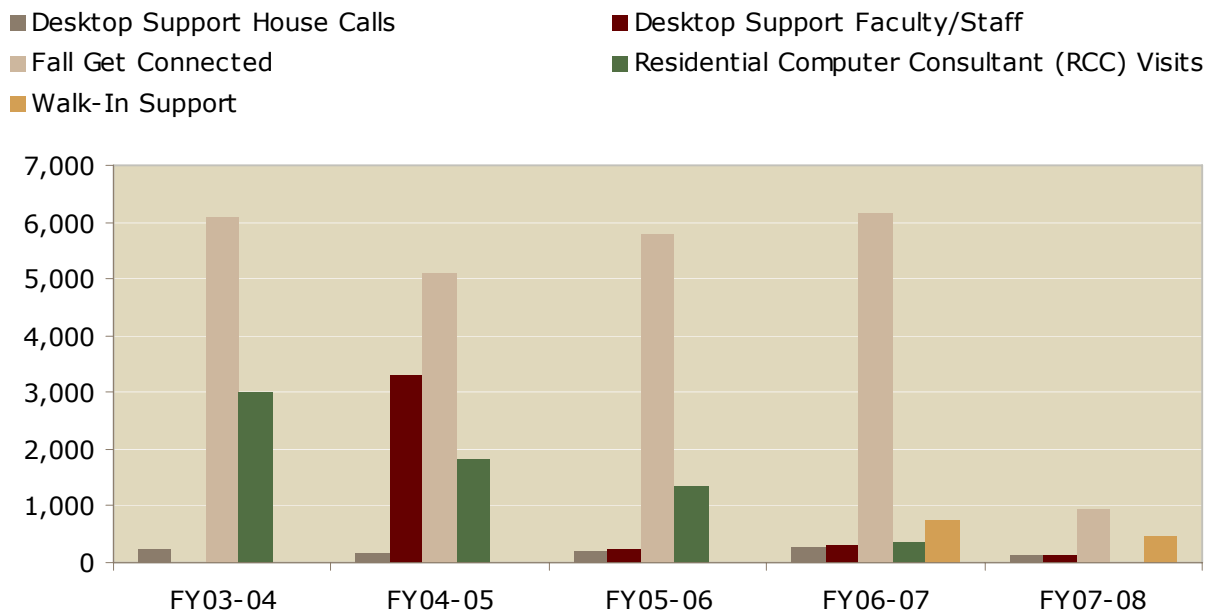


The graph above shows the number of tickets opened by University Computing Support (UCS)/4Help over the past five years.

4Help saw a slight increase in ticket volume this year due to the implementation of VT Alerts and the consolidation with Online Course Systems (OCS). 4Help began taking initial trouble tickets for OCS, and OCS now uses 4Help’s ticketing system for problem escalation. 4Help saw an increase in the number of questions related to account password questions and password resets.

The large number of trouble tickets in 2004 is a result of significant virus activity during that time period. That activity has substantially decreased as a result of Information Technology virus-prevention measures and expanded user-education efforts.

Support Tickets, Calls, and Visits



The graph above shows the distribution of support tickets, calls, and visits by type.

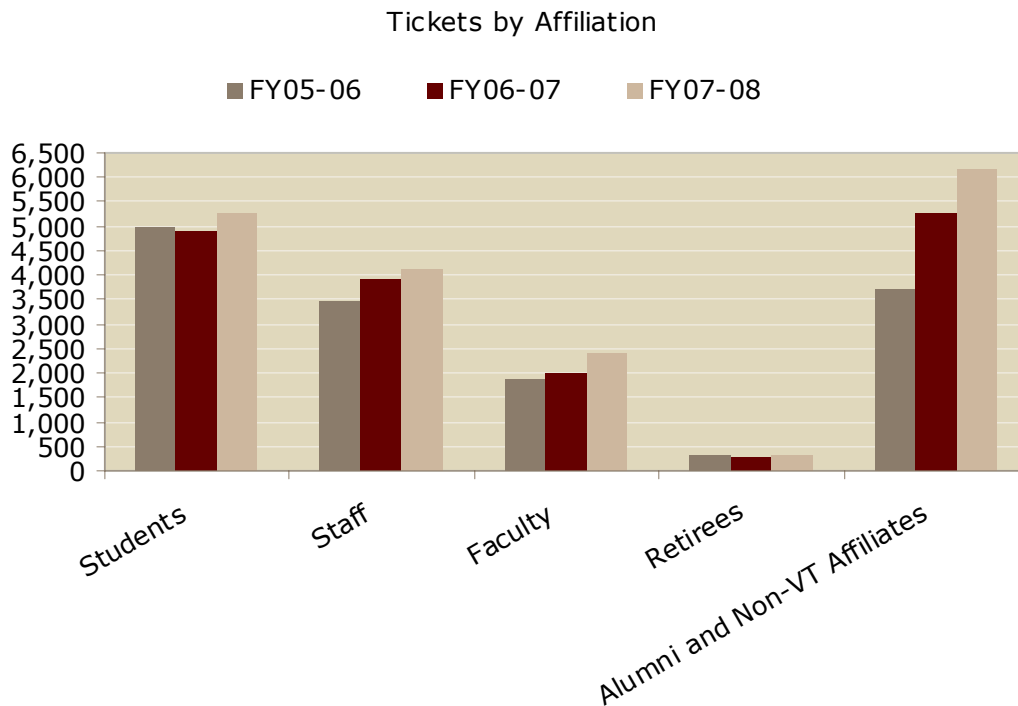
As shown, the numbers of *desktop support house calls* and *desktop support to faculty and staff* show a decrease although the service continues to be well utilized.

(NOTE: The large number of desktop support faculty/staff tickets for 2005 is the result of counting all visits of any kind to a faculty/staff office. This number is now computed by counting only visits where a full-time staff member goes to an office and provides on-site assistance.)

The number of students requiring residence hall room visits during the Get Connected period radically decreased this year because of program changes. The model has shifted to one of calling 4Help for assistance prior to dispatching a Get Connected staff member to the residence hall. In addition, the student body continues to become more knowledgeable about computer security, in part, due to our educational efforts on this topic during New Student Orientation.

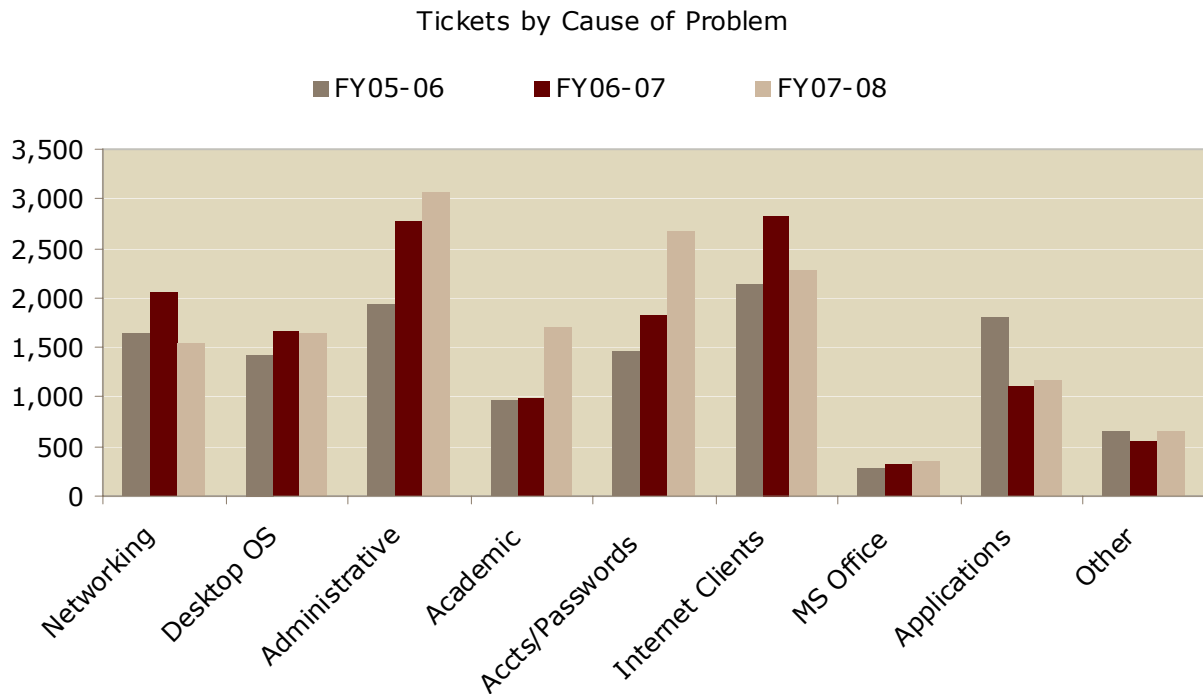
In the 2006–2007 fiscal year, 4Help replaced the Residential Computing Consultant program with a walk-in support model, providing assistance to both residential and off-campus students. This year UCS refined procedures for newer Windows and Macintosh Operating Systems to provide better, more efficient service to university constituents. Changes were made to our scheduling system to increase efficiency, and we continued to update our procedures to address new computer issues and provide more streamlined services.

In the 2007–2008 fiscal year, there was a decrease in the number of walk-in services provided because the service was temporarily discontinued during the migration of the entire support staff to a new location.



The graph above shows the distribution of trouble tickets based on the affiliation of the caller.

Keeping in mind that many people have multiple Virginia Tech affiliations, we record the affiliation of those seeking computing assistance where possible. All categories showed an increase this year, including the number of questions from those without an active Virginia Tech affiliation such as alumni, prospective or admitted students, and parents. Tickets from these callers are categorized as *alumni and non-vt affiliates* in the graph above. The overall increase in the number of tickets this year was primarily due to the implementation of VT Alerts, the collaboration with OCS to provide first-level support for their applications, and questions related to the new alumni gateway.



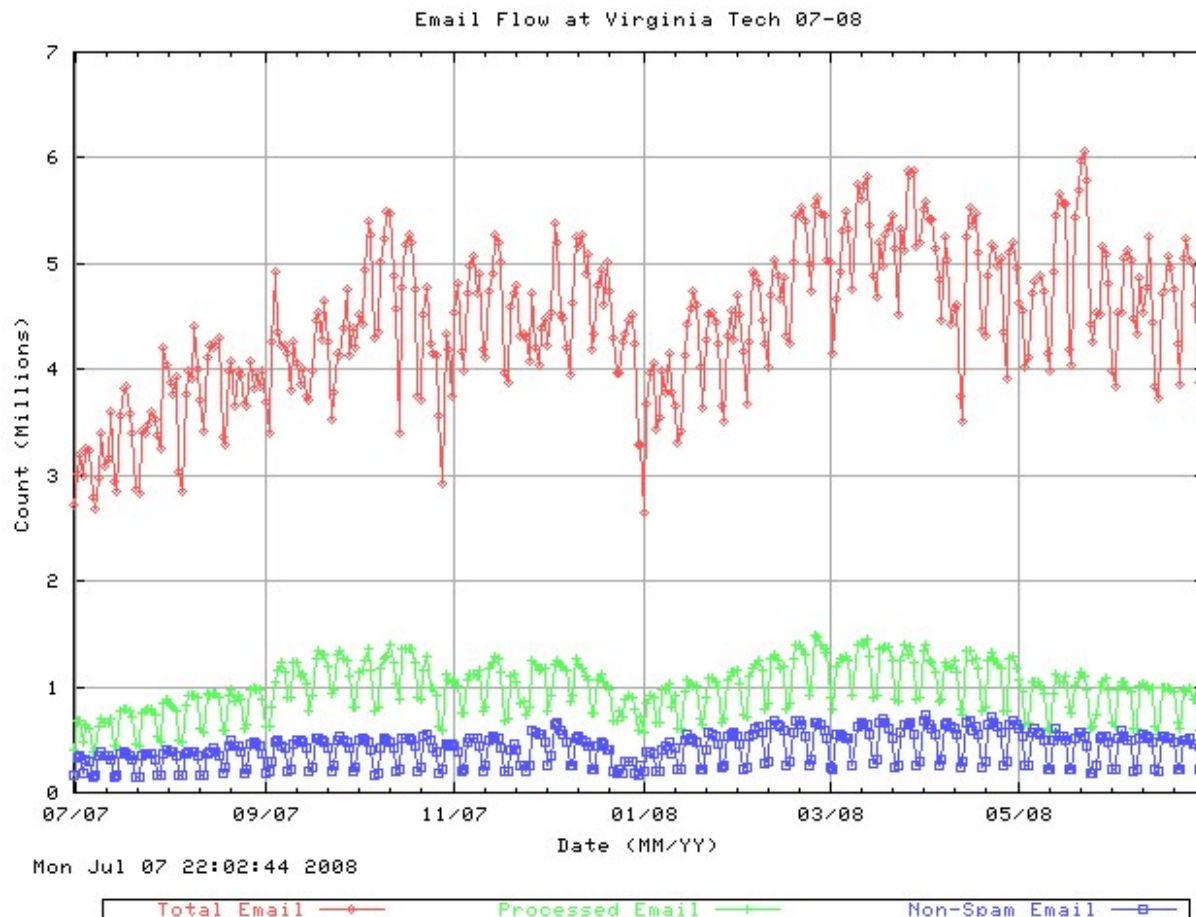
The graph above displays the various causes associated with problem tickets.

The largest increase this year was in the *administrative* category, which includes calls related to Information Technology-provided applications and services such as Banner, Mail, Filebox, Hosting, network attached storage, and Hokies Domain issues. The number of administrative tickets increased due to the implementation of VT Alerts.

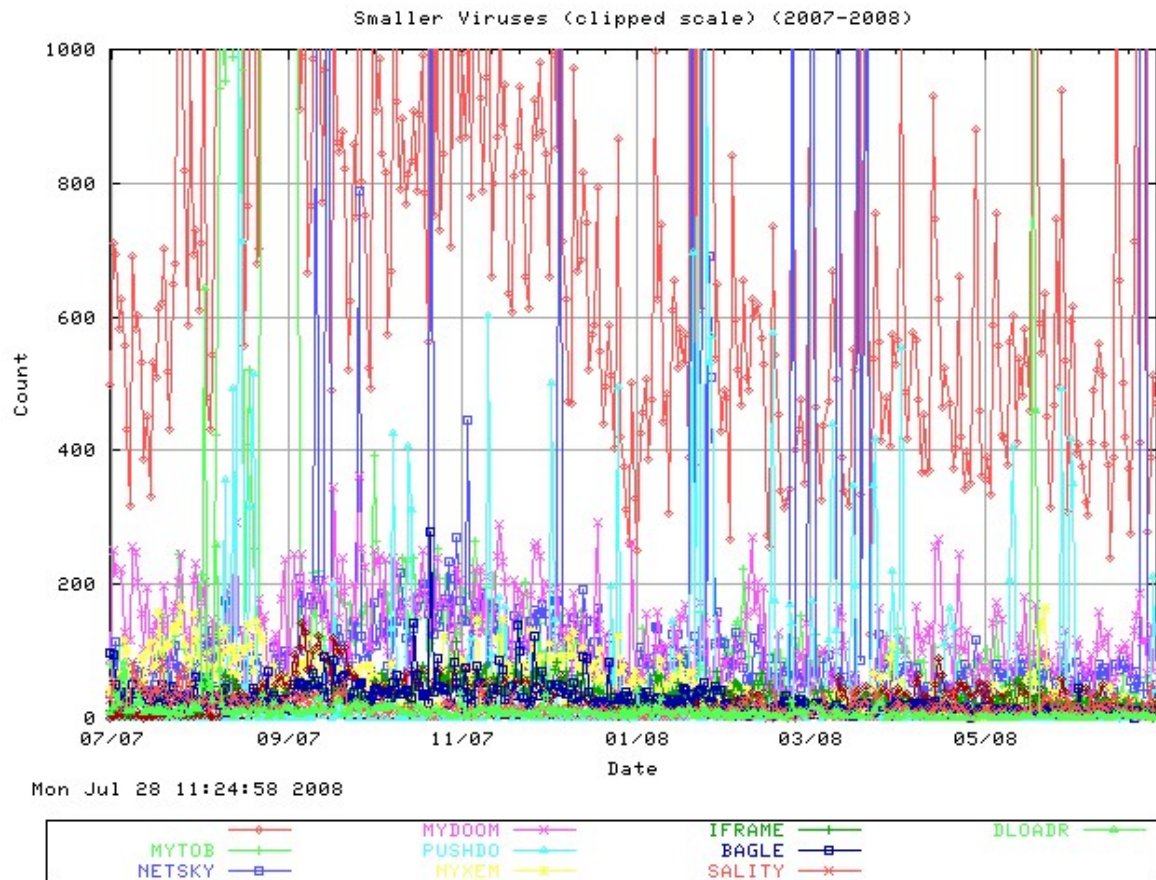
Tickets in the *academic services* category, which includes Hokie SPA, LISTSERV, and Blackboard, increased as a result of UCS handling first-level support for Online Course Systems. In addition, 4Help began accepting first-level support calls for Auralog software used by the foreign language department at Virginia Tech.

Due to the implementation of the new Alumni Online Directory, there was also a significant increase in the number of calls related to accounts and passwords.

Systems Support

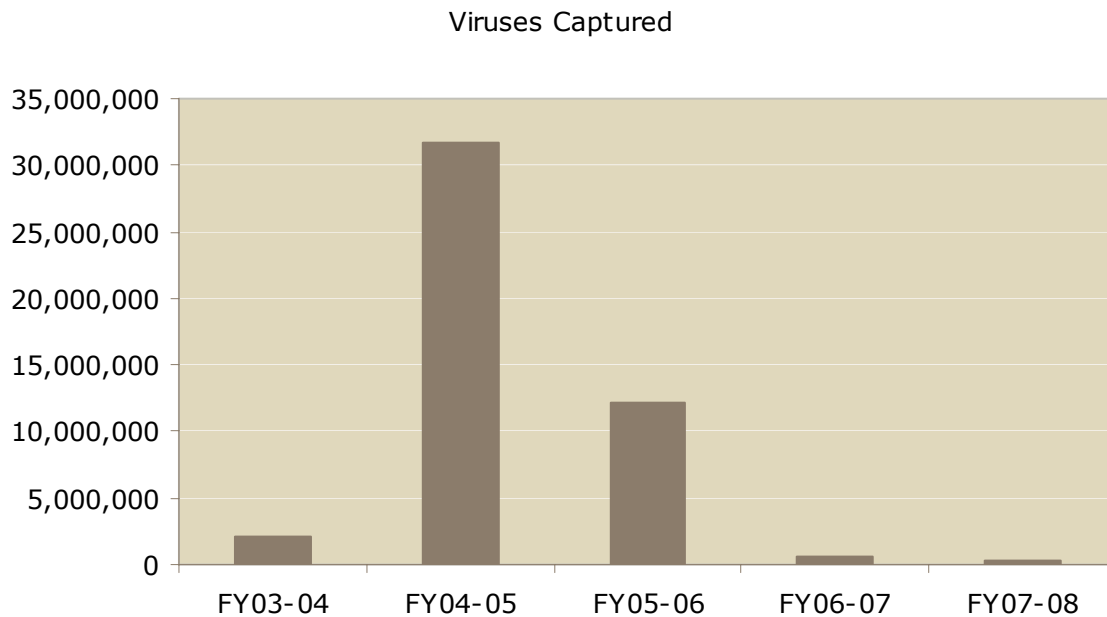


This graph illustrates the flow of all e-mail into the Virginia Tech domain during the fiscal year—July 2007 through June 2008. The red line hovers between 3 and 6 million and represents all e-mail messages received. The green line, in the 300,000 to 1.5 million range, represents messages actually processed through the system (not blocked or rejected due to viruses or suspected spam). The blue line, between 100,000 and 600,000 messages, represents those messages that were delivered and not tagged as being potential spam.



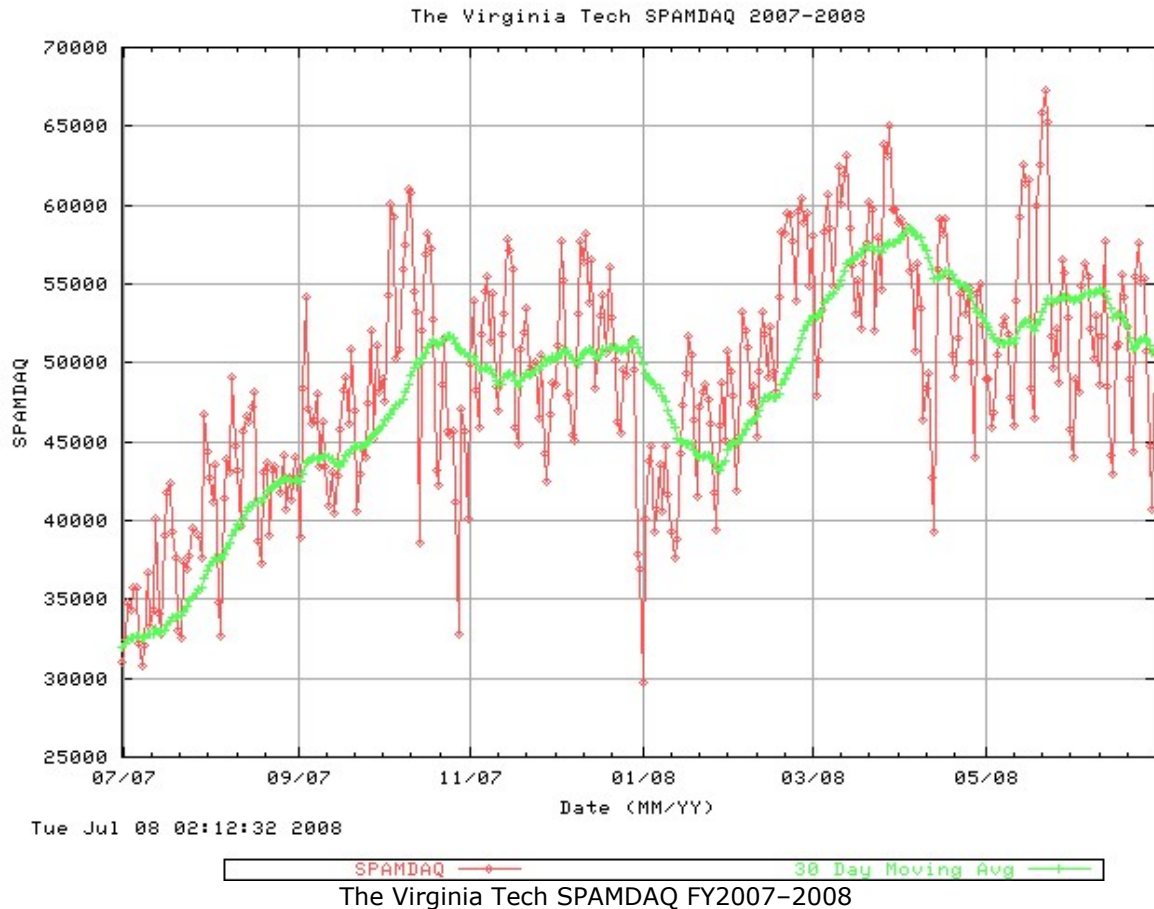
This graph represents the “Top Ten” viruses received at Virginia Tech during the fiscal year. All of these viruses were intercepted by the virus scanners.

Many of these viruses are several years old; MYDOOM was released in late 2004 and BAGLE in early 2002. Viruses are not eradicated; they are only blocked and prevented from doing damage. Very few new viruses are released “into the wild” these days, but the older ones continue to plague users.



This graph illustrates the number of computer viruses captured by the scanners associated with the central e-mail systems. Although the numbers showed a slow, gradual increase from the initial implementation (2001), the spike seen in 2005 was a direct result of a major virus outbreak (MYDOOM) which severely disrupted operations at Virginia Tech.

The dramatic decrease in the 2006–2007 fiscal year and continued decrease this year are indicative of increased user awareness, improved client software penetration (VTnet provides software to all university affiliates at no charge at the start of each fall semester), and the decline of e-mail as a delivery mechanism for “malware.” Malware can now be received via Web bugs, instant messaging, and other services deployed by younger users, such as college students.



The graph above illustrates the Virginia Tech “SPAMDAQ.” This index reflects the severity of incoming spam. Much like a stock index, it shows the long-term ebb and flow of unsolicited/unwanted e-mail received by Virginia Tech’s central e-mail servers.

The SPAMDAQ is computed by comparing a single day’s intake of spam, as detected by Virginia Tech’s spam and virus filters, against the average spam received during Fall Semester 2003 (August 25–December 18, 2003). The number “10,000” is set as the index value for the median spam amount. (A score of 5,000 means half the index amount was received; a score of 20,000 would mean twice the index amount was received.)

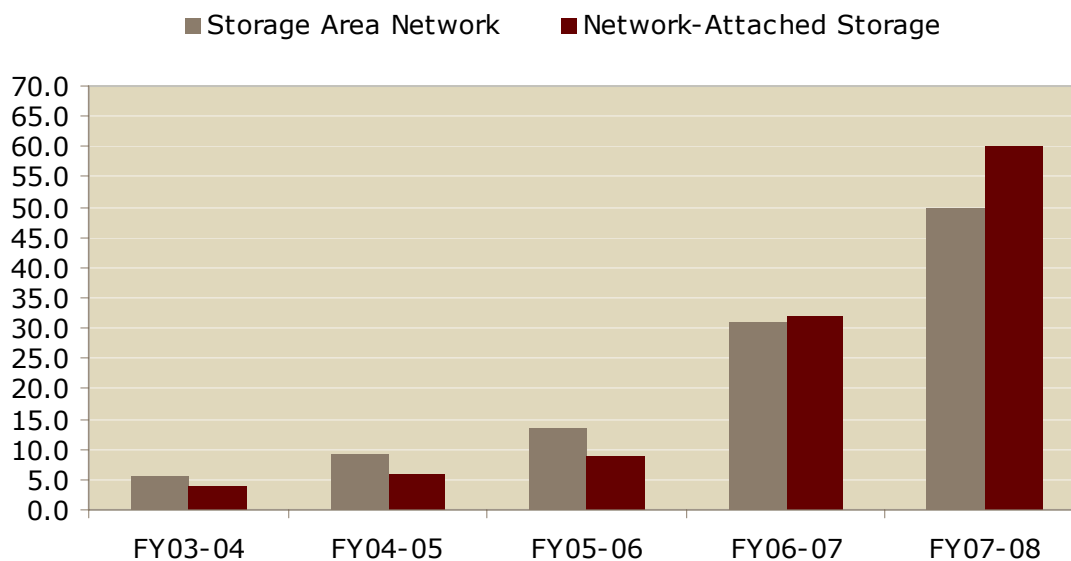
Abuse complaints

	Threats	Harassment	Abusive	E-mail break-in
July 2007	0	0	0	0
August 2007	0	0	0	0
September 2007	0	1	0	0
October 2007	1	0	1	0
November 2007	0	0	0	0
December 2007	0	0	0	0
January 2008	0	1	0	0
February 2008	1	1	0	0
March 2008	0	0	0	1
April 2008	0	0	1	0
May 2008	0	0	1	0
June 2008	0	0	2	0
Total	2	3	5	1

This table illustrates the number of complaints received through the *abuse@vt.edu* account about events not related to unsolicited e-mail (or spam). The table shows, of the thousands of messages received annually, only a handful (11) relate to matters requiring immediate corrective action.

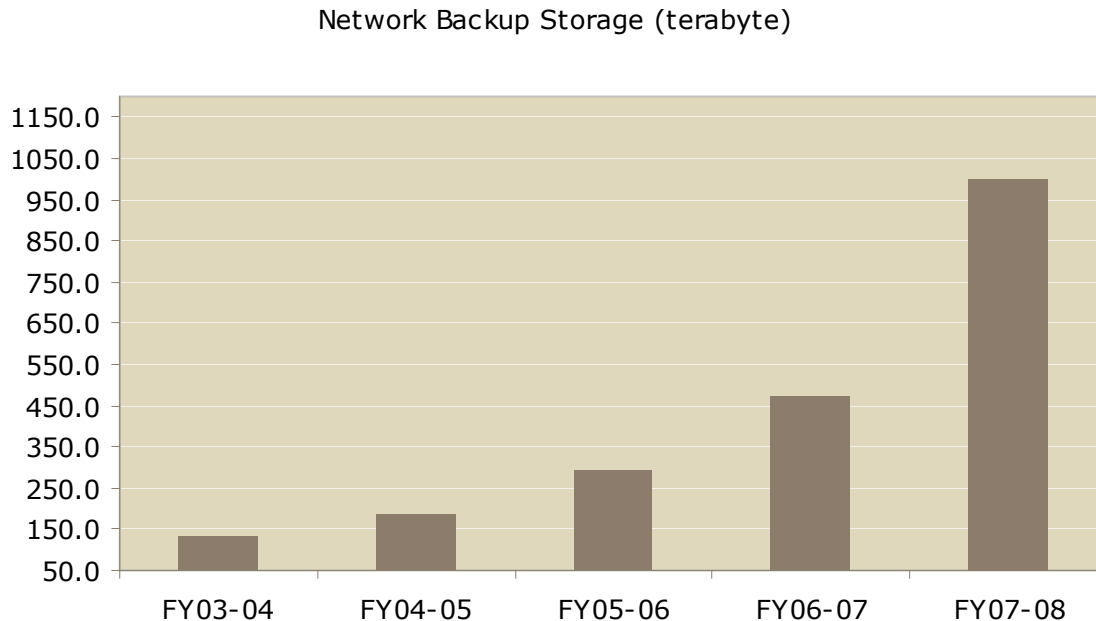
Note: Semester breaks (including winter and summer) impact the volume and type of traffic/complaints considerably.

Storage Added (terabyte)



This graph illustrates the amount of data stored on the centrally managed storage resources (SAN and NAS). Gradual increases occurred, as expected, over the 2003–2006 period as the availability of such services became more widely known, and colleges and departments that had previously run their own file servers switched to the central service.

The dramatic increase in 2007 is a direct result of data preservation requirements associated with the events of April 16th. Continued attention to the need for centralized storage accounts for the almost twofold increase this year.



This graph illustrates the amount of data stored on the centrally managed backup service (disks and tapes). Gradual increases occurred as expected over the 2003–2006 period as the availability of such services became more widely known, and colleges and departments that had previously run their own file servers switched to the central service.

The dramatic increases in the past two years are a direct result of data preservation requirements associated with the events of April 16th.

UNIX Administration Services—Managed systems

Group	Availability	Number of hosts
Content and Knowledge Management	99.96962 %	
—Production	99.93924 %	1
—Development/preproduction	100.00000 %	1
Content Management System	100.00000 %	
—Production	100.00000 %	1
—Development/preproduction	100.00000 %	1
Collaborative Technologies Unit	99.99927 %	
—Production	99.99890 %	17
—Development/preproduction	99.99964 %	8
DBMS/Banner Systems	99.99100 %	
—Production	99.99036 %	18
—Development/preproduction	99.99164 %	9

Learning Technologies	99.99807 %	
—Production	99.99776 %	16
—Development/preproduction	99.99839 %	12
eCommunications	100.00000 %	
—Production	100.00000 %	1
eProvisioning Systems	99.99910 %	
—Production	99.99874 %	6
—Development/preproduction	99.99946 %	7
GIS System	99.99931 %	
—Production	99.99931 %	1
Hosting/Filebox	99.99884 %	
—Production	99.99856 %	9
—Development/preproduction	99.99912 %	5
Imaging	99.99766 %	
—Production	100.00000 %	1
—Development/preproduction	99.99533 %	2
Information Warehousing	99.99237 %	
—Production	99.99490 %	2
—Development/preproduction	99.98984 %	2
Information Technology Acquisitions	99.99895 %	
—Production	99.99952 %	9
—Development/preproduction	99.99839 %	2
Middleware	99.99473 %	
—Production	99.99159 %	18
—Development/preproduction	99.99787 %	23
HPC/Research	99.99508 %	
—Production	99.99016 %	15
—Development/preproduction	100.00000 %	1
Research Projects	99.99959 %	
—Production	99.99959 %	4
SETI/QA	99.99917 %	
—Production	100.00000 %	1
—Development/preproduction	99.99833 %	3
UNIX Administration Services	99.99378 %	
—Production	99.99850 %	3
—Development/preproduction	99.98906 %	6

The table above displays the availability of servers managed by the UNIX Administration Services Team.

Percentages of less than 100 percent represent unscheduled downtime for a particular service. In most environments (wherever the number of servers is greater than one), service is provided by clustered servers so an outage on a single host does not actually cause a disruption. The hours of operation are, in all cases, 24 hours per day, seven days per week, and 365 days per year. Figures for both production and test (development and preproduction) servers are shown as an average for the overall service availability percentage.

The number of hours of downtime over the course of the 07–08 fiscal year is extremely small. Using the Information Technology Acquisitions production hosts as an example, 99.99952

percent of 8760 hours (24 hours x 365 days) means those production servers were down for less than one hour during the entire period.

Blacksburg Electronic Village

The Blacksburg Electronic Village (BEV) initially worked with seven counties to construct and host community development websites with support from a Department of Commerce Technology Opportunities Program (TOP) grant that ended in 2004. Two counties have elected to pay BEV an annual fee to continue the service.

TOP: Registered villagers and organizations, 2007–2008

County	Villagers	Organizations	Organization directory listings
Cumberland	227	48	110
King and Queen	490	16	276
Total	717	64	386

The number of domain names supported has dropped as some TOP counties have discontinued service and some Sprint/NetworkVirginia customers have moved to alternate providers.

BEV services

	FY04–05	FY05–06	FY06–07	FY07–08
Domain names supported	227	296	281	274
Websites (full service)	63	66	56	62
Websites (community connections)	125	123	130	113
E-mail boxes	503	504	479	481
E-mail lists	128	157	155	142
E-mail volume per week (valid messages)	17,000	23,000	30,000	36,000
E-mail volume per month (valid messages)	74,000	100,000	130,000	156,000
E-mail volume per year (valid messages)	884,000	1,196,000	1,560,000	1,872,000

BEV website and e-mail services continue to be popular, although an increasing number of customers have migrated to nationally based service providers such as Google and Yahoo.

E-mail volume continues to climb. E-mail remains a popular form of communication for BEV's customer base.

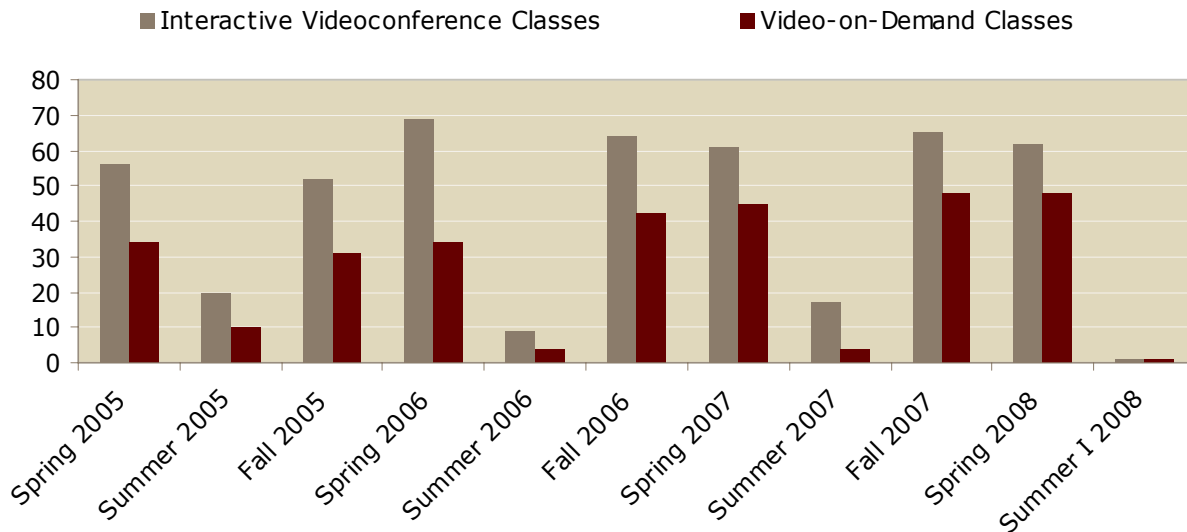
BEV's Web Support Services project, using undergraduate staff to provide at-cost Web development service to campus organizations and area nonprofits, has seen an increase in project scale for new websites and major redesigns. In addition to Dreamweaver template-based sites, Web Support Services now develops sites based on Drupal, an open source content management system.

BEV Web Support Services projects

	FY06-07	FY07-08
New websites or major redesigns completed	10	6
Site maintenance or assistance projects completed	6	8
Projects in progress as of June 2008	4	4
Proposals in development as of June 2008	1	4

Video/Broadcast Services

Interactive Videoconference and Video-on-Demand Classes



The graph above shows the total number of *Interactive videoconference classes* and *video-on-demand classes* supported by Video/Broadcast Services (VBS).

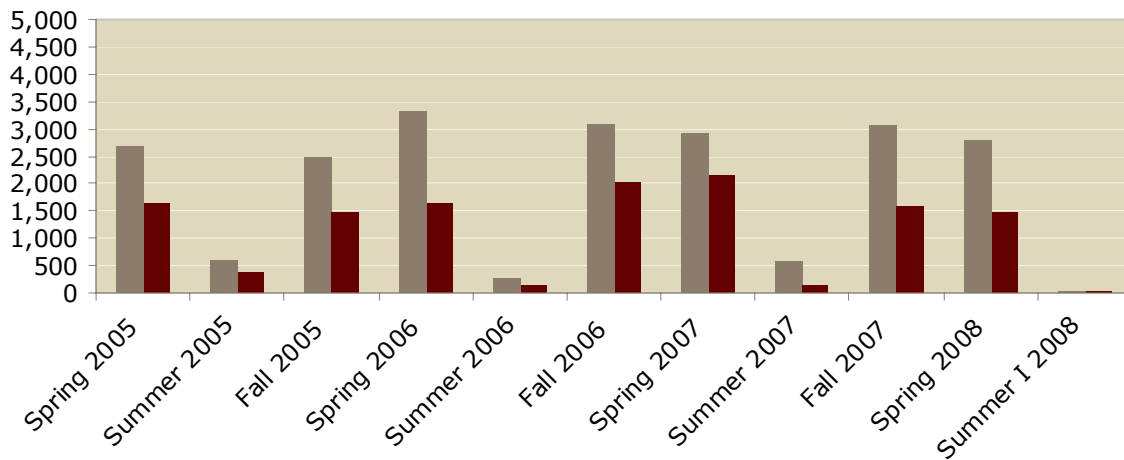
VBS maintains and operates Virginia Tech's 32 interactive videoconference (IVC) classrooms throughout the commonwealth. VBS coordinates the scheduling of on- and off-campus IVC classrooms, provides video bridging services, and hosts class lectures as video-on-demand files.

Since the technology upgrade in our IVC classrooms over the summer of 2006, there has been a corresponding increase in the demands on the streaming media capabilities.

NOTE: The number of classes reported for Summers 2005–2007 included those for *both* Summer Sessions rather than only those through the end of the fiscal year/Summer Session I.

Interactive Videoconference Class and Video-on-Demand Hours

■ Interactive Videoconference Hours of Service Provided ■ Video-on-Demand Hours of Content

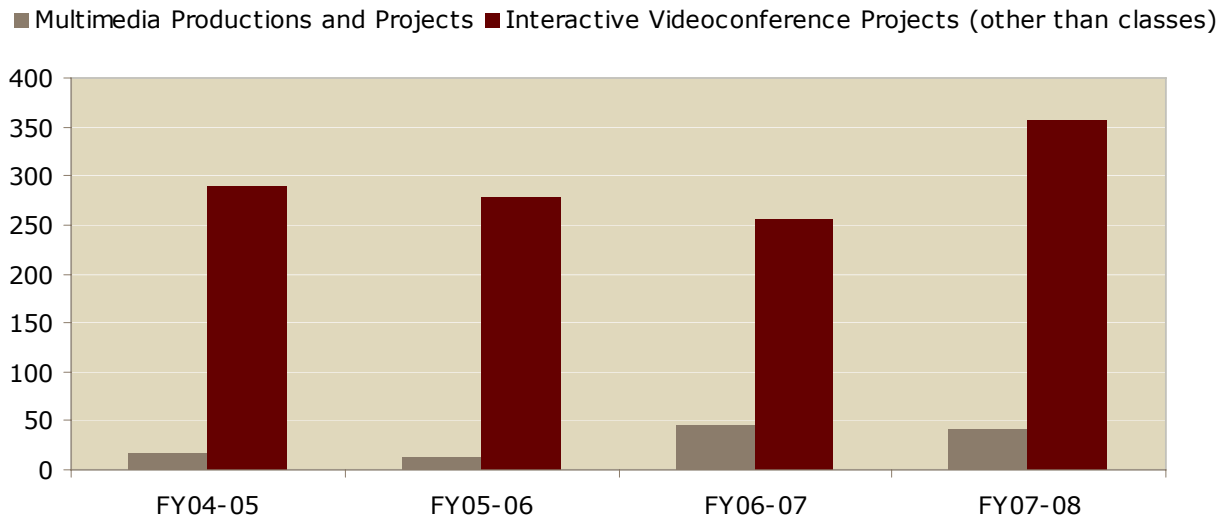


This graph indicates total hours of service provided by VBS for interactive videoconference classes and the total hours of lecture material prepared and hosted as video-on-demand files.

VBS IVC classrooms now have the capability to broadcast two separate channels of information simultaneously—dual video. VBS also developed a process to capture and stream dual video content in a single video-on-demand file. The 2006 implementation of dual video in the IVC classrooms and streaming media led to an increase in the number of faculty members requesting that their courses be archived as video-on-demand files.

NOTE: The number of hours reported for Summers 2005–2007 included those for *both* Summer Sessions rather than only those through the end of the fiscal year/Summer Session I.

Multimedia and Interactive Videoconferencing Projects



The IVC facilities are used for many "one time event" interactive videoconferences including instructional use such as connecting guest speakers with Virginia Tech classes and assisting with preliminary exams, thesis, and dissertation defenses. The facilities also support administrative meetings among dispersed campuses.

Also depicted in this graph is the tally of completed multimedia productions. New efficiencies in equipment setup and on-location preparations have been realized, resulting in the capacity to accept on-location production requests with less lead time.

VBS put a new facility into operation in 2007—a fully capable production truck equipped to meet the requirements for on-location video and multimedia production. Equipped with the technology to connect with Virginia Tech's existing network infrastructure and the Network Operations Center in RB XIV, the new production truck gives VBS an additional video production resource capable of broadcast via satellite uplink and Internet protocol.

VBS also maintains and operates the Video Network Operation Center (VNOC) in Research Building XIV. The ATM facilities and video bridges were converted to IP facilities during the summer of 2006. ATM videoconference systems and ATM video bridges were decommissioned upon completion of the IP conversion project.

Interactive Videoconference Facilities

	FY04-05	FY05-06	FY06-07	FY07-08
VNOC-ATM video bridges	2	2	0	0
VNOC-IP video bridges	0	2	3	3
VNOC-IP VCRs	0	2	3	3
ATM origination sites	23	23	0	0
ATM receive sites	18	17	0	0
IP origination sites	0	0	22	22
IP receive sites	0	0	10	10
RAID 5 streaming media storage server (terabytes)	1.1	2.2	7	10

In 2006, VBS operated two Codian IP Video Bridges and two Codian IP VCRs. In early 2007, VBS added a Video Bridge and an IP VCR dedicated to research and development. This arrangement gives VBS the capacity for offline testing of videoconferencing software upgrades and patches without jeopardizing the integrity of the machines used in daily productions.

During this fiscal year, a portion of the VNOC's research and development (R&D) infrastructure was moved from the Corporate Research Center (CRC) to Whittemore Hall. The core of the new R&D area consists of a multi-conference unit and an Internet protocol videoconference recorder. The new on-campus infrastructure provides a redundant system to maintain operations in case of an emergency at the CRC location.

Service calls by VBS engineer

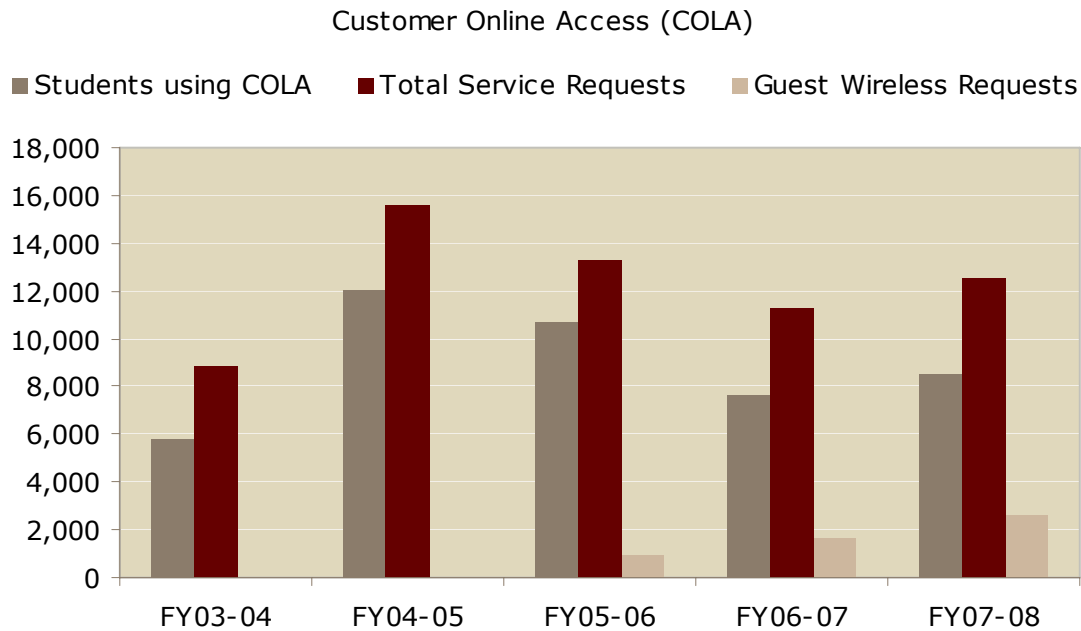
	FY05-06	FY06-07	FY07-08
Off-campus calls resolved by remote access or telephone support	65	53	51
Off-campus calls resolved by on site-visit	17	10	8
On-campus calls resolved on-site	21	26	27

VBS Field Engineering provides planning, installation, and maintenance services for Virginia Tech's interactive videoconference facilities located on the Blacksburg campus and across the commonwealth. VBS Field Engineering handles routine and preventive maintenance of video systems, providing a fast response for the repair or replacement of broken equipment and coordinates efforts with the VNOC to resolve communication problems.

Systems Development and Administration

Customer Online Access (COLA) is the telecommunications customer portal. This chart shows three COLA statistics:

- *Students using COLA*—The number of students who made at least one service request during the year using COLA;
- *Total service requests made by students*—The number of service requests and/or service updates (wireless LAN or Long Distance Authorization Code) made by students using COLA;
- *Guest wireless requests*—The number of service requests made by university guests using COLA to register for sponsored wireless LAN service.



Trend analysis of the two student statistics indicates the use of COLA by students peaked in 2005 and has decreased since that time. This decrease is likely due to two factors. First, there was a rapid increase in the use of wireless LAN by students during the period of 2003 through 2005 to reach a near-saturation point. It is to be expected after a large increase in the number of customers during the first couple of years a service is offered, the activity would decrease to a steady state generally determined by the number of students new to the university. Second, during 2006 and 2007 on-campus summer orientation, the Student Telecommunications staff registered many students for wireless LAN service and long distance authorization codes. These numbers are not reflected in COLA's *total service requests*.

The third statistic relates to guest wireless LAN—a service that has only been offered via COLA since 2006. The large increase in 2006–2007 and 2007–2008 is related to the significant growth in use of that service offering by those visiting campus.

Field Engineering

This graph indicates the number of completed work orders of various types as well as the total of all types of orders completed.



The sharp increase in voice/data orders from 2006 to 2007 can be attributed, in part, to the completion of the University Gateway Center and the Surge Facility and the move of the Office of Sponsored Programs from Collegiate Square to Research Building 15. In addition, numerous voice/data orders were worked in the days following the April 16th tragedy including the relocation of the Department of Engineering Systems and Mechanics and the dean of engineering from Norris Hall and supporting the needs of multiple command centers, counselors, and call centers.

NOTE: In years 2003–2006, the graph illustrates total work orders processed and worked by the department. Beginning in fiscal year 2006–2007, only work orders completed by Field Engineering are illustrated. Examples of “non-field” work orders include the following: NetworkVirginia, cellular orders, main switch, and PBX software-only orders.

Capital projects

	FY04-05	FY05-06	FY06-07	FY07-08
Total RJ-45 jacks installed (each)	5,548	4,400	1,923	1,639
Total Cat 6 station cable installed (feet)	818,400	1,101,000	415,700	312,460
Total optical fiber fusion splices (splices)	1,776	1,656	1,136	768

The table above shows the number of jacks, the amount of station cable, and the number of fiber splices completed by Field Engineering for capital projects—new construction and major renovations—during each fiscal year.

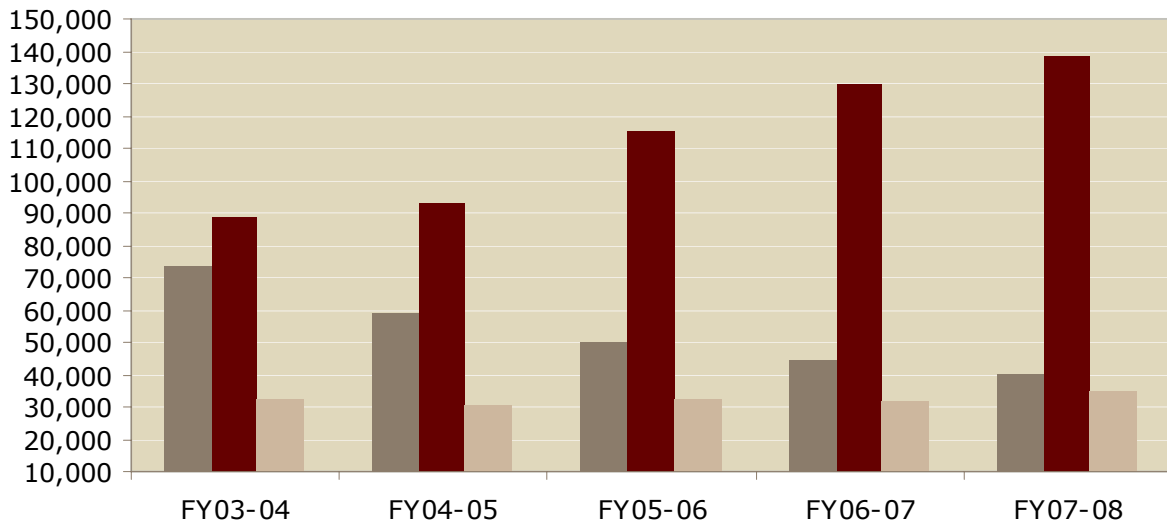
Capital project statistics are compiled for projects completed between July 1 and June 30 of each year. These projects typically have a construction duration of one to four years. Field Engineering is frequently engaged in capital project installations where statistics of work performed are not posted until the annual report year in which the buildings/renovations are finished. This report also contains statistics for new construction installations in the Corporate Research Center.

During the past fiscal year, some of the buildings for which new network connectivity was completed are the Surge Space Facility, the Building Construction Lab, Burruss Hall Renovation, the Institute for Critical Technology and Applied Science A at the Corporate Research Center, and the Institute for Distance and Distributed Learning at Gateway Center.

Business Operations

Services Overview

■ Customer Invoices ■ Current Services ■ Service Activations, Deactivations, and Changes

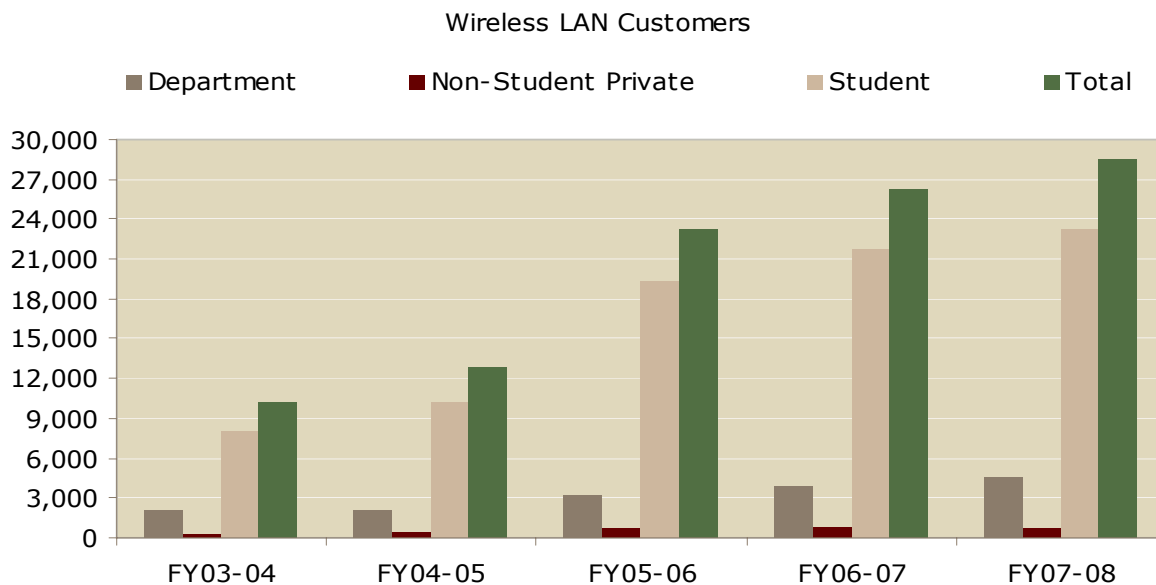


The graph above depicts, by fiscal year, the number of customer invoices issued by Network Infrastructure and Services, the number of current services billed to customers, and the number of service activations, deactivations, and changes.

The decline in the quantity of customer invoices is the result of the decreasing number of student telecommunications customers requesting modem pool services and long distance authorization codes and a decrease in the number of customer invoices to non-student private accounts.

The increase in the number of current services billed to customers is primarily the result of the constantly changing cellular and cellular data service, equipment, and accessory offerings. These changes result in an ever-increasing number of customers ordering new cellular services and equipment. New and existing customers can change service plans or equipment more than once in the course of one fiscal year resulting in multiple service activations/deactivations/changes.

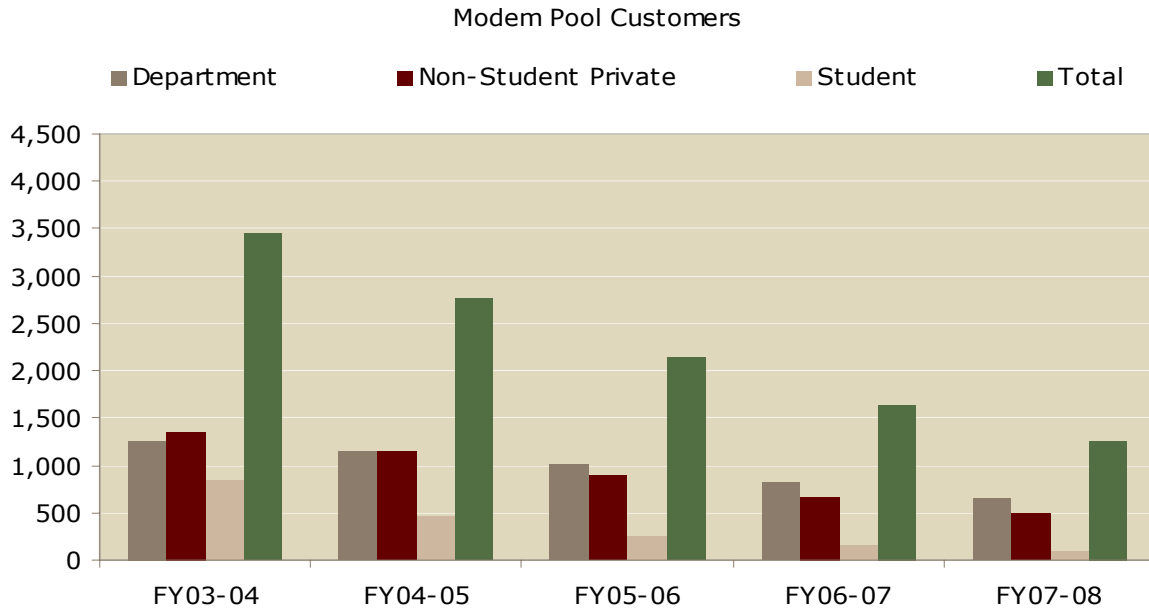
The number of service activations, deactivations, and changes represents the number of moves, adds, and changes to departmental telecommunications services. Such changes are often a result of moves to new or renovated office space and the resulting domino effect when another department relocates to the space previously vacated. Student orders for modem pool service and long distance authorization codes are also reflected in these totals.



The graph above depicts, by fiscal year, the number of wireless LAN subscribers by customer type—department, non-student private, and student.

The increase in the number of wireless LAN subscribers is attributed to transitioning the service from a pilot offering to a billable production service, the continuous/ongoing network expansion making the service available to the academic and administrative spaces across campus, and the availability to campus visitors via a university sponsor.

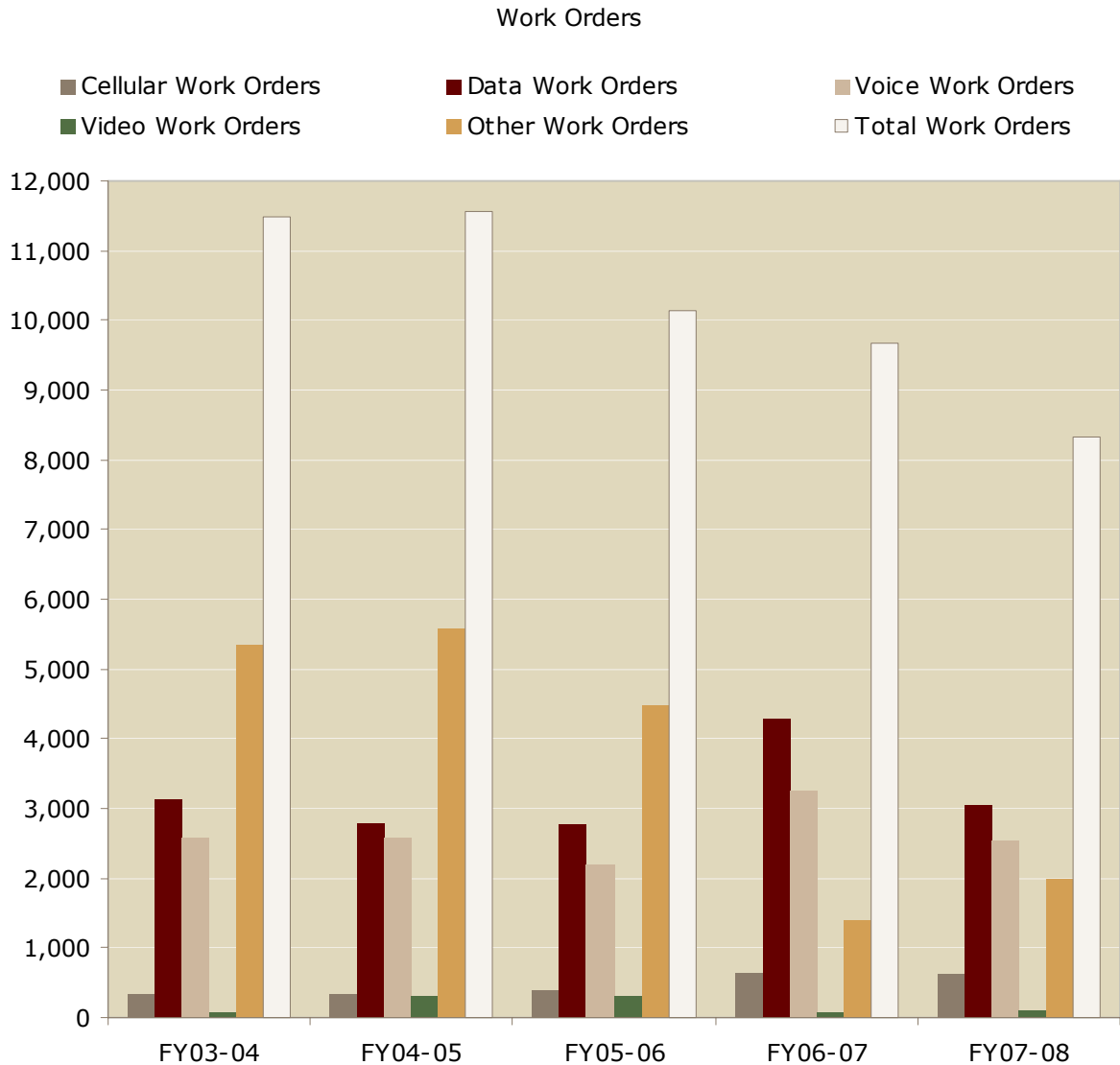
Students represent 82% of the total number of subscribers.



The graph above depicts, by fiscal year, the number of modem pool subscribers by customer type—department, non-student private, and student.

The decline in subscribers is due to the availability of other competitive broadband offerings—such as DSL and cable modems—from telecommunications, cable television, and satellite providers. In many local apartment complexes, data service offerings are included with the rental package.

Ordering and Provisioning



This graph represents the distribution by work order type and the total number of work orders completed since fiscal year 2003–2004.

Voice orders are for digital or analog service. *Data orders* include those for 10BaseT, 100BaseT or 1000BaseT Ethernet connections. *Video orders* are associated with campus CATV service, and *cellular orders* are for voice or mobile messaging services. *Other* work orders include those for PBX software only, time and materials, cable plant only, and the installation of wireless access points.

CNS began processing orders for cellular services in 2003. During 2005, CNS began offering mobile messaging services resulting in a gain in cellular orders which peaked in 2006–2007. Migration to mobile voice and data persisted in 2007–2008. The number of orders for cellular data service has remained constant as faculty members and administrators request mobile access to e-mail and calendaring.

The increase in video orders during 2004–2005 and 2005–2006 is directly related to two capital projects: The Inn at Virginia Tech, Skelton Conference Center, and Holtzman Alumni Center Complex, and the Westside Lane Stadium expansion.

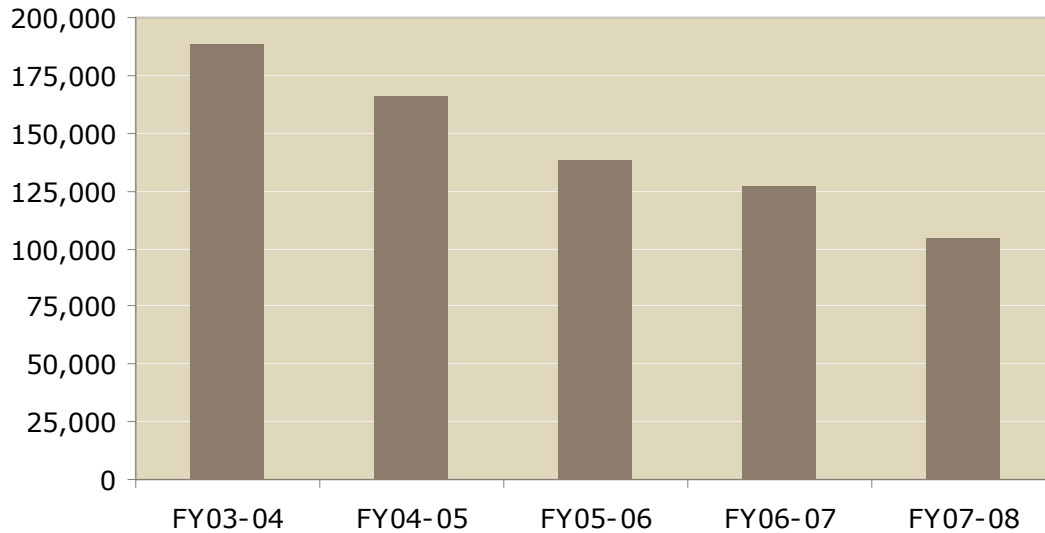
During 2004–2006, CNS installed a wireless network in most administrative and instructional buildings on campus. This new network deployment accounts for the large number of *other* orders during that period in the above graph. Two additional projects contributing to the increased number of orders in this category during 2004 and 2005 are the Edward Via Virginia College of Osteopathic Medicine building and hotel rooms at The Inn at Virginia Tech.

In 2006–2007, increases in data and voice work orders are attributed to several projects. Many renovations occurred on campus including changes in Burruss Hall that displaced several departments. As these departments moved, other groups relocated. After the renovation was completed, another round of moves occurred to facilitate the Henderson Hall renovation. In addition, a complete renovation of Cowgill Hall resulted in moves to the Surge Building. Also contributing to the increase were a major infrastructure improvement for the art department at the Armory, orders related to the April 16th tragedy, and completion of the University Gateway Center.

Increased use of wireless data and cellular services has led to a decline in the total number of orders processed during the last couple of years. In addition, departments are scaling back on telecommunications services due to budget reductions.

Public Relations

Calls to University Switchboard



As shown above, the number of telephone calls received at the University Switchboard during the past five years has decreased. The proliferation of cellular telephone use with the carriers' directory assistance services, along with ready access to an array of directory listing services on the Web, contributed to the trend.

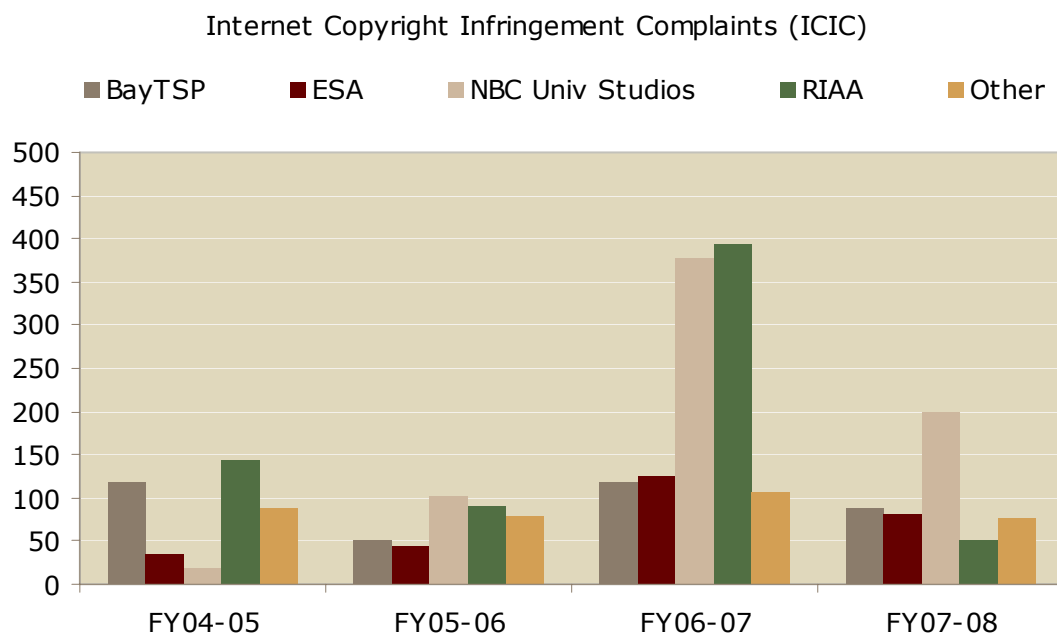
The amount of support per call, however, has increased. The University Switchboard is an integral contact point for the entire university, as well as one of the key components of Virginia Tech's emergency communication system. Increasingly, the university operators receive requests for campus information as opposed to simple inquiries for telephone number listings.

The shift in the kind of inquiry received adds to the handling time per call but also increases caller satisfaction. The provision of the added service has offset the decrease in call volume in terms of the time required to handle inquiries for switchboard services.

The Digital Millennium Copyright Act (DMCA) addresses the protection of copyrights for content that can be stored, played, copied, or transmitted in a digital format. The DMCA came about, in part, as a legislative response to the proliferation of file-sharing or peer-to-peer software, which is a widely popular method for obtaining and sharing music and movies.

DMCA guidelines allow owners (or their agents) of copyrighted music, movies, photos, audio books, and software to contact Internet service providers (ISPs) to request they promptly curtail

illegal sharing of copyrighted material by a given user. Virginia Tech, as the campus ISP, is obligated to address reported cases of alleged Internet-based copyright infringement (Internet copyright infringement complaints or ICICs) emanating from its network.



Virginia Tech has received a fairly consistent quantity of these notices each year since they first appeared until the volume *tripled* during the 2006–2007 academic year compared to the prior year. The increase was largely due to intensified efforts on the part of copyright owners and agents to address and publicize the illegal file-sharing problem.

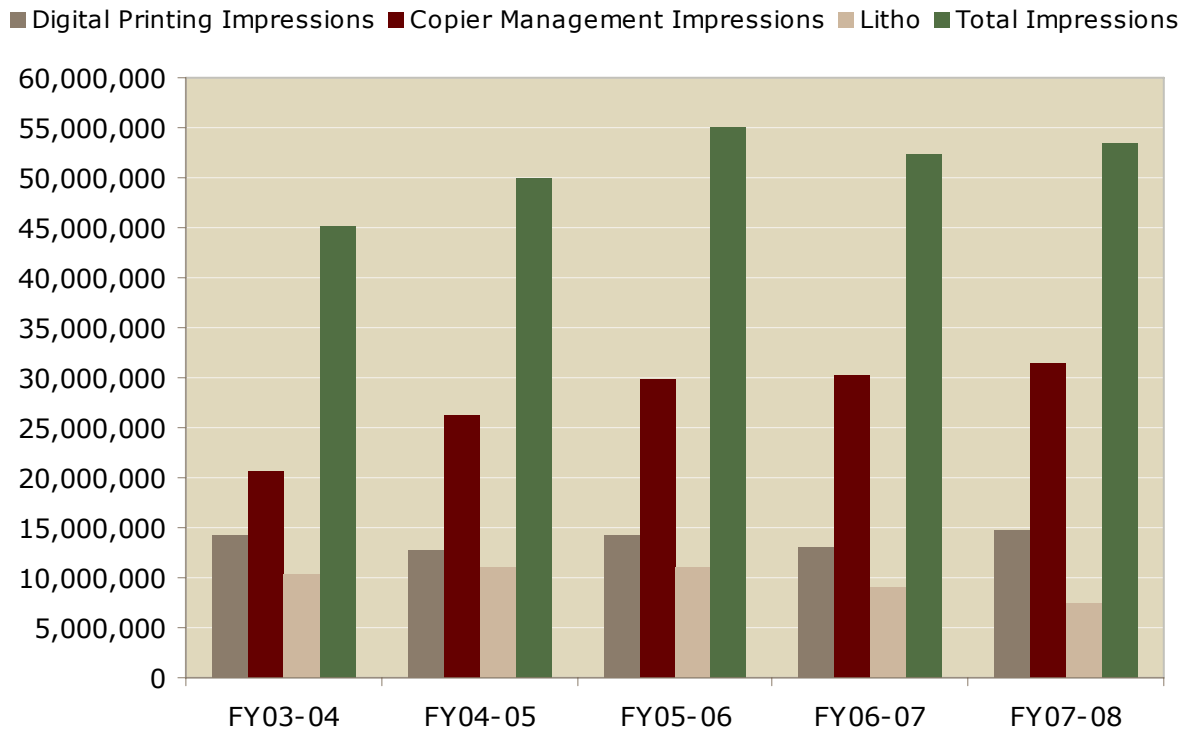
Over the period of 2004–2008, the principal originators of ICICs received by Virginia Tech have been BayTSP, the Entertainment Software Association, and NBC Universal Studios. At our request, Recording Industry Association of America (RIAA) curtailed referrals to Virginia Tech shortly after April 16, 2007, and did not resume sending them until May 2008.

As depicted in the graph, the total number of complaints for 2004–05 was 401 and for 2005–06 was 367, while the volume mushroomed to 1,122 for 2006–07. The number for this past fiscal year declined to 498, reflecting the fact that RIAA referrals were received for only two months during the fiscal year.

University Printing Services

This graph displays the number of printer and copier impressions completed by University Printing Services over the past five fiscal years.

Printer and Copier Impressions

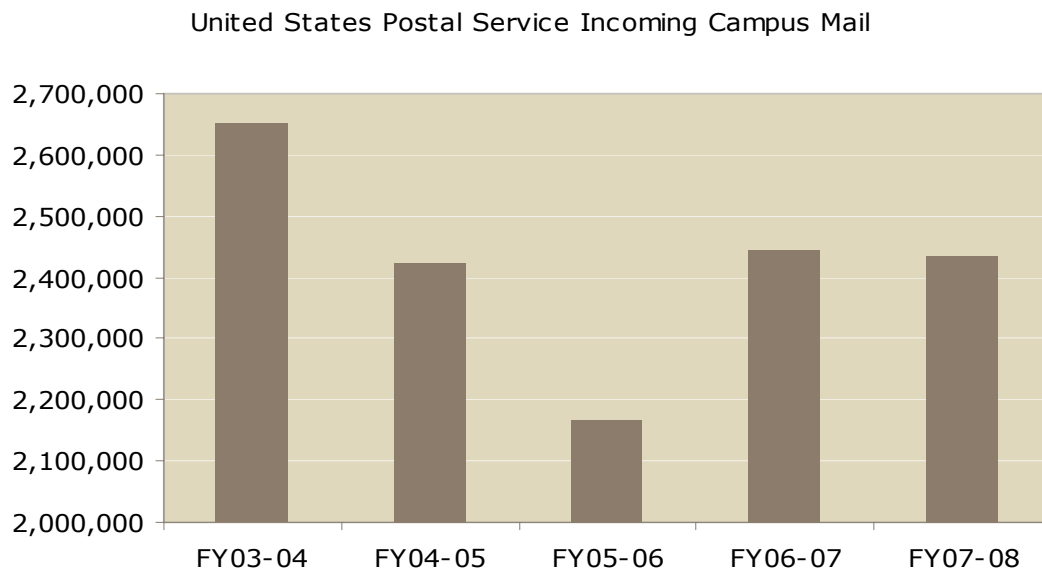
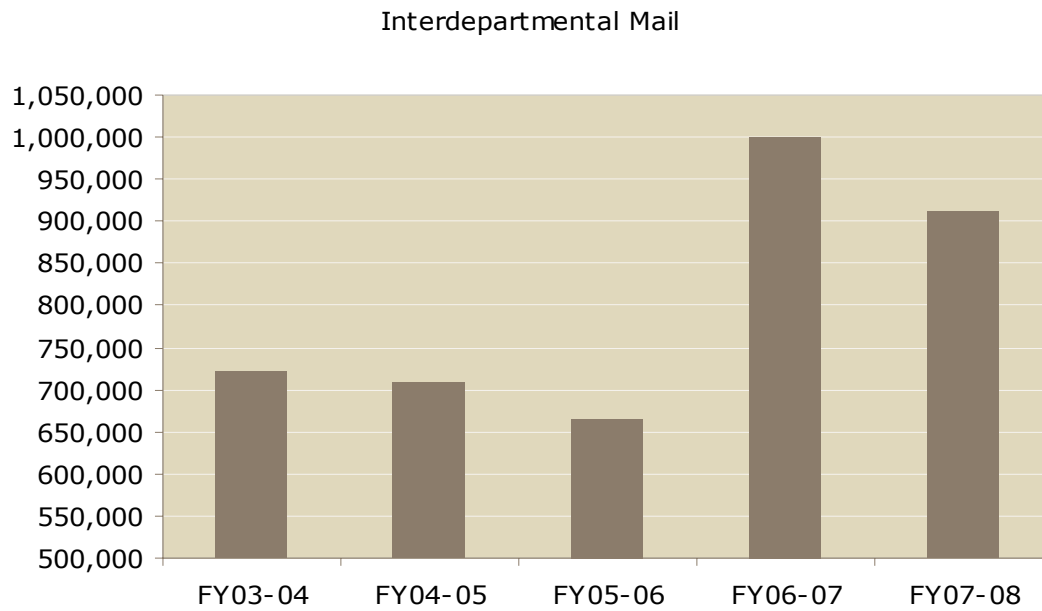


The number of digital printing impressions rebounded this year with the addition of two full-color devices. The Copier Management Program continues to grow but has reached some maturity.

The quantity of litho impressions fell. However, the addition of a five-color press has resulted in more impressions produced in eight months than in the entire previous year on the older equipment. It is expected that, in a full year, the five-color press alone will approach 3,000,000 impressions per year.

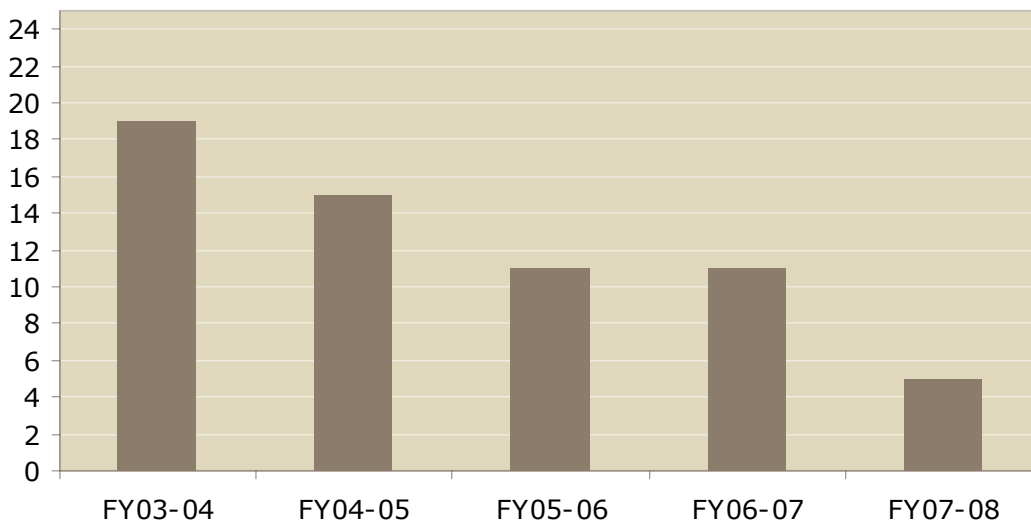
Mail Services

This graph indicates the amount of mail sent from one department or individual unit to another on campus. The number of individual units and mail stops on campus is increasing, and there appears to be greater use of campus mail. A contributing factor for 2007 was increased mail following the events of April 16th.



The graph above shows the amount of mail brought into University Mail Services by the United States Postal Service. The number of individual units and mail stops on campus is increasing, and more mail is being received. A contributing factor for 2007 was greatly increased mail following the events of April 16th.

Mail Stops Added



This graph represents the number of new mail stops added during each of the last few fiscal years. A mail stop is a pre-identified location in an academic or administrative building where a University Mail Services (UMS) carrier drops off and picks up United States Postal Service mail and interdepartmental mail. A building may have multiple mail stops.

Typically, as new buildings are occupied, additional mail stops are created. Vacated spaces are backfilled, so mail stops are normally not eliminated. Therefore, the number of mail stops continues to grow. As the graph shows, a net of 61 mail stops have been added since July 2003. This increase is consistent with the continued physical expansion of the university including new construction and leased space.

However, during 2007–2008, Mail Services experienced an anomaly as the *total* number of mail stops decreased slightly from the prior year. This decrease results from the following conditions:

- Some off-campus mail stops for departments were merged with an on-campus stop for the same department;
- Departments in some of the recently occupied buildings required fewer mail codes than the previous building occupants.

Currently, UMS employees provide service to 320 mail stops at least once per day.

Projects

A new information environment for research and innovation

For the university to realize its mission, a reliable, leading-edge, information environment must be available—anytime and anyplace—to students, researchers, the faculty, and the staff. Over the past decade, Virginia Tech’s information environment has grown more complex. Each successive surge in innovation creates new challenges. Successful programs, such as NetworkVirginia, National LambdaRail, and the Blacksburg Electronic Village, have helped Virginia Tech fulfill its objectives for outreach, education, and technology transfer. Locally, approximately 28,500 students, 5,900 faculty members, and 3,800 staff members are supported by an elaborate infrastructure encompassing approximately 200 buildings.

In 2007, Network Infrastructure and Services initiated a project, focused on transforming the university’s technology environment, for the Six-Year Capital Outlay Plan. The university will draw on expertise and research in computer science and engineering, electrical engineering, the Mobile and Portable Radio Research Group, pervasive computing, high-performance computing, and high-performance networking to develop a customized infrastructure integral to future learning, discovery, and engagement efforts. In addition to many research and instructional uses, Virginia Tech will leverage the new environment to develop technologies and strategies for emergency and crisis response. Other areas of focus will be cybersecurity and cyberforensics.

This capital project will provide new infrastructure to deliver integrated, optical and next-generation, mobile technologies. Through our engagement in national and international networks and through partnerships with progressive industry leaders, we will extend pervasive access to our campus environment with enhanced, worldwide mobility and ease-of-use. The new environment will connect members of the university community to any person, information source, or computational resource required.

The project will provide a comprehensive, underlying infrastructure to support the new Virginia Tech information environment now and in the future, and it includes re-conceptualization and replacement of legacy spaces and components.

Four key areas of improvement are planned: access spaces, distribution, intelligent infrastructure, and pervasive access.

Access spaces. The antiquated concept of a “telecommunications closet” must become a thing of the past. Modern and future systems require space and environmental support for advanced components with intelligence integrated and distributed throughout. The facilities must have adequate space, power, cooling, and security to support the new paradigm.

This project will allow us to construct new spaces and redesign existing ones. It considers (1) current and future infrastructure, (2) sufficient electrical, air conditioning, and heating capacity requirements, (3) pathway requirements, (4) safety and security, and (5) accessibility.



The project design requires approximately 100 new spaces distributed across campus. The exact size of each space will be based on individual building size and the respective needs of the university community occupying the building. Through consolidation of existing spaces, new design practices, and new construction, we anticipate eventually having approximately 460 specialized access spaces for infrastructure and application support—a net decrease of almost 100 spaces.

Distribution. Much of the current in-building infrastructure on campus is quite old and inadequate. The proposed in-building distribution will address approximately 50 percent of the campus to enable development of the high-performance information environment and will support potentially hundreds of thousands of access devices.

Traditional “outside plant” technology and topology are designed to support operation of legacy architectures. The proposed between-building distribution system will be based on an innovative, carefully planned architecture designed to offer next-generation performance, reliability, survivability, and flexibility. Key project components will include (1) replacement of utility tunnel pathways for fiber, (2) diverse routes from each building to at least two information centers, and (3) spare capacity to provide for future needs.

Intelligent infrastructure. Intelligent infrastructure consists of the electronics required to connect a future array of access devices including personal mobile communicators, high-

resolution displays, desktop systems, and high-performance research computing. It also includes interconnection of all the campus devices to global networks as well as ancillary devices which help implement network policies and facilitate operations.

This project will provide a complex information environment, requiring research-class expertise as well as operational management and development. It must be configured in a manner to allow for continuous development and innovation without diminishing reliability. These factors are important because the technology infrastructure will attract more and more critical research, teaching, and learning applications. It must be constructed to respond dynamically to changing requirements and drive new forms of collaboration.

Pervasive access. Virginia Tech is a world leader in research and invention of wireless and mobile network technology. Support for this area of innovation, combined with an ever-growing demand and reliance on pervasive technology, drives the need for Virginia Tech to develop the most advanced campus system. NI&S will provide a scalable solution to meet the burgeoning requirements of today's users as well as the demands of future applications.

The proposed environment will consist of emerging and proven technologies. The centralized mobility controllers, communicating with each other and with devices located throughout campus building and outdoor spaces, will incorporate the use of developing, pervasive technologies. The infrastructure will provide enhanced radio features, allowing the system to dynamically adapt to a changing environment as well as providing quality-of-service mechanisms and the ability to intelligently redistribute clients. These capabilities are necessary for the successful adoption of learning and instructional tools where students and lecturers are seamlessly collaborating.

The proposed infrastructure will leverage the new pervasive access, the systems, and the distribution infrastructure to deliver enhanced fixed and mobile support. Deploying applications on a converged infrastructure provides opportunities for reduction in implementation costs and operational expenses. The new information environment will reduce barriers to advanced and constantly changing applications.

The funding plan for this \$31 million technology environment project calls for full, non-general fund support. At the meeting of the Virginia Tech Board of Visitors in June 2007, the capital plan was reviewed at a joint session of the Finance and Audit Committee and the Building and Grounds Committee. The funding plan includes revenue bond authorization that will be repaid by revenue generated from auxiliary enterprise operations.

For more information, contact Jeff Crowder, crowder@vt.edu.

Support for university research and innovation

Network Infrastructure and Services is taking a two-pronged approach to support research and development within the university community. The first method is to provide resources and tools

needed to support faculty and students in their investigations. The second is to become active participants in information technology-related research. The main areas for the latter are virtual computing, advanced networking, and high-end computing. These activities are in addition to the internal research and development efforts—reported elsewhere in this document—needed to support existing Information Technology services.

Support for research across campus. One of the strengths of NI&S is the wealth of talent and resources able to be marshaled in support of research. The department's goal is to connect researchers across campus with resources and talent within NI&S.

One of the most interesting of these efforts was with Professor Tarajit Kaur (also known as Teresa Sylvina), Director of Laboratory Animal Resources in the Department of Biomedical Sciences and Pathobiology, Virginia–Maryland College of Veterinary Medicine.

Professor Kaur and colleagues around the globe are investigating how interactions between humans, primates, and the environment influence the spread of diseases. NI&S assisted in the development of a research grant (Teresa Sylvina, et al., "LUCID: Land Use Changes and Infectious Disease Dynamics in Primates," National Science Foundation (NSF) Ecology of Infectious Diseases) to continue funding the field research taking place at Mahale Mountains National Park in Tanzania. If the grant is funded, NI&S will develop and support a database to make the results of the field observations securely available to a group of international researchers. In addition, NI&S personnel will help develop the software for the PDAs used to gather data in the field.

A longer-term effort, which will benefit researchers in Electrical and Computer Engineering, is NI&S support of the Global Environment for Network Innovations (GENI). GENI is a National Science Fund (NSF)-sponsored program to develop a facility for experimentation in network communications, distributed computing, cybersecurity, and network services. This program is a "clean-slate approach" to a possible future Internet; compatibility with the current Internet is not a goal.

Researchers will be able to get a "slice" of the GENI infrastructure on which to run their experiments without interference from other activities. The mechanisms and technologies needed to implement GENI have yet to be fully developed. NI&S personnel are helping to define standards and interfaces to ensure researchers will be able to utilize GENI for their investigations.

Personnel from NI&S are actively involved in providing advanced networking capabilities to researchers across campus through connections with National LambdaRail, the Mid-Atlantic Broadband Cooperative, NetworkVirginia, and the Mid-Atlantic Crossroads. In addition, we have been working with personnel in the Department of Computer Science to utilize these networks in their research.

Virtual computing environments for research and pedagogy. The traditional approach to providing a computing service—whether it is a payroll application or a computer laboratory for student use—is to purchase hardware and software dedicated to a specific set of tasks. As the

number of computer services has proliferated, so has the number of systems providing those services. At the same time, the speed of computer hardware has increased to the point that most systems are underutilized much of the time. Virtual computing is a way to encapsulate the operating system and application software so several virtual environments can share the same physical resources as though they were running by themselves on dedicated hardware.

The enterprise computing world has been quick to embrace virtualization as it leads to significant savings in hardware, space, power, and cooling. Virtualization allows better sharing of physical resources and enables great flexibility in deploying highly customized services quickly and at low cost. We believe many of the same benefits will result from developing tools and technology to apply virtualization to teaching and research activities at Virginia Tech.

The goal of the project is to develop the technology needed to deploy virtualization in advanced teaching and research at the university. Virtual computing environments can be accessed from any networked computer and allow students to utilize course-related software when they wish rather than requiring them to go to a lab during specific hours. As a related benefit, the same virtual environment is accessible from lab machines eliminating the problem of configuration creep that often plagues computing labs.

The ease with which a new environment can be configured allows faculty to set up environments tailored specifically for the needs of the class. They are assured students will see exactly what was intended, thereby allowing faculty and teaching assistants to focus on the course content itself rather than the computing infrastructure.

Finally, virtual computing gives faculty and students the ability to create computing environments to support their research. In many cases, researchers will gain access to resources they would not otherwise be able to afford if they had to purchase their own hardware. At the same time, researchers can gain access to expensive software because virtualization facilitates better utilization of software licenses across the university community.

Some virtualization tools available for enterprise use can be reused for a teaching and research environment. Other functionality needs to be created specifically to support the use of virtualization in an academic environment. Several important, required functionalities were prototyped this year. One of the technologies developed resulted in a paper being published: Mark K. Gardner and Wu-chun Feng, "Towards a Virtual Ecosystem for K–8 Education," 2nd International Conference on the Virtual Computing Initiative (ICVCI 2), Research Triangle Park NC, May 15–16, 2008.

We are beginning to investigate various avenues for external funding in this area—see Wu-chun Feng, et al., "Bridging the Digital Divide through Virtual Computing: A Model for Creating Intellectual Communities and Stimulating Economic Growth in Southwest and Southside Virginia," Commonwealth of Virginia Technology Research Fund.

The goal for the coming year is to have a minimally functional system available for use by select faculty and students from which additional experience can be obtained. Depending on the

challenges and solutions discovered, it may be possible to allow more widespread use of the prototype by the end of the next fiscal year.

Advanced networking. Virginia Tech is well positioned to advance the state-of-the-art in networking research by virtue of its membership in various network consortia and cooperatives including National LambdaRail, Mid-Atlantic Broadband Cooperative, NetworkVirginia, and Mid-Atlantic Crossroads. To utilize the capacity of these high-speed networks successfully requires improvements in protocols and services. The primary goals of the advanced networking area have been to identify research topics, seek funding, and mentor students. The two research topics pursued this year were flow (session) migration and composable protocols.

Flow migration is the ability of a flow of network packets associated with a particular session to migrate from one network path to another without the connection being dropped. It would enable a professor to unplug the Ethernet cable from his laptop and go to the office of a colleague without an already-established videoconference session failing. The connection would seamlessly migrate from the wired Ethernet to the WiFi connection in the building. A prototype implementation was developed by a summer intern, Patrick Butler, and resulted in a proposal submission to seek funding to continue the project: Wu-chun Feng and Mark Gardner, "Increasing the Robustness of Communications through Flow Migration," NSF Computer Systems Research.

Network protocols have traditionally been implemented in a monolithic way. As the number of networked applications grows and as the needs of those applications become more diverse, it is no longer sufficient to try to design a single protocol that is everything to everyone. The composable protocol project is designed to make it easier to develop network protocols specifically tailored to the needs of an application. By identifying and implementing functionalities in an orthogonal way, a multitude of custom protocols can be assembled from a few basic building blocks to meet the distinct needs of individual applications. Support for the project is being sought through a proposal: Wu Feng and Mark K. Gardner, "Composable Protocols for Flexible High-Performance Networking," Department of Energy Office of Advanced Scientific Computing, Mathematical, Information, and Computational Sciences Division.

High-end computing. Theory, experimentation, and computation are the three legs upon which the modern scientific method depends. The goal of NI&S work in high-end computing is to ensure computing resources sufficient to meet the needs of university researchers are readily available.

Because high-end computing is, almost by definition, on the "bleeding edge," much still remains to be done in order to create the computing systems of tomorrow. It is estimated that systems able to perform more than one quadrillion calculations per second are needed to solve some of the top problems being considered by researchers. (By way of comparison, the fastest desktop computers perform around 100 billion operations per second—10,000 times slower.) There are various ways to assemble such a computer. The old approach was to design a monolithic machine with a defined amount of computing power. It is no longer possible to build supercomputers of the needed capability in this way.

The approach currently employed is to connect a collection of computing nodes (each of which is a fast server) into a computing cluster. NI&S collaborations with the Department of Computer Science seek to identify alternative ways in which large computations can be solved by temporarily linking clusters across the continent via high-speed networks. The work began with the creation of an *ad hoc* grid computer to perform genome sequence searching. A proposal was recently submitted to NSF to formalize and automate the creation of such computers: Wu-chun Feng, Eli Tilevich, Ali Butt, and Mark Gardner, "Genie: Making Reusable High End Computing a Reality," NSF High End Computing University Research Activity.

Another challenge for high-end computing is monitoring the behavior of the computers and to analyze and tune them to achieve high performance on scientific applications. The difficulty of monitoring such systems is growing as processor counts of one million or more are thought necessary to achieve a quadrillion calculations per second. In collaboration with the Renaissance Computing Institute in North Carolina, a proposal was submitted to NSF to address this issue: Wu-chun Feng, Rob Fowler, Allan Porterfield, and Mark Gardner, "A New Model for Performance Measurement, Analysis, and Tuning," NSF High End Computing University Research Activity.

Finally, NI&S is continuing to support Advanced Research Computing as it seeks to acquire or develop high-end computing capability to augment and ultimately replace the venerable System X supercomputer. This year, various meetings have been held with vendors and representatives from partner universities in the region to discuss the possibility of submitting a NSF Track 2d proposal to acquire a supercomputer capable of performing quadrillions of operations per second on scientific computations. The deadline for submitting such a proposal is November 2008.

For more information, contact Mark Gardner, mkg@vt.edu.

High-performance computing capacity and support enhancements

Increasing the computing and storage capacity available for high-performance and research computing is an ongoing objective at Virginia Tech. A consolidation and virtualization project is underway. A large (one petabyte) storage increase is also being pursued.

During the past fiscal year, 50 terabytes of storage was added (in an SGI Network-Attached Storage unit) providing "scratch space" for researchers' data. Random Access Memory (RAM) was added; an OS upgrade was performed; and we began integrating SGI systems into the research computing scheduling and resource management systems.

Although no Information Technology-owned servers were added to the pool of equipment available, department-owned servers were relocated to the Andrews Information Systems Building Data Center and are under the management of Systems Support and Advanced Research Computing (ARC). This arrangement allows ARC to "harvest" spare compute cycles from the machines and offer them for general research use.

A high-performance computing version of Linux (Yellow Dog Linux for HPC) was installed on the System X cluster.

Members of the Systems Support and ARC teams participated in the Super Computing Conference held in Reno, Nev. in the fall of 2007 (<http://sc07.supercomputing.org/>) and supported the “HPC Boot Camp” held at the University of Virginia in August 2007 (www.arc.vt.edu/pdf/VT_UVA_bootcamp.pdf). Virginia Tech will host the Boot Camp sessions in August 2008.

For more information, contact William Dougherty, william@vt.edu.

Northern Virginia Aggregation Facility

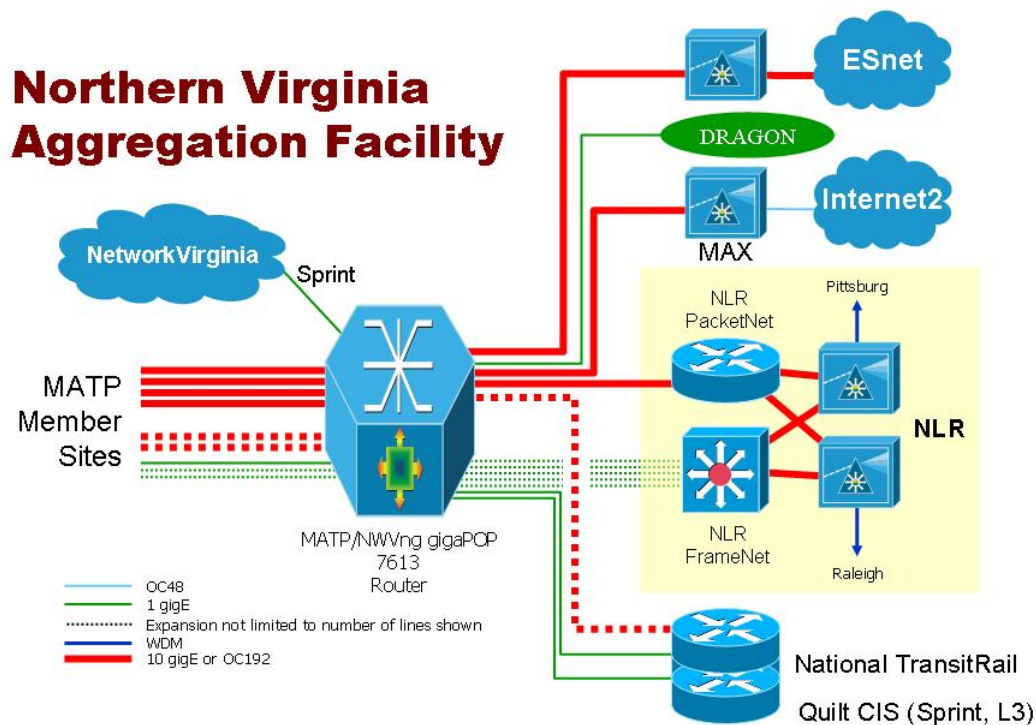
Virginia Tech operates the Northern Virginia Aggregation Facility (Facility) to provide a high-performance, research and education network aggregation and exchange point for institutions located in the mid-Atlantic region. The Facility evolved from the NetworkVirginia gigaPOP created by Virginia Tech in 1996 with the aid of a National Science Foundation grant. The objectives at that time were to provide aggregated access to the NSF’s vBNS network and the early Internet2 network.

An ongoing goal for the Facility is to provide extremely high-capacity, gateway access to regional, national, and international research networks and global Internet content in order to enhance the research competitiveness and educational effectiveness of regional institutions. A second goal is to maximize the benefit/cost ratio through efficient and effective fiscal and technical management.

The Northern Virginia Aggregation Facility is managed by the Virginia Tech Operations Center under the direction of the NI&S Strategic Initiatives group. The Facility is located in McLean, Virginia, in a strategic location with proximity to several national network access points.

The Facility currently provides gateway access to the following major networks and services:

- National LambdaRail
- Internet2
- United States Department of Energy ESnet
- NASA Research and Education Network
- Mid-Atlantic Crossroads
- NetworkVirginia
- Commodity Internet service (including commercial services)
- National TransitRail



More than 800 universities, colleges, schools, and research labs throughout the mid-Atlantic region are served by the Facility. Several research universities, including Virginia Tech, maintain dedicated 10Gbps links through agreements negotiated by NI&S. These links place those universities on par with the best-connected institutions worldwide.

The Northern Virginia Aggregation Facility sustained reliable, high-performance operation during this year with availability exceeding 99.999 percent. Several milestones were achieved as the Facility continues to expand and improve:

Commodity Internet service. The Facility offers bulk commodity Internet service (CIS) to higher education clients. Participants include Virginia Tech, the University of Virginia, Virginia Commonwealth University, Old Dominion University, and the College of William and Mary. Aggregate savings to these institutions exceeded \$1.2 million this year. The CIS gateway capacity was doubled to 2Gbps during this year. Two new participants, W&M and VCU, were added. ODU increased their access capacity by 50 percent to 300Mbps.

National TransitRail. A gateway to National TransitRail (NTR) was added and is currently under evaluation and development. NTR is an innovative, new program operating over National LambdaRail (NLR). It provides peering with hundreds of the Internet's largest content providers and commercial Internet service providers (ISPs). An NTR connection may offload as much as 65 percent of CIS traffic by providing direct access to services like Google and Yahoo to reduce costs and improve performance.

MAX. On behalf of the Mid-Atlantic Terascale Partnership (MATP), Virginia Tech negotiated a connector agreement with the Mid-Atlantic Crossroads (MAX) to provide connectivity to NLR for MAX participants. This agreement significantly expands NLR participation in the region while distributing costs more broadly and increasing regional collaboration. The agreement resulted in a \$450,000 offset to benefit MATP members, including Virginia Tech. (MATP is a consortium of research institutions in the mid-Atlantic region supporting the development of the National LambdaRail). The connector agreement approach may serve as a model for NLR expansion nationwide.

MBC. The Facility implemented a fiber-optic tie cable to interconnect the Mid-Atlantic Broadband Cooperative (MBC) long-haul network which joins the Southside Virginia region to Washington, D.C. and Atlanta. This initiative provides an opportunity to expand research and economic development to the area served by MBC by providing high-performance, low-cost access to everything the Facility can reach.

NI&S plans to continue the development and expansion of the Northern Virginia Aggregation Facility. Through MATP, one goal is to aggressively increase use of the planned upgrade to the NLR network. Through relationships with our connectors, MAX, MBC, and other participants, we will extend regional collaboration and access. The CIS and NTR services will continue to expand and drive down costs for Internet access. Virginia Tech is developing a new program to “virtualize” the Northern Virginia Aggregation Facility using regional fiber-optic networks like MBC to provide the same access and services in rural locations. A prototype is under development in the New River Valley area.

For more information, contact Jeff Crowder, crowder@vt.edu.

Encrypted Data Storage Working Group

Protecting university data is important for many reasons including privacy concerns, legal requirements, financial implications, and the need for protection of research information and other intellectual property. The proliferation of mobile devices has compounded the security risks of unauthorized information disclosure due to theft and loss because such equipment allows more opportunity for physical access to the hardware. Encryption has become the widely accepted technology choice for securing desktops, laptops, tablet PCs, PDAs, and other mobile devices from inadvertent disclosure of the sensitive information stored on them.

The Encrypted Data Storage (EDS) Working Group was formed November 15, 2006, and includes participants from NI&S. The team is charged with identifying data privacy issues associated with the use of desktop and mobile devices and investigating encryption solutions to protect the confidentiality and integrity of sensitive university data from accidental or unauthorized disclosure. The focus is on encrypted file systems rather than encrypting individual files or e-mails. In addition, the group is pinpointing those situations where encryption may not be appropriate.

The group has evaluated most of the major, commercial, encryption products available for desktop and mobile device storage, developed a requirements document, and plans to provide an enterprise-scalable solution that will minimize costs for departments.

For more information, contact Phil Benchoff, benchoff@vt.edu.

Self-service password resets

Password **reset** means changing a password to an account or ID without knowing the old password. Password **change** means changing an old password to a new one when the owner of the account or ID knows the old password. At Virginia Tech, 4Help handles approximately 7000 requests for password resets each year. Over 90 percent of the resets are thought to be for PID or Hokies passwords.

An NI&S staff member is participating in a group working to develop a self-service, PID/Hokies password reset tool. Such a tool would reduce users' frustration and eliminate the need for them to call 4Help to have a password reset. A self-service tool would significantly reduce the workload of the 4Help staff members and allow them to concentrate on more complex problems.

The self-service password reset service, currently in early development, will permit users who do not know their PID or Hokies password to authenticate and reset their own password online. The service will significantly reduce costs (the estimated cost for each reset handled by 4Help is approximately \$18.00) and provide a more secure authentication level compared to the current operator-assisted telephone method.

Future plans call for the development of the ability for an eToken user to reset their password online as well. The service would provide a more efficient and less costly alternative to the current requirement to appear in person at the Student Telecommunications Office to reset an eToken password and will definitely be needed before any large-scale deployment of such devices to the faculty and staff.

In order to use such a tool, users would establish a “high assurance personal identity profile” of predefined questions and answers and use identity credentials like PID/password in conjunction with the profile to enhance the security level. Users will be given the opportunity to choose from a list of predefined questions as well as the ability to enter their own questions and answers to create their personal authentication profile. They could use the self-registration Web application, at any time, to make changes to the profile and select new questions/answers. Questions would be randomly selected from the individual’s profile and presented to the user for a response. If incorrect responses are detected, the Web application would enforce blocking after a predefined threshold of invalid responses had been received.

For more information, contact Phil Benchoff, benchoff@vt.edu.

Information and Communications Infrastructure Group report and recommendations

In May 2007, as part of the university's response to the tragic events of April 16, 2007, President Charles Steger asked the vice president for information technology "to examine our existing systems and determine what enhancements to them would strengthen our emergency response/notification capabilities in the future and /or propose a new system or systems that might accomplish the task."

To carry out this work, Vice President Earving L. Blythe established the Telecommunications Working Group. Group members included experts representing information technology, law enforcement, and the university administration. NI&S personnel worked on this task during the summer of 2007 and contributed to the resulting internal review and report. A copy of the report is available at www.vtnews.vt.edu/documents/2007-08-22_communications_infrastructure.pdf

The report provided a comprehensive review of information technology resources. It included an analysis and evaluation of the internal and external communications infrastructure and information systems used during the crisis and identified tactics and strategies for improvements. The recommendations—many of which could be critical during the response to a future emergency situation—identified elements of the existing communications infrastructure that presented opportunities for improvement and included some within the NI&S area of responsibility.

Some of the work associated with the recommendations was completed quickly by reconfiguring existing technology or by implementing changes using relatively simple or available solutions. Longer term, strategic opportunities—those involving fundamental research and development, substantial financial costs, and/or innovation in policy, methods, and technology across multiple disciplines—were also identified.

NI&S has implemented many of the initiatives recommended in the wake of the April 16 shootings. Highlights of what has been completed during the 2007–2008 fiscal year and projects currently in progress include the following:

- Resources required for essential personnel to work remotely are now included in the NI&S continuity of operations plan.
- Electronic message boards—the VT Alerts: Classroom initiative—have been deployed in each centrally assigned classroom on the Blacksburg campus as an additional way to make emergency information available. The signs will communicate information about campus emergencies or other significant events.
- NI&S developed the VT Alerts Notification Console, a Web-based application that provides a single, common, user interface for University Relations and the Virginia Tech Police Department: the console makes the complexity of multiple notification

technologies and channels less apparent and helps insure emergency messages can be issued quickly even under difficult conditions.

- Toll-free telephone numbers have been reserved for emergency use.
- Work is ongoing to evaluate the process of providing guest access to the wireless network during an emergency.
- Network monitoring has increased and diagnosis of wireless problems has been improved.
- Work continues to optimize the university's network and campus telephone system to allow for improved performance in an emergency.
- Improvements for the Virginia Tech Police Department's dispatch office including technology improvements to dispatch consoles and a radio interoperability system are ongoing.
- Centralized Web communications are fully redundant and load balanced.
- Work continues to provide more capacity and load balancing for additional Information Technology support services.
- Work with cellular carriers regarding planned improvements to existing networks continues.
- Work is in progress to solicit proposals from cellular service providers to establish contracts for improved outdoor cellular coverage on the main university campus.
- NI&S has received approval to participate in the Federal Wireless Priority Service program, and implementation is underway.

NI&S expects to work on the suggestions for improvement resulting from the various reports and analyses of the tragedy for some time and will continue to develop and expand the long-term strategy beyond the scope of the Information and Communications Infrastructure Group Report. Together with other Information Technology groups and university academic programs, NI&S has articulated a strategic vision to create a next-generation, information architecture to be built from the ground up. The new digital, IP-based, unified, communications architecture will support integrated multimedia applications, advanced security capabilities, and new features including sensor networks and pervasive computing models. It will be capable of going beyond simply supporting the response and recovery phases in an emergency situation and will provide a platform for all stages of emergency management including mitigation and avoidance.

For more information, contact Richard Hach, rhach@vt.edu.

VT Alerts

Virginia Tech's implementation of a vendor-provided, emergency notification product is branded as "VT Alerts." The system expands the university's ability to send critical news and information to the university community during campus emergencies because it allows subscribers to receive urgent notifications even if they are away from a computer or university telephone.

Implementation is on an “opt-in” basis; individuals are encouraged to subscribe, but are not required to do so. All Virginia Tech students, faculty, and staff, regardless of geographic location, are eligible. At the end of the 2007–2008 fiscal year, approximately 21,000 members of the university community have subscribed.

A subscriber can select up to three contact methods. Contact methods include mobile phone, office phone, local residence phone, other phone, instant messaging (SMS), text messaging, and e-mail. The system will be used only in the most critical, emergency situations, as determined by University Relations or the Virginia Tech Police Department. Virginia Tech does not update contact information from other sources and does not verify the accuracy of the data. Each subscriber **MUST** verify and update their contact information and preferences.

During fiscal 2008, three university-wide tests of the system were conducted. We continue to work with the vendor to “fine tune” processes in order to notify as many people as possible as quickly as possible during an emergency. NI&S has worked with University Relations and the Virginia Tech Police Department to streamline the notification process and to help ensure first responders are registered to use VT Alerts.

Testing of the system will occur at least once a semester.

For more information, contact Pat Rodgers, prodgers@vt.edu.

VT Alerts enhancements

VT Alerts is an initiative aimed at providing rapid notification about campus emergencies or other significant events to all members of the university community, wherever they may be. During the summer of 2007, University Relations and Information Technology developed the first component of this initiative, which primarily targeted personal mobile communications devices such as wireless telephones.

This initial thrust, now known as “VT Alerts: Mobile,” provides the means to deliver important notifications to individual members of the university community via the Short Message Service (SMS, also known as TXT or text messaging) and via voice telephone calls. The VT Alerts: Mobile component augments existing notification mechanisms, such as e-mail and the university website, which have long been used to communicate significant events to the campus community.

In April 2008, the university established funding to support the development of two important new components of the VT Alerts initiative. First, a Web-based application for use by University Relations and the Virginia Tech Police Department will provide a single, common, user interface for all notification channels. The central goal of this project is to encapsulate the complexity of the underlying notification technologies and to ensure notification messages can be issued quickly and correctly even under conditions of duress. This application is provisionally known as the “VT Alerts Notification Console.”

Second, a new channel for VT Alerts, known as “VT Alerts: Classroom,” will place a digital signboard in each centrally assigned classroom on the Blacksburg campus. These signs will communicate information about campus emergencies or other significant events into the classroom.

VT Alerts Notification Console. The project to develop the VT Alerts Notification Console was initiated in May 2008, with University Relations and the Virginia Tech Police Department as the primary stakeholders. Individuals from many different areas of Information Technology are part of the team responsible for the project development and system integration. The project is divided into multiple phases. Only a portion of the initiative has been funded at this time.

The initial notification console product resulting from this project will integrate notification message delivery for VT Alerts: Mobile, Web, and e-mail delivery (now known as VT Alerts: Online), and VT Alerts: Classroom. With future funding, additional notification channels, such as the university’s WeatherLine, cable television system, outdoor loudspeaker system, and the voicemail system, will be integrated.

As of June 30, 2008, we anticipate completion of the major portion of the use case analysis—a process that determines the behavior of the application from the perspective of the application user. The process must precede the actual software development. We anticipate the final product will be available for use by University Relations and the Virginia Tech Police Department before August 25, 2008.

VT Alerts: Classroom. The project to develop VT Alerts: Classroom—an additional channel for notification messages to the university community—was also initiated in May 2008. Stakeholders for this effort include the Office of the Provost, University Facilities (under the Vice President for Administration), University Relations, and the Virginia Tech Police Department. Communications Network Services is providing the staff to complete the physical installation of the sign equipment and the related network facilities. Individuals from many different areas of Information Technology are part of a team responsible for software development and systems integration for this project.



As of July 1, 2008, CNS has completed more than 75 percent of the network facilities installation work to support the classroom project. We anticipate the physical installation of the sign equipment will begin around July 15. The system will be fully operational by August 15, 2008.

For more information, contact Carl Harris, ceharris@vt.edu.

E-discovery efforts

E-discovery activities at Virginia Tech increased in importance, intensity, and frequency with the changes in Federal Rules of Civil Procedure (December 2006) and as a result of data collection and preservation efforts undertaken to prepare for litigation anticipated after the events of April 16, 2007.

Data collection for events related to the tragedy was completed during the 2007–2008 fiscal year. A total of 150 data custodians were interviewed and 211 images were taken. Six other cases involving criminal investigations, civil litigation, or personnel actions were also handled by Systems Support staff during this period.

The department obtained software to perform index and retrieval operations on computer images and recover deleted data. A small lab—with equipment purchased by NI&S and assistance from the university’s legal office—has been established in a secure room in the Andrews Information Systems Building Data Center. Sensitive retrieval operations can be performed in this facility. Standard operating procedures documents have been prepared and are currently under management review.

In the near future, we expect to formalize the process by which the Office of Legal Counsel and other university departments engage the Systems Support e-discovery team. Plans to fund ongoing e-discovery equipment and software needs and possibly dedicating a position to this effort are subjects under discussion.

For more information, contact William Dougherty, william@vt.edu.

NI&S Advisory Subcommittee

In fiscal year 2007–2008, the Office of Vice President for Information Technology put an advisory committee structure in place to better involve its constituents in technology-related issues, discussions, and planning. The NI&S Advisory Subcommittee (which will work in parallel with similar subcommittees for Learning Technologies, Enterprise Systems, and the Information Technology Security Office) was charged “to provide advice and counsel that assists in guiding, supporting, and communicating Network Infrastructure and Services’ strategic aims at Virginia Tech.”

Over the next several years, NI&S must acquire and deploy the next-generation technologies the university will need in order to pursue top-30 research status, provide technology-enriched learning environments, and engage across the commonwealth to improve economic opportunity and quality of life for Virginia citizens. To those ends, the subcommittee will advise NI&S leadership as it integrates strategic directions for voice, data, and video; identifies and analyzes needs; and evaluates alternatives related to network infrastructure, computing systems, and services.

For more information, contact Judy Lilly, jlilly@vt.edu.

Printing Services and Mail Services transition to Administrative Services

In an effort to prepare for the deployment of the new information environment for research and innovation that will occur during the next decade, CNS recognized the requirement to devote as many resources as possible to this endeavor. Printing Services and Mail Services have reported to the Associate Vice President for Network Infrastructure and Services for approximately 10 years. While these two organizations have been important assets to NI&S, they provide centralized services more consistent with others provided by the Office of the Vice President for Administrative Services.

The Vice President for Administrative Services recently realigned his areas of responsibility. As he did so, it became apparent that Printing Services and Mail Services could better serve the university community by becoming part of that organization and leveraging the synergies created by a closer association with other entities providing centralized services of a similar nature. In addition, time spent by CNS employees supporting and managing these two groups could be utilized for technology-related activities more closely aligned with CNS strategic goals and objectives.

In preparation for the move, CNS staff involved with the support and management of these two organizations began holding planning meetings in February 2008. Once the scope of the transition was documented, planning meetings were held with representatives from Administrative Services. A project plan was developed and closely monitored.

The transition was effective on July 1, 2008, with one exception. The successful Copier Management Program continues to be managed by Printing Services and billed from a CNS information system. This arrangement will continue until a new system is purchased and configured by Printing Services.

For more information, contact Pat Rodgers, prodgers@vt.edu or John Pollard, jpollard@vt.edu.

Student workforce initiatives

One of the university's goals is to harness student effort for various information technology-related tasks and to provide occasions for experiential learning at the same time. NI&S offers a number of opportunities for students to obtain valuable education and experience—information technology-related *and* business-based—that extend beyond the classroom. Such opportunities allow students to expand their knowledge and skill base.

Field Engineering/Network Engineering. In May 2008, 19 students—recruited primarily from the university's engineering departments—began summer employment helping CNS field technicians and network engineers with the installation of telecommunications cabling and equipment in new construction and the upgrade of network services to existing facilities. The student workers assist with pulling cable, installing network portals, documenting completed work, removing old equipment, assembling and installing new equipment racks, testing and certifying new connections, and other related tasks. While not as extensive as the RESNET projects of the late 1990s when approximately 100–120 students were employed each summer, this activity is a valuable source of hands-on field experience for fledgling engineers.

Blacksburg Electronic Village/Web Support Services. In the Blacksburg Electronic Village, a highly successful Web development program is in progress. Web Support Services (WSS) employs a team of four to six students, under the direction of a full-time manager. WSS offers complete life-cycle support for branded, accessible, secure websites including design, development, implementation, and ongoing maintenance. The group is knowledgeable about new Virginia Tech website templates and branding standards. The team uses secure, standards-compliant, Web design and development practices consistent with Virginia Tech's guidelines for university customers and provides similar services to nonprofit community groups. Initial work on Information Technology websites allowed the team to solidify business processes, operating procedures, and project methodologies. The fee-for-service program provides students with valuable, real-world experience to supplement their academic studies. Students who take full advantage of the program enjoy a three-stage career culminating in a leadership position responsible for the proper delivery of products and services to paying customers. Recent graduates have received offers from Microsoft and Intel and indicate the experience they gained in WSS helped set them apart from their peers and contributed significantly to their market competitiveness.

Research. An effective way to investigate new ideas is to hire student interns during the summer and/or advise students as they complete independent study courses. Hiring and advising students, who are often identified through faculty recommendations, is of great benefit to researchers and engineers at NI&S as a low-cost method of developing new ideas. It benefits students because they gain real-world experience and receive mentoring from professionals in their field of study.

The following list includes some of the projects on which NI&S engineers worked with and advised students during the past year.

Active network flow migration. The ability to migrate active network flows leads to a more robust network with enhanced features and functionality. NI&S staff advised an undergraduate summer intern who created a prototype implementation in this area.

Networking security. Local area networking originally developed in an era of trust and, as a result, still contains significant vulnerabilities. NI&S engineers advised a graduate summer intern who developed a concept and prototype implementation to increase the security and maintainability of local area networks.

Virtualization. Virtualization is a hot topic in computing. Staff members with NI&S advised two students for a computer science independent study course. The goal was to benchmark the performance of various virtual computing technologies. Follow-on work is currently being pursued by an undergraduate summer student.

Video/Broadcast Services. During the academic year, Video/Broadcast Services employs six or eight students to assist full-time staff with daily, on-site, operational support of the interactive videoconferencing classrooms. On-call student crews are available for first-level, on-site troubleshooting of videoconference connections and provide information and assistance on the effective use of the interactive videoconferencing facilities.

University Computing Support. University Computing Support provides a variety of work experiences for Virginia Tech students. 4Help employs a group of 20 to 25 technically knowledgeable, student consultants to provide second-level computer support for Virginia Tech affiliates. They provide assistance with university-offered services such as e-mail and online resources, as well as general support for Windows and Macintosh computers. Students also assist customers via a walk-in service, which offers hands-on, personalized help with more complicated problems. Many student consultants work at 4Help for two or three years before they graduate and begin a career in their chosen field. Based on feedback from former consultants, experience at 4Help has given them more opportunities to succeed in post-graduation job searches.

Another UCS initiative—in the Content and Knowledge Management unit—provides the opportunity for several graduate assistants to work as technical writers and editors for various Information Technology websites as well as the comprehensive Knowledge Base.

UCS participation in New Student Orientation (NSO) is aimed at assisting new students with the campus information technology environment. Each summer during NSO, UCS employs 10 students, working in conjunction with full-time staff, to interact one-on-one with the families of incoming first-year students. They provide information about computing services and software available at Virginia Tech. The staff works to ensure the 5200+ incoming freshmen who attend NSO have a functional PID and password so they can complete course requests on the second day of their orientation sessions. In addition, they ensure each student has obtained a copy of the VTnet Software Security and Networking Package and a Security Checklist. The staff prepares

and presents an in-depth, thirty-minute, Computer Security Requirement presentation covering a wide range of computing and networking topics. The presentation is delivered to both parents and students four times daily during NSO and allows incoming freshmen and their families to become familiar with the computer basics and network security available at Virginia Tech.

Now in its tenth year of support and service to the university, the UCS “Get Connected” program serves students who request in-person assistance in setting up their network connection, Internet, and e-mail configurations by offering computer consulting in the residence halls during the fall move-in period. UCS hires 60–65 students to work for a two-week span providing on-site technical computing support to approximately 8900 incoming freshman and returning students who live in the residence halls. A walk-in service is also available for students who live off campus. This program allows for a smooth transition into the Virginia Tech computing environment and ensures the majority of students have their computers fully functioning and well-secured by the first day of classes.

UCS will pilot a student hiring website (www.studentjobs.it.vt.edu) this fall. This resource will provide information about information technology jobs available to students at Virginia Tech and allows them to apply online for a position. Currently, the website includes information about positions within the UCS group, but it can easily be expanded for use by any department within Information Technology wanting to hire student employees.

The Information Technology Strategic Plan calls for an increase in the number of funded positions for graduate and undergraduate students in the division. In helping to meet this goal, NI&S intends to provide support and practical learning opportunities for students whenever possible.

For more information, contact Dan Joyce, dgjoyce@vt.edu.

Rate reduction

A major goal of NI&S is to anticipate the university community’s technological needs, and, through sound fiscal management, provide the leadership to create innovative and cost-effective solutions with the best combination of price, performance, stability, availability, and reliability.

Maintaining and enhancing an advanced communications infrastructure and providing leading-edge technology services require an up-to-date and evolving funding model. In the fall of 2007, Communications Network Services initiated an effort to better align overall telecommunications rates for services with the capacity consumed by university departments. As a result, departments experienced reductions in various voice and data recurring telecommunications service costs effective July 1, 2008. It is hoped the savings realized from these reductions—including a lower, per-minute, domestic long distance rate—will provide some relief to departments from expected budget reductions.

CNS will continue to work with the university administration to align the department rates for services with the capacity used. We anticipate continuing the telecommunications rates restructuring over the next several years.

For more information, contact Pat Rodgers, prodgers@vt.edu.

NetworkVirginia initiatives

Richard Hach has recently assumed responsibility as the director of NetworkVirginia. He will also serve as the member representative to Internet2 and the Quilt, a coalition of advanced regional networks.

NetworkVirginia is a Virginia Tech outreach program delivering broadband network services to an estimated 1.4 million people statewide. The network's primary goal is to improve the quality of life and enhance economic competitiveness in our region through flat-rate pricing and guaranteed access to advanced communications services. NetworkVirginia serves rural and underserved communities and also provides the world's most advanced research network infrastructure for regional universities and research laboratories. Originally designed to handle advanced multimedia applications needed at research and education locations, today the network is open to anyone. Over 2000 participating sites include those in higher education, K–20 education, municipalities, health care, museums, libraries, government, small local Internet Service Providers, and other businesses.

Network Infrastructure and Services provides program administration, contract administration, and oversight for NetworkVirginia. In addition, the Virginia Tech Operations Center provides order processing, network management, and trouble reporting and resolution services. Our extensive work with NetworkVirginia has allowed us to influence the commonwealth's information economy and has led to an improvement in the quality of life for citizens in every corner of the state.

In October 2007, NI&S negotiated a contract addendum with Sprint to modify and update NetworkVirginia pricing, extend the overall agreement, provide for continued network management, and expand available service options.

Services under NetworkVirginia are frequently updated to offer the latest access technologies, applications support, and network capacity at the lowest possible prices. Future plans include continuing to update network service technology and negotiate lower prices for participants statewide; and a project in collaboration with service providers and the Virginia Department of Education to leverage NetworkVirginia in an effort to provide broadband access and advanced network services to every K–12 school in the commonwealth.

Additional information about NetworkVirginia may be found at www.networkvirginia.net/ and www.networkvirginia.net/netva or contact Richard Hach, rhach@vt.edu.

Satellite/remote communications service

Communications Network Services has provided many communications solutions to the faculty and staff to support teaching and learning, discovery, research, and engagement efforts. With assistance from our communications and information technology vendor partners, many problems posed by our customers can be readily solved with generally available equipment and service offerings or through custom solutions designed in collaboration with CNS.

The discovery and dissemination of new knowledge takes place in the Commonwealth of Virginia, around the country, and around the world. From stream ecology research in Gauley Bridge, W.Va., to a research scientist working in “the wilds of Tanzania” or the desert of Atacama Province, Chile, security and project communications are a high priority. During 2007–2008, CNS successfully used Mackay Communications, located in Raleigh, N.C., to assist our customers with the use of satellite phones to support various projects in remote locations. Departmental customers assisted in this way included those from the College of Veterinary Medicine, the Office of International Research, Education, and Development, and the Departments of Geosciences and Biological Sciences.

CNS will continue to consult with our customers regarding voice and data applications to meet their specific needs including those related to inadequate landline service, instructional design and technology and the use of mobile smartphones, advice regarding cellphone use for faculty and staff traveling internationally, and safety concerns while in remote areas.

For more information, contact Richard Hach, rhach@vt.edu.

Network upgrade—Sterrett Facilities Complex

Departments located in Sterrett Facilities Complex include the Virginia Tech Police Department, the main Facilities’ offices, the Planning, Design and Construction group, and the Office of the University Architect. These units transfer large data files, such as building design plans and CAD/GIS files. They need reliable, high-speed connectivity to the campus network and the Internet. The goals for this network upgrade project are to provide higher bandwidth services to the occupants’ desktops and to install multiple outside pathways to the complex.

During the 2007–2008 fiscal year, redundant, diverse, outside plant (OSP) pathways have been constructed, and OSP fiber-optic cabling has been installed. This diverse connectivity ensures network service will not be interrupted if one of the fiber-feeds is damaged or destroyed. New telecommunications equipment rooms have been built and equipped with enhanced equipment racks and network electronics.

New station cabling is being installed this summer, and all users should have upgraded connections by the beginning of the fall 2008 semester. Building occupants will have the option of 10/100/1000BaseT service to the desk. The complex will connect to the campus core network with our standard gigabit-over-fiber connection. A second, hot standby, or backup gigabit-over-fiber connection, will be installed for redundancy.

For more information, contact John Pollard, jpollard@vt.edu.

Network core routing upgrade

Virginia Tech's campus network is a large and sophisticated resource, playing an integral part in the daily lives of all members of the university community. A single infrastructure is optimized and deployed; our network adheres to the Internet standards as implemented by the higher education community.

As the expectations of and demand for the benefits of networking technology continue to grow, it is critically important that Virginia Tech's information technology infrastructure, architecture, and ongoing operations support the university's mission. The campus core network must serve the challenging needs of computing-intensive research, educational collaboration, and a myriad of administrative applications.

Virginia Tech relies on NI&S to provide the planning and design support for the implementation of all new or upgraded network services to address current and future converged technologies demands. A key departmental objective is to advance the capabilities of and provide daily support for our existing infrastructure and services while simultaneously planning for increased capabilities to empower the members of the Virginia Tech community. By reviewing and replacing equipment that has reached its end-of-life or the peak of its performance ability, we ensure the university's central computing infrastructure is regularly refreshed.

Campus core backbone routers handle network traffic between the buildings they serve and other core routers including access to central campus computational services or the public Internet. Service requirements for these routers are always increasing as new buildings come online, current building networks are upgraded, and as users increase their network usage.

Each part of the network must scale to meet new needs. During the past year, three campus core backbone routers were upgraded to provide increased bandwidth availability and redundancy to the building(s) served. Plans have also been made to upgrade uninterruptible power in July 2008.

For more information, contact Jeff Bevis, jeff.bevis@vt.edu

Residence hall network upgrade

As a matter of course, today's students expect ubiquitous, high-speed access to the campus network, including e-mail, library resources, departmental servers, online educational content and collaboration tools, and the Internet. Using a reliable and leading-edge network, Virginia Tech's students must be able to gain access to online resources at any time of the day or night.

NI&S seeks to advance the capabilities of our information technology infrastructure and services while simultaneously planning for increased capabilities as newly evolving technologies become available. The campus residence hall network had not been upgraded since the initial installation was completed about 10 years ago. The original network was not supportive of the demands of the students living on campus. Therefore, it was critically important to increase the bandwidth available to individual users and improve the overall reliability of the equipment by replacing all network electronics in the residence halls.

Communications Network Services engineers designed a new network that provides a tenfold increase in bandwidth to each user and establishes building redundancy on all intra- and inter-building network backbone links. Installation of the network started in May 2008 and will be completed during the summer before the students return for fall semester.

For more information, contact Jeff Bevis, jeff.bevis@vt.edu

Power upgrade at Cassell Coliseum

One of the university's main telecommunications switchrooms is located in Cassell Coliseum. Over the years, additional equipment with greater power requirements has been installed at this location. The electrical power equipment there needed to be upgraded for several reasons:

- The small, uninterruptible power supply (UPS) was giving alarms on a regular basis as a result of load issues;
- There was a need to install additional equipment at Cassell as an offsite, backup location for the Andrews Information Systems Building;
- The total electrical capacity of the switchroom needed to be increased to handle the additional load.

The overall objectives of this project were

- to complete the power change without powering down the Rolm telephone switch;
- to increase the switchroom power feed from 400 amps to 800 amps;

- to replace the backup generator with a larger model to handle increased load;
- to install an 80 KVA UPS to allow for additional equipment to be installed in the switchroom.

All necessary work associated with this project was accomplished during this fiscal year. In addition, three racks of disk storage equipment have been installed in the switchroom to be used as off-site backups. In the near future, there will be a need to install additional air conditioning equipment at this location as well.

For more information, contact Marshall Fisher, mfisher@vt.edu.

Backup/storage fiber channel extension

The Storage Management Team (SMT), of the Systems Support department, provides central backup services for client and server systems at Virginia Tech. Due to historical limitations of the mainframe computing model, backup targets were housed in the same facility as the hosts being protected by the service. It was a critical goal of SMT to engineer backup targets located in off-site facilities to guard against a disaster at the main facility, the Andrews Information Systems Building (AISB). Engineering an infrastructure to support both mid-range and long-range fiber channel communications was a requirement.

SMT first developed a disk-based backup target environment on the Sun StorageTek 6140 Arrays (6140). Backup and restore testing was completed on the Cisco MDS 9216i Multilayer Fabric Switch (MDS) which integrates fiber channel and IP communications. This technology would make it possible to locate backup targets at any location where facilities might be provisioned using IP over WAN connections.

After testing multiple router IP connectivity and backup application functions, a second deployment was completed. The backup target 6140's and a remote-end MDS switch were moved to a new, secure site in Cassell Coliseum. Fiber-optic circuits were provisioned to support backups between AISB and Cassell Coliseum using fiber channel communications, and the service was moved into a production mode.

To provide for recovery in case of a disaster affecting the town of Blacksburg and the campus, it is possible the primary backup site might need to be moved to a location that is more remote than across the Virginia Tech campus. A possible location at the University of Virginia has been discussed. Such a site might be developed as a secondary backup location. The communications technology is already in place and tested.

For more information, contact Ray Stell, stellr@vt.edu.

Server and storage/backup infrastructure upgrades

In an effort to ensure servers are appropriately sized for the application load and adequate storage and backup facilities are available, NI&S Systems Support began systematically replacing equipment that was three to five years old or older in 2004.

During this fiscal year, 45 servers were replaced along with the storage area network (SAN) equipment. Servers were replaced in all administrative areas—Banner, e-mail, eProvisioning, Middleware, and Portal—as well as those providing instructional support for Learning Technologies.

A SAN replacement upgraded the technology and expanded the storage capacity from 10TB (on the IBM “Shark” SAN deployed in late 2001) to 30TB (on the DMX from EMC). In addition, network-attached storage (NAS) space was increased. An upgrade to the tape backup system was completed with additional disk drives expanding storage capacity.

Data collection and preservation efforts impacted migration plans for all three systems as older files and file types must be retained for possible litigation purposes.

Investigations are underway to determine the feasibility of consolidating much of the administrative server equipment and “virtualizing” the services on IBM hardware. Due to the large amount of idle cycles these servers experience, it is hoped the “spare” compute power can be dedicated to high-performance and research computing. Completing the migration from older equipment to the newly purchased hardware should be accomplished within the next three to six months.

For more information, contact William Dougherty, william@vt.edu.

Wireless classroom collaboration with the College of Engineering

In the fall of 2006, the College of Engineering started a tablet PC computing initiative that requires all incoming freshman to purchase a tablet PC. The tablets, along with the adoption of new instructional applications, give the college the ability to transform the traditional classroom environment into a dynamic, interactive session that engages students and encourages active classroom participation. The college, Learning Technologies, and NI&S have collaborated to enable the interactive learning environment through the use of the tablets on the campus wireless network.

In support of engineering faculty members who are actively using these collaborative learning tools, CNS enhanced the wireless network in 16 classrooms in seven different buildings. NI&S engineers developed techniques and best practices to create a robust, stable environment that met the needs of instructors and students. The upgrade was completed before the beginning of the fall semester and was successfully utilized in many College of Engineering classes.

An important strategic goal of the university is to incorporate new forms of technology into instruction in order to enhance the educational experience of students across the curriculum. The tablet PC requirement is in its third year, and the use of collaborative learning software has grown within the College of Engineering and spread to other colleges and departments. In anticipation of this increased demand, CNS will upgrade the wireless network in all centrally registered classrooms during the summer of 2008.

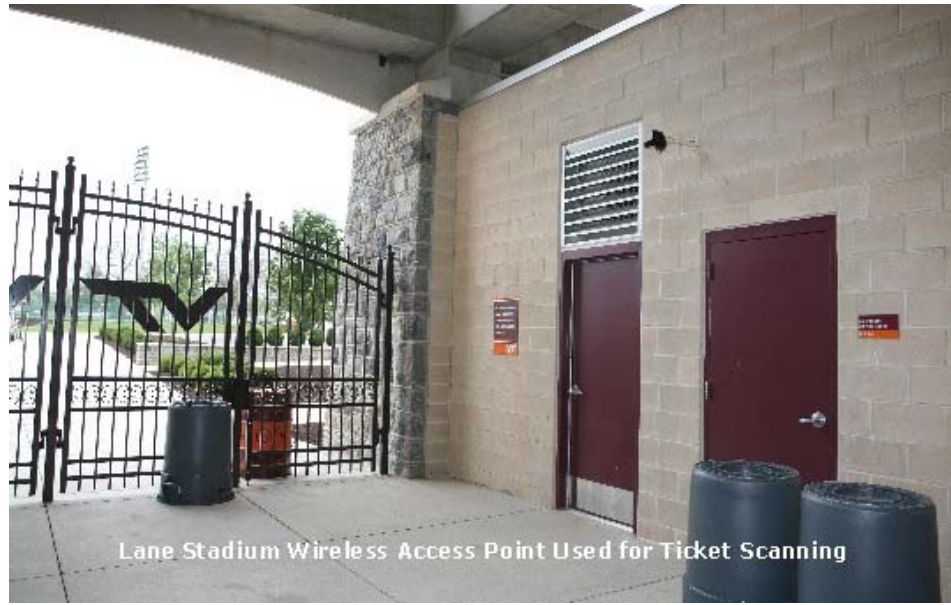
For more information, contact Steven Lee, stlee@vt.edu.

Wireless ticket scanning for the Athletic Department

The Virginia Tech Athletic Department purchased a handheld, ticket-scanning system for use at athletic event entrance gates. Utilizing the handheld scanners will help increase the speed with which fans are able to enter various campus athletic venues. The scanners provide real-time alerts related to ticketing problems, including counterfeiting. The system also allows customers to print their own tickets after they complete an online purchase.

In order to provide these real-time services, CNS installed a private wireless network in Cassell Coliseum for the 2007–2008 basketball season. The wireless network will be expanded to Lane Stadium in time for the 2008 home football games. The stadium network will require the installation of rugged and robust equipment able to handle the special needs of an outdoor location.

For more information, contact Steven Lee, stlee@vt.edu.



802.1x network access implementation

802.1x is a standards-based protocol allowing authorized users authenticated access to network resources. The first application of this protocol at Virginia Tech will permit access to the campus wireless LAN service. The current access method requires a user to log into the network through a webpage regardless of how the user wants to use the network. 802.1x will allow users to authenticate through a “supplicant” on their machine. (Wikipedia defines a supplicant as “an entity at one end of a point-to-point LAN segment that seeks to be authenticated by an authenticator attached to the other end of that link. In practice, a supplicant is a software application installed on an end-user's computer.”) If the user wishes to and the device supports the process, the access credentials can be stored on the device. Once configured in this way, the user's device will permit the user to log in automatically when the network is accessed and immediately proceed with their work.

During the 2007–2008 fiscal year, all necessary services were developed to allow 802.1x network access implementation. Users are able to access the network through our fully supported methods of authentication—Hokies ID and password or a network access certificate. If the user's device does not support one of these methods, PID and password or PID and CHAP secret—our unsupported methods—may be utilized. The final steps supporting full production service, including the posting of appropriate Knowledge Base articles and comprehensive compatibility testing, will be complete by the end of June.

Other potential uses of 802.1x network access include port-based access control on parts of the campus wired Ethernet network and allowing Virginia Tech to participate in access agreements providing visitors at participating universities access to each others' networks without further authorization requirements.

For more information, contact Jeff Bevis, jeff.bevis@vt.edu.

Residential wireless expansion

Rapid changes in technology, mobility, flexibility, and the nature of broadband infrastructure are changing the way the university community lives and works. The expectations of and demand for the benefits of that technology continue to grow. Wireless network cards have become a standard item on laptops, tablet PCs, and other portable/mobile devices, and the university requires that all entering students have a laptop or tablet PC with wireless capabilities. Students consider wireless service to be a necessity for their everyday activities and rely heavily on the flexible access it provides.

Building on pilot project begun in 2007, Student Programs requested wireless LAN coverage for 18 additional common areas and classrooms in student residence halls. This request supports a current NI&S initiative to increase access to the wireless LAN in *all* residential common areas. CNS has begun the work on the requested deployment. The goal is to complete the work before the students return to the residence halls in August 2008.

For more information, contact Jeff Bevis, jeff.bevis@vt.edu.

Classroom wireless upgrade

An important strategic goal of the university is to expose and incorporate new forms of technology into instruction in order to enhance the educational experience of students. Across the curriculum, Virginia Tech faculty members are increasingly using the wireless network to interact with students and transform the traditional classroom environment into a dynamic, interactive session that engages students and encourages participation.

During a pilot project implemented in the summer of 2007, techniques and best practices were developed to provide a robust, stable, wireless environment that met the classroom needs of instructors and students. The pilot results were used to develop a standard architecture for other lecture halls and provided a guideline for future applications of the classroom wireless network. This architecture was deployed with great success to accommodate attendees at the Common Solutions Group conference at the Holtzman Alumni Center.

All centrally controlled classrooms are gaining additional wireless LAN capacity through the use of multiple access points and/or adding "A" band radios to the existing "BG" band. Installation was about 90 percent complete by the close of the fiscal year with the remaining installations to be finished in July 2008.

For more information, contact Jeff Bevis, jeff.bevis@vt.edu.

COLA: cellular provisioning

Customer Online Access (cola.cns.vt.edu) is the NI&S Web-based customer portal for departments, students, and university guests. The suite of applications available on COLA allows users to provision telecommunications services, manage accounts, and electronically access bills.

The COLA interdepartmental communications request (ICR) provides departments with the ability to create and manage orders for telecommunications services. The application has been serving some departments in a pilot stage for almost two years as the Systems Development Administration Team incrementally added support for more order types.

This year, provisioning for cellular service was added to a portfolio including network, telephone, and video orders. The addition of cellular provisioning completes the COLA ICR application and positions the organization to release COLA ICR to all departments in the coming fiscal year and retire the legacy ICR application. The broad release of the COLA ICR application should improve the effectiveness and efficiency of both the CNS Order and Provisioning Team and the departmental telecommunications ordering processes. Additionally, the release will position the ICR process to integrate with the university's HokieMart system for order approvals.

For more information, contact Morgan Allen, allenm@vt.edu.

Kestrel port assignment

Project Kestrel was established to build a next-generation, telecommunications management system for NI&S. Eventually, it is expected to replace the current legacy systems such as ATLAS and NEMISYS. The primary goal of the project is to improve organizational effectiveness through better application usability, reduced reliance on proprietary software, and enhanced software reliability, maintainability, and extensibility.

A major focus area for Kestrel is the development of a network infrastructure documentation system significantly more advanced than existing methods. The Kestrel design recognizes the dynamic nature of the communications environment and provides the ability to document infrastructure at an appropriate level of detail throughout the entire infrastructure lifecycle. Additionally, Kestrel's network documentation system architecture integrates resource provisioning, cable plant management, and related fixed assets management, ensuring strong accountability for the university's investment in communications technologies and associated infrastructure.

Kestrel's most significant accomplishment this year was the December 2007 product release of the port assignment application used by the Operations Center network technicians to assign and

manage network device ports. The application provides an integrated and customized Web interface designed with particular attention to usability. The application streamlines the process required to assign and activate a network port by reducing the number of open applications needed from four to two and providing template-based interaction with the network device to improve efficiency and accuracy.

The Kestrel plan—likely to take several years to complete—calls for incremental replacement of small, functional pieces of legacy systems as well as the provision of new functionality not previously addressed. During development, Kestrel will continue to interoperate with existing systems so regular work functions outside the scope of current Kestrel development can continue normally.

The port assignment product release was important because it established an improved commitment to usability as a primary concern of application development. Additionally, the product release established the framework and proof-of-concept that Kestrel could be developed while interoperating with legacy applications.

Another important accomplishment this year for Kestrel was the establishment of the Eclipse Rich Client Platform (RCP) as the basis for future Kestrel development. Post-project analysis of the Port Assignment application release determined that Kestrel will likely need to be a mix of Web-based applications and rich client applications. Evaluation of rich client technology and approaches led to the conclusion that the Eclipse RCP would be a good fit, and early prototypes have been successful.

For more information, contact Morgan Allen, allenm@vt.edu.

Switchboard directory

The university's switchboard operators assist individuals who contact the university at its main telephone number by providing telephone listings for on-campus students, faculty and staff members, and departments of Virginia Tech.

This year, a new Web-based tool was developed and released for switchboard operator use. The new tool replaced a legacy system that relied heavily on internally managed telephone listing information. The new application leverages the university's Enterprise Directory and extends that information through a much smaller and more focused set of internally managed information. The result is the ability to provide more accurate responses, improved support to callers, and closer alignment of the switchboard function with the university Web-based directory. Additionally, the new approach simplifies and streamlines information management within Communications Network Services.

Systems Development solicited input from the university switchboard operators and used their insights during the development process. One request made by switchboard staff was to provide a data input screen for logging information about calls the operators transfer to the Virginia Tech

Police. The requested feature was quickly designed and implemented, resulting in improved accuracy of the data submitted and a reduction in the time required to share and to evaluate the data collected.

In order to leverage the heavily used directory interface, switchboard and Systems Development staff members will continue their collaboration through ongoing refinements to the directory utility.

For more information, contact Morgan Allen, allenm@vt.edu.

Networked geographic information systems implementation

Geographic information systems (GIS) technology is an important tool for planning and managing all types of infrastructure including communications facilities. The power of GIS increases dramatically when the associated information and tools are connected in a network. NI&S has collaborated with members of the eCorridors team to implement networked GIS systems.

NI&S began using GIS in 2002 to plan fiber-optic cable routes to serve tobacco-growing counties in Southside and Southwest Virginia. This work was part of a Virginia Tech outreach project to assist those regions in developing telecommunications infrastructure to promote economic development. Later, NI&S, eCorridors, and the Blacksburg Electronic Village utilized GIS in other outreach efforts including work funded through the National Telecommunications and Information Administration Technology Opportunities Program and assistance to the New River Planning District Commission for development of a regional fiber to the premises project.

A constant objective of the GIS-related efforts has been to share common maps, drawings, and datasets with others via a networked server. Examples of such data include the university campus basemap, street maps, site/building locations, populations, telecommunications cable routes, utility routes, orthophotography, various boundaries, parcels, service areas, and other geographic/demographic information.

NI&S and eCorridors personnel have given a series of presentations to key stakeholders on campus to demonstrate the capabilities of a prototype, enterprise GIS system for centralized spatial data access and interdepartmental data sharing. Individuals from the library, University Planning, Design, and Construction (UPDC), the Center for Geospatial Technologies, Environmental Health and Safety Services, Site and Infrastructure Development, and the Utility Survey Group attended these demonstrations. Experiences with the integration of GIS, computer aided design (CAD), and university enterprise databases were discussed; and we began promoting the sharing of common master data. Meetings with GIS staff from the Town of Blacksburg were also held.

NI&S Systems Development and Administration acquired two new server machines to support ESRI ArcSDE and ArcIMS Web GIS applications. These machines, along with NI&S Oracle

databases, provided proof-of-concept for a networked, enterprise GIS system, including Web services.

NI&S and eCorridors personnel later met with the director of Virginia Tech Real Estate Management to discuss how enterprise GIS could be used to support their parcel mapping application. GIS parcel data in Autodesk Map format was recovered from an inactive server by eCorridors personnel, and they imported it into ArcGIS for future ESRI Web GIS access.

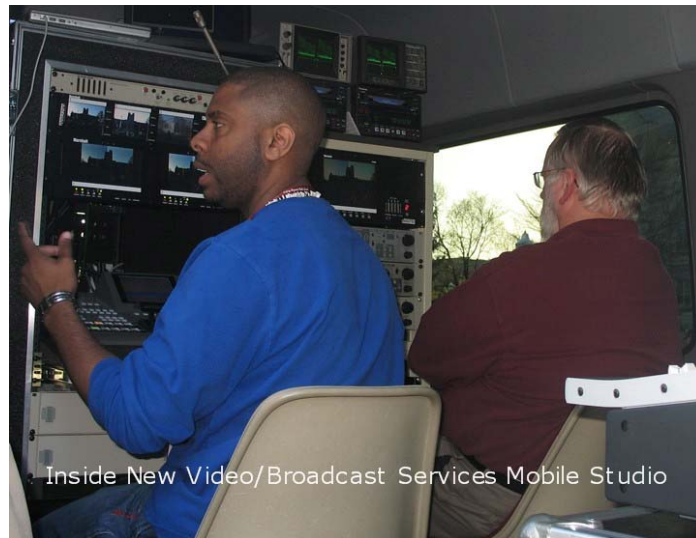
In August 2007, eCorridors and NI&S demonstrated various uses of GIS and CAD to the Vice President for Administrative Services and described the need to access/share master data with other departments. An interesting part of the demonstration showed how AutoCAD building floor drawings could be geo-referenced and overlaid on a GIS basemap of the campus that included all desired buildings, streets, parking lots, etc. This capability is useful for space management, public safety, and many other applications. One can also do queries to display a particular campus space or office along with associated database information, such as occupant and telephone number. Another example of a useful GIS query is to display all the spaces managed by a particular college or department along with summary database information.

In the first half of 2008, a number of meetings to explore the feasibility of implementing a university-wide enterprise GIS system were held with interested parties from academic and administrative departments. Implementation plans are being made—a major achievement for all involved. The project will result in significant benefits for the university as departmental systems are implemented to take advantage of shared GIS maps, drawings, databases, and services.

For more information, contact John Nichols, john.nichols@vt.edu

VBS on-location production capabilities

The Video/Broadcast Services Production Unit produces highly acclaimed, instructional video and multimedia for Virginia Tech. In 2007, Video/Broadcast Services put a new production facility into operation—a fully equipped truck capable of meeting the production and engineering requirements for on-location video and multimedia production. The mobile studio has the capability to interface with Virginia Tech's existing network infrastructure and the Network Operations Center. Along with the production and distribution assets in place in Whittemore, the new mobile facility gives VBS an additional video production resource capable of broadcast via satellite uplink and Internet protocol.



The project was three years in the making—portions of the required equipment inventory were purchased in 2005 and 2006. The complete facility was first used to provide the media pool feed from the Drillfield for the remembrance ceremonies on April 16, 2008.

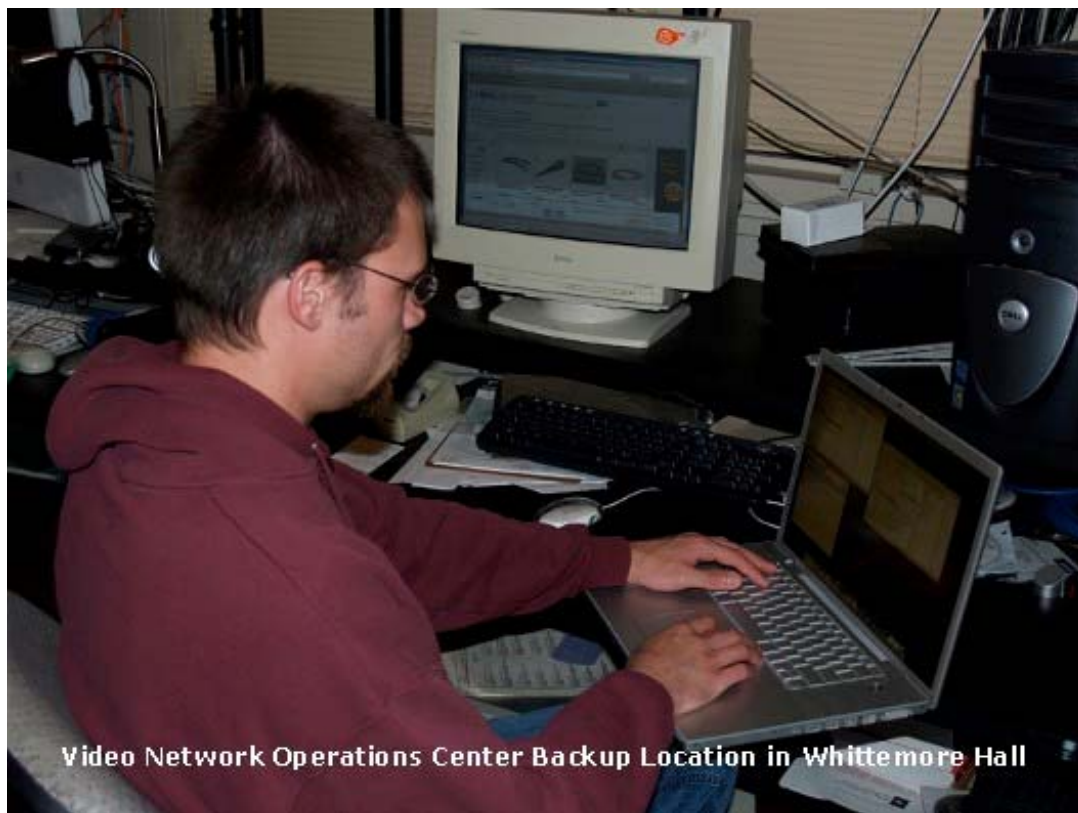
For more information, contact Mark Harden, mharden@vt.edu.



Redundant Video Network Operations Center

The Virginia Tech Network Operations Center (VNOC) is located in the Andrews Information Systems Building at the Corporate Research Center (CRC). The VNOC provides a one-call, trouble-reporting center and help desk with experienced personnel who monitor distant sites and troubleshoot problems remotely.

During the past year, Video/Broadcast Services has implemented remote access capability and backup of all critical VNOC equipment to enable normal operations in case of an emergency. Part of the VNOC's research and development (R&D) infrastructure has been moved from the CRC to Whittemore Hall on the main campus. The core of this new R&D area consists of a multi-point conference unit and an Internet protocol videoconference recorder (IP-VCR). This infrastructure provides a redundant system of current production equipment and provides the ability to maintain operations in case of emergency.



Drills of the emergency plan and backup procedures proved the R&D infrastructure could achieve operational status in a matter of seconds after the plan had been initiated. Weekly backups of all production equipment guarantee an up-to-date record of all system information.

In March 2008 during a system-wide failure of the University of Virginia's videoconferencing infrastructure, the VNOC provided all services necessary for UVA to continue operations for 48 hours using the emergency plan and redundant equipment.

Future plans include the development of a statewide plan to allow the VNOC to provide similar emergency assistance to universities across the commonwealth.

For more information, contact Mark Harden, mharden@vt.edu.

Internal chat room and wiki dashboard for Information Technology Support

Information Technology Support management and staff are constantly striving to enhance the level of service and support provided to the university community and to improve the center's ability to address the university's technology concerns in a timely and professional manner. They engage in proactive planning and ongoing review of policies and procedures to enhance the staff's ability to respond to user needs in a timely and effective manner.

As a part of these ongoing efforts, the communication between a co-located call center and help desk has been improved through the utilization of a chat room and wiki. These improvements have facilitated more rapid communication and collaboration on problems between multiple Information Technology groups.

Information Technology has adopted the use of Jabber IM and chat rooms to facilitate informal, open communication among various units. The improved communication has been especially significant in Information Technology Support where there is a need to "connect" two help desks which are in physically separate locations. By using topic-specific chat rooms, support personnel can quickly ask informal questions and have access to an entire other "room" of experts.

A wiki provides a central repository for information. Users can create, edit, and find information quickly. The ease of interaction and operation make a wiki an effective tool for mass collaborative authoring. NI&S introduced a Confluence Wiki to its employees in 2006. It contains hundreds of pages, includes over 30 groups (user communities), and over 40 spaces (areas of function or interest) including the Information Technology Support Dashboard.



For more information, contact Joyce Landreth, jlandreth@vt.edu.

University Computing Support relocation

University Computing Support provides end user technical support for many of the information technology services offered to students, the faculty, staff, and other Virginia Tech affiliates. In an effort to create an environment that is welcoming, accessible, and able to better address the needs of all our constituents, plans were announced during the fall of 2007 to relocate UCS from its facilities in Torgersen Hall to a consolidated location at the University Mall.

The UCS move was completed in January 2008 after construction of the new office space was completed, office furniture and equipment were moved, and telecommunications services were installed. The new facility enables UCS staff to occupy contiguous office space and houses the student consulting area in the same location.

The new space—in a central, easy-to-reach location with adequate parking—is particularly supportive of our new walk-in support model which provides one-on-one computer assistance for students, faculty, staff, and retirees. Support is provided for wired and wireless connectivity, the university's modem pool, DMCA complaints/uploading violations, recovery from viruses, complete computer restorations, and data backup and recovery. Including a walk-in model as one of our support services has enabled us to assist our growing number of mobile users, provides an escalation path for issues better diagnosed in person rather than over the phone, and serves all user populations more efficiently.



The move to University Mall also included staff members who provide extended executive support services, those who support Goodlink devices, and the Content and Knowledge Management group. The call center and network operations groups remain in Research Building 14 at the Corporate Research Center.



For more information, contact Joyce Landreth, jlandreth@vt.edu.

Content and Knowledge Management Group merger

The Content and Knowledge Management group manages the public content for Information Technology's two computing reference tools:

- www.computing.vt.edu, a directory of computing services offered by Virginia Tech
- www.answers.vt.edu, a knowledge base with answers to common questions and computing problems experienced by Virginia Tech faculty, staff, and students

In order to consolidate and enhance the overall workflow of both groups, CKM was organizationally and physically relocated to become part of University Computing Support. The main goal of this reorganization was to create an improved process and functionality for the production and maintenance of website content.

CKM depends heavily on 4Help to identify end-user needs because that group has direct communication with our users. 4Help staff members are able to identify problems, document solutions, and submit the information to CKM for formatting and publication. Conversely, 4Help depends on CKM to act as the “gatekeeper” for the release of new or updated applications. Both groups utilize student employees. By combining resources—particularly student resources—we expect to see a dramatic increase in workflow efficiency enabling more timely and accurate output of information.

4Help staff members have experienced an increasing level of frustration with the tools available to submit information for the Knowledge Base. The current application needs significant enhancement and is increasingly difficult to maintain. Another objective of the reorganization is the migration of the current Knowledge Base to a modern and improved content management system. Full-time, professional staff at 4Help will be able to assist with researching, developing or purchasing, and implementing a better system for producing content for the university community. A public knowledge base of higher quality with improved search capabilities will allow our customers to find solutions more efficiently and enhance our ability to provide better customer service.

For more information, contact Joyce Landreth, jlandreth@vt.edu.

Online Course Systems and 4Help

Online Course Systems (OCS) was originally created to support faculty members in their efforts to integrate instructional technology with their course presentations as well as provide online tools to facilitate research activities. The group supports all course management systems/tools at

Virginia Tech and provides system administration for Blackboard, Courseware, and other instructional software.

In an effort to improve service and support, the help desk features of Online Course Systems merged with 4Help on December 1, 2007. At that time, 4Help and *answers.vt.edu* became the primary contact for all OCS-related support questions. OCS has a Remedy queue, and 4Help can escalate problem tickets directly to them when appropriate.

Online Course Systems and UCS work closely together to ensure consistent, high-quality support and services to the faculty, staff, and students who have questions about Blackboard, Scholar, ePortfolio, CourseEval, DyKnow, Courseware, ElementK, or iTunesU. In addition, OCS personnel are working with *answers.vt.edu* staff to increase the amount of information about OCS services available in the searchable, online Knowledge Base.

For more information, contact Joyce Landreth, jlandreth@vt.edu.

Educational Broadband Service license renewal

Educational Broadband Service (EBS), formerly known as Instructional Television Fixed Service, is a wireless service that can be used for a variety of fixed, mobile, or portable communications services. It has been used for the transmission of educational and instructional programming by both educational institutions and nonprofit organizations. Virginia Tech is an EBS licensee and, in addition to educational programming, had leased its excess capacity to a firm providing digital, wireless, television services. That lease expired in 2007.

The EBS license held by the university has been successfully renewed through the year 2017. The Federal Communications Commission (FCC) has recently adopted new rules and developed a plan to promote more efficient use of the spectrum and accelerate the growth of new communications technologies. Following the transition from previous channel locations to new spectrum blocks, FCC operating rules now provide additional flexibility regarding the use of EBS for instructional programming and other services.

With continued interest in the EBS spectrum to support next-generation wireless broadband services, Virginia Tech, in addition to the traditional instructional programming use of EBS, has been reviewing the potential of its spectrum to provide broadband access/high-speed Internet services within its geographic service area, including underserved populations.

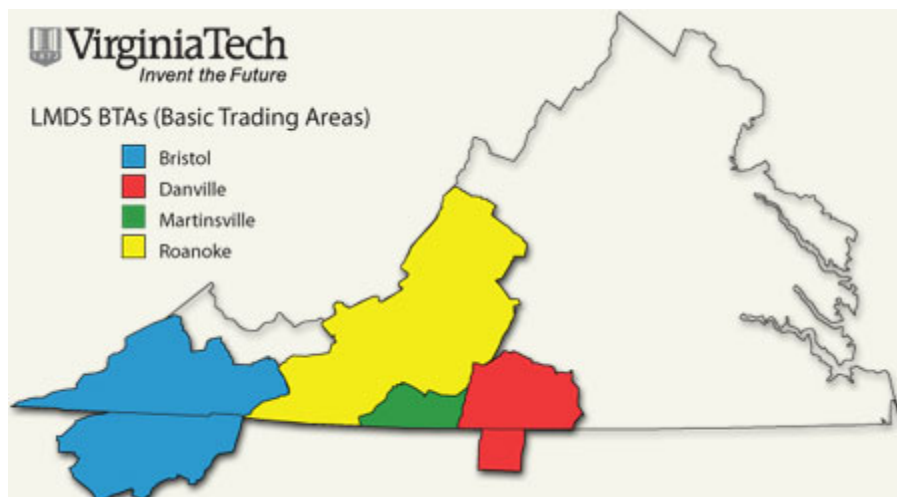
For more information, contact Richard Hach, rhach@vt.edu.

Local multipoint distribution service

In the United States, local multipoint distribution service (LMDS) is a wireless data service that uses FCC-licensed frequencies in the 27.5 GHz to 31.3 GHz range of the electromagnetic spectrum. Different frequencies may be used in other countries. The service may be used for point-to-point and point-to-multipoint broadband data links. Line-of-sight distances up to a few miles can generally be supported using one- to three-foot dish antennas. Equipment is available to support throughput speeds up to 800 megabits per second. The A Block license provides 850 MHz of contiguous bandwidth and could potentially support much higher speeds in the future.

The Virginia Tech Foundation acquired four A Block LMDS licenses in June 1998. Virginia Tech manages the use of the licensed spectrum through an operating license and lease agreement between the Foundation and the university. Due to the lack of affordable equipment, the FCC has granted an extension of the initial ten-year deadline for meeting “substantial service” requirements until June 1, 2012. The LMDS equipment market did not develop as originally anticipated, and the only equipment readily available is limited to point-to-point backhaul on certain frequencies or is very expensive. A request has been submitted to the FCC to renew the licenses for another ten-year term. The licenses cover most of Southwest Virginia as well as parts of North Carolina and Tennessee. The license areas include the Roanoke, Martinsville, Danville, and Bristol basic trading areas (BTAs), which cover an area of 16,000 square miles and are home to about 1.6 million citizens.

Virginia Tech's LMDS License Areas



Map of LMDS License Areas

Roanoke BTA: Bath County, Rockbridge County, Alleghany County, Botetourt County, Craig County, Bedford County, Roanoke County, Roanoke City, Giles County, Montgomery County,

Franklin County, Pulaski County, Floyd County, Wythe County, Carroll County, and Grayson County

Martinsville BTA: Patrick County, Henry County, and Martinsville City

Danville BTA: Danville City, Pittsylvania County, Halifax County, South Boston and Caswell County, N.C.

Bristol BTA: Smyth County, Grayson County, Washington County, Bristol City, Russell County, Dickenson County, Wise County, Scott County, and Lee County. The following Tennessee counties are also included in the Bristol BTA: Hawkins County, Kingsport City, Sullivan County, Carter County, Johnson County, Johnson City, Washington County, Greene County, and Cocke County

Virginia Tech's LMDS objectives are as follows:

- Leverage LMDS for wireless technology research
- Promote rural broadband infrastructure development

Virginia Tech has leveraged LMDS spectrum in several research and outreach areas. In 1998, the university led the creation of the LMDS Research Consortium which brought together licensees, equipment manufacturers, and research laboratories to develop and promote LMDS technology.

The university's wireless research groups (www.wireless.vt.edu) have conducted research sponsored by an array of military, federal, and commercial affiliates including the National Science Foundation, the National Security Administration, the Defense Advanced Research Projects Agency, the U.S. Customs Service, Boeing, Lockheed Martin, Hughes, ITT, and others. Other groups at Virginia Tech, including the Space and Wireless Business Center, the Blacksburg Electronic Village, and eCorridors have used LMDS for research and outreach programs.

In addition to research, Virginia Tech has engaged in multiple test bed and commercial build-out projects. In 1999, Virginia Tech constructed one of the first rural point-to-multipoint LMDS systems—a test bed in association with WavTrace and Harris Corporation. The test bed, located in Blacksburg, supported multimedia applications including Web-based video, weather data instrumentation, and remote office access at multi-megabit-per-second speeds.

In 2001, the university entered into an agreement to lease a portion of the spectrum in the Roanoke BTA allocation to a wireless network service provider exploring the use of Radiant Network's LMDS mesh wireless technology for commercial and residential service.

Unfortunately, in 2001 a major recession occurred in the telecommunications industry that lasted several years; many LMDS equipment manufacturers went out of business during this time. As of June 2008, LMDS service providers are still waiting for more affordable and higher functionality products to become available. Given the high bandwidth of the LMDS spectrum, it

can be used to provide higher speed backhaul services that cannot be provisioned in the lower frequency microwave bands.

In 2008, Virginia Tech began developing an LMDS service project to assist other entities in the implementation of high-speed Internet protocol (IP) backbone links for on- and off-campus applications. Multiple links will be deployed across southwestern and Southside Virginia over the next few years. The service would be particularly beneficial for sites without affordable access to broadband transport or to those that need diverse, redundant routes for disaster avoidance in case existing transport routes are cut.



WavTrace LMDS multipoint hub deployed at Virginia Tech

For this project, LMDS point-to-point links are currently planned for the Institute of Advanced Learning and Research in Danville, the City of Martinsville, the University of Virginia at Wise, and at Virginia Tech in Blacksburg. These links will use a new version of LMDS wireless equipment made by Ceragon Networks called FibeAir IP-Max2. The equipment supports gigabit Ethernet links plus up to eight T1 channels, with full-duplex throughput up to 400 Mbps. Throughput can be doubled by adding a second radio module. Since heavy rain can cause signal attenuation and possible signal dropouts, the advanced IP-Max2 is designed to automatically adapt its modulation method to maintain maximum performance. It gives priority to T1 channels and can also prioritize IP traffic over the gigabit Ethernet channel so the most important traffic gets through during periods of signal degradation. Initial deployments are expected over the next year. The current phase of LMDS deployment must be completed before the new FCC deadline of June 1, 2012.

Virginia Tech intends to continue to conduct research involving wireless technology generating value beyond the delivery of service. The university plans to focus on use of information technology in emergency management. As high-capacity LMDS equipment becomes more available and less expensive, Virginia Tech will aggressively seek to leverage the spectrum for rural infrastructure development and for high-capacity campus and community services.

For more information, contact John Nichols, john.nichols@vt.edu.

The Edward Via Virginia College of Osteopathic Medicine

The Edward Via Virginia College of Osteopathic Medicine (VCOM) is a post-baccalaureate, professional, medical college in Blacksburg, Va. It is a nonprofit, private corporation initially funded through several foundations that were established by the late Marion Bradley Via. Edward Via was instrumental in dedicating funds to this initiative. John Rocovich, the Via attorney, served as the rector for Virginia Tech during the time VCOM was founded and was the individual instrumental in founding the college. The vision for the College is to provide healthcare for Southwest Virginia and the Appalachian region, and to promote biomedical research with Virginia Tech. VCOM is located in Virginia Tech's Corporate Research Center. (www.vcom.vt.edu/)

Since 2001, VCOM has operated with a collaborative agreement with Virginia Tech. The university and VCOM recognize the contributions each makes to the other's mission and goals, and they have agreed to provide certain services and resources to the other. This collaboration creates an environment that promotes excellence in education and research.

Information Technology has worked closely with VCOM over the last eight years to provide services necessary to support their ever-changing environment. Services currently provided by Information Technology to VCOM include support and backup of servers, Web hosting, course management services, and network connectivity.

For more information, contact Pat Rodgers, prodgers@vt.edu.

Protection of telecommunications infrastructure during steam distribution upgrade

Virginia Tech's physical campus in Blacksburg is constantly expanding and will continue to do so for the foreseeable future. A strategic plan to serve utility demands associated with the physical expansion, changing fuel and technology developments, and the evolving mission of the campus has been developed to address the university's increasing heating/cooling requirements.

A portion of the plan focuses on the required upgrade to existing steam distribution systems located in the campus tunnels. In the spring of 2007, the university began work on this significant project. Campus steam tunnels have also been used as pathways for the cabling (wiring) infrastructure used to provision the university's mission-critical information technology services and building control systems.

The telecommunications infrastructure located in the tunnels is crucial for many daily activities at the university. Therefore, an important goal for the overall project is to protect the cabling in order to avoid interruption of essential university information technology services.

Throughout this lengthy and complex project, NI&S has worked closely with University Planning, Design, and Construction and the project contractors to protect critical telecommunications infrastructure in the university steam tunnels. NI&S has employees on-site at all times when project contractors are working near our infrastructure to monitor project activities and to ensure protective measures are in place before contractors begin work in any tunnel section. Protective measures include rigid sheathing along walls where cabling is mounted and fireproof materials wrapped around cabling where it crosses the tunnels.

Our field monitors have witnessed instances where protective measures were not installed before contractors began work. On those occasions, NI&S employees requested that contractor work cease until the protective measures were properly installed. Our on-site monitors also observed events where the protective measures were, indeed, effective in preventing damage to our infrastructure that would have likely occurred had those measures not been in place. To date, there has been no damage to our telecommunications infrastructure in the steam tunnels as a result of contractor work related to this project.

Work is ongoing during the summer at the important Owens cable crossing and is planned to take place at the highly critical Cassell cable crossing in August 2008. Contingency plans are constantly reviewed and updated, as required. We will continue to work closely with UPDC and project contractors to protect our infrastructure until the steam plant upgrade is finished. The projected completion date is mid-October 2008.



Protective Materials for Information Technology Infrastructure in Campus Steam Tunnels

For more information, contact John Pollard, jpollard@vt.edu.

Continuity of operations plan

The governor has directed the university and all state agencies to complete agency-level continuity of operations plan (COOP) plans. This fiscal year, along with other departments providing essential university services, NI&S formalized its COOP plans.

A formal NI&S COOP plan will benefit the department if we should experience an event such as a building fire or a pandemic flu. In addition, the overall plan will enable the university to more effectively plan for relocation space(s) and resources for all departments.

All NI&S groups actively participated in the development of our formal COOP plan this year. The many COOP-related discussions and planning sessions we had in past years facilitated this effort, and the ongoing process raised the general level of awareness and preparedness.

We developed a single, consolidated COOP plan including all NI&S units. The plan was submitted to the Acting Director of Emergency Management (DEM) on March 31, 2008. A consultant was hired to guide the various university groups involved in the overall effort, and our plan was sent to the university's COOP consultant for review and comment. As of late June, we have not yet received feedback on our plan.

There is no doubt that NI&S is better prepared to respond to an emergency as a result of these regular and ongoing internal discussions. Our plan will be a "living document" and will be updated annually to ensure it is robust, coordinated with other university COOP plans, and supportive of important university information technology needs. When the vacant DEM position is filled, we will coordinate with the DEM and others in the university administration to exercise the plan periodically.

For more information, contact John Pollard, jpollard@vt.edu.

Net@EDU Converged Communications Working Group

The purpose of the Converged Communications Working (CCWG) is to engage the vendor community and institutions of higher education in discussions regarding converging services, wireless technology, spectrum issues, and best practices. At the same time, the group attempts to highlight future technology and strategic direction.

The CCWG provides information to Net@EDU members during the annual meeting held each February and at the EDUCAUSE national meeting in October. The CCWG also provides topic-specific information through day-long sessions offered at both meetings. The content of these sessions is developed by the group's steering committee. John Nichols and Richard Hach of

Network Infrastructure and Services are both members of the steering committee. The Converged Communications Steering Committee (CCSC) chooses topics based on current importance to the community such as Emergency Notification Management or those of general interest to the members such as the deployment of 802.11n or the status of WiMAX technologies.

As part of future planning efforts, the CCSC has prepared a “Peer Survey on Emergency Communications Notification and Management in Higher Education,” which will be distributed later this year. Results of the survey will be tabulated and distributed to Net@EDU members to provide a way to measure their institution’s preparedness compared to others. In addition, committee members Mike Staman of Macon State College, Mark Katsouros with the University of Iowa, and Richard Hach with Virginia Tech are collaborating on a feature-length article for *EDUCAUSE Review* on the topic of Emergency Communications Notification.

For more information, contact Richard Hach, rhach@vt.edu.

SANS computer and information security training

The SANS (SysAdmin, Audit, Network, Security) Institute provides intensive, immersive, training sessions designed to help information technology personnel master the practical steps necessary for defending computer systems and networks against the most dangerous threats—the ones being actively exploited. Each year, SANS programs educate more than 12,000 people worldwide.

SANS training can be taken in a classroom setting from SANS-certified instructors, through self-paced courses over the Internet, or in mentored settings in locations around the world. In July 2007, Virginia Tech supported its first SANS training course. Others have been held since that time and approximately 600 participants have attended these conferences. The use of interactive videoconference technology provides the opportunity to teach courses to large audiences without travel expenses or disruptions to participants’ work schedules. Video/Broadcast Services’ (VBS) administrative and technical support of the SANS conferences is considered an integral part of successful program delivery.

The SANS Institute has scheduled VBS support for two conferences during the summer of 2008. Several other conferences are in the planning stages for 2009.

For more information, contact Mark Harden, mharden@vt.edu.

WVTF and WVTF Radio IQ on campus cable

During the past year, Video/Broadcast Services completed a project allowing Virginia Tech's radio services to be broadcast over the campus cable television system. State-of-the-art radio receivers were installed for WVTF and WVTF Radio IQ. The installation of antenna systems for these new receivers—allowing for more stable reception—is planned for the future.

Completion of this project has provided an additional communications channel for emergency alerts.

Campus cable channels have been dedicated for these services. Channels 2, 4, and 6 are used for WVTF's primary broadcast programs. WVTF Digital Radio IQ is available on channels 3 and 5. Radio IQ is an extended news service radio station featuring BBC programming and National Public Radio talk programs as well as locally produced public affairs shows.
(www.radioiq.org/about.htm)

For more information, contact Mark Harden, mharden@vt.edu.

Fujitsu technology grant to the College of Engineering

In August 2007, Dr. Glenda Scales, associate dean for International Programs and Information Technology in the College of Engineering (COE), asked Video/Broadcast Services to make a short, high-quality video explaining a million-dollar technology grant from the Fujitsu Corporation to COE. The college is well known for its leadership role in personal computing. According to a press release from September 2007, the grant assists in the “creation of ‘digital opportunities’ for underserved students, as well as pre-college students interested in studying math, science or engineering at Virginia Tech.”

With this grant, COE hopes to provide young learners with an “increase in technology literacy, allow hands-on and interactive theme-based activities, and acquire basic skills about computers.” The technology award included digital cameras, projectors, printers, scanners, and over 300 tablet PC's. The equipment is used by COE in outreach programs for

- undergraduates who may lack the resources to purchase a tablet PC;
- the Virginia Tech Center for Engineering Diversity which runs a camp for underserved middle-school students who want to learn technology;
- Apple Ridge Farm in Copper Hill, Va., which serves at-risk teens from Roanoke and the rest of southwestern Virginia.

The master of the video—featuring some of the young people using the advanced equipment on campus and at Apple Ridge Farm—was shown at the fall meeting of the COE Alumni Advisory Board and the Committee of 100. Associate Dean Scales noted that “the project will have lasting memories for me because of your exceptional teamwork and expertise combined with your great sense of humor. It was a pleasure working with you.”

A low-resolution version of the video is available as video-on-demand at:

http://light.vbs.vt.edu/adhoc/fall2007/COE_Tablet_Initiative.mov

For more information, contact Mark Harden, mharden@vt.edu.

Commonwealth Graduate Engineering Program annual conference

The Commonwealth Graduate Engineering Program (CGEP) is a consortium of five Virginia universities—University of Virginia, George Mason University, Old Dominion University, Virginia Commonwealth University, and Virginia Tech. Formed in 1983, the group collaborates to provide graduate degree offerings for both on-campus students and working engineers through on-site and televised graduate classes. CGEP provides high-quality, post-baccalaureate, engineering education for practicing engineers and scientists interested in maintaining and enhancing their skills.

In 1998, the delivery of the program courses was converted from satellite to two-way, interactive videoconferencing. Then, at the beginning of the fall 2006 semester, after identifying needed improvements in instructional delivery methods, Video/Broadcast Services completed the transition of the CGEP courseware from asynchronous transfer mode to state-of-the-art Internet protocol H.323 which offers dual-video stream capability.

Representatives from the five CGEP universities and from some of the receiving sites met in Charlottesville on Friday, June 6, 2008. A policy and procedures manual was distributed, and discussions were held to clarify and/or amend items in the manual. A historical bulletin for the program’s 25th anniversary was given out which included articles written by past and present directors and instructors in the CGEP program. This bulletin can be found at www.cgep.virginia.gov/overview.php.

During the June meeting, desktop delivery of classes was discussed as a possible future advancement once technical issues are resolved.

For more information, contact Mark Harden, mharden@vt.edu.

Certification for water treatment plant operators

In Virginia, a waterworks operator is required to demonstrate a specified amount of knowledge and experience to maintain their license. Since these licenses expire biennially, operators must maintain proficiency through certification classes. The use of interactive videoconference technology, provided by Video/Broadcast Services, affords these professionals convenient access to real-time, high-quality instruction and minimizes the disruptions to their work schedules.

In 2007, we concluded the Class VI Operators conferences which are aimed at the operators of the smallest class of water treatment plants. This fiscal year, we supported seven “Water Quality” broadcasts with approximately 720 participants statewide. The broadcasts include instruction on topics applicable to all six classes of waterworks professionals throughout Virginia.

In collaboration with the assistant director of Continuing and Professional Education, VBS is working to confirm a series of broadcast dates under a new grant for the 2008–2009 fiscal year. These new sessions will maintain our involvement in delivering these essential training opportunities and support one of the university’s strategic initiatives to develop the commonwealth’s workforce through training and continuing education.

For more information, contact Mark Harden, mharden@vt.edu.

Ordering and Provisioning activity and initiatives

The Ordering and Provisioning group serves as the primary point of contact between CNS and the university community. O&P plans and coordinates the development and submission of letters of estimate, meets with departments, receives and processes interdepartmental communications requests (ICRs), initiates work orders, and follows up with customers after the completion of the work. O&P is in an excellent position to evaluate customers’ telecommunications needs. The O&P team facilitates customer requests for telecommunications equipment and services and coordinates NI&S efforts to fulfill those requests including arranging meetings with other NI&S groups, particularly engineering and technical staff, upon customer request.

O&P staff members provided extensive support for several significant telecommunications projects during the past fiscal year. Bishop-Favrao Hall, housing the Department of Building Construction and the Myers Lawson School of Construction, was completed in early January 2008. The Institute for Critical Technology and Applied Science (ICTAS) A in the Virginia Tech Corporate Research Center was finished in Fall 2007, and departments moved into this building as laboratory space was completed. ICTAS supports and promotes cutting-edge research at the intersection of engineering, science, and medicine. The new facility seeks to promote the

promise of nanotechnology. The Virginia Tech Police Department relocated to new space adjacent to the Sterrett Facilities Complex in October 2007. Work has begun on the Henderson Hall renovation and Black Box Theater. The project will update aging Henderson Hall, provide academic space for the visual and performing arts programs, and construct a new performance venue.

Extensive data network upgrades were completed in Major Williams Hall (100BaseT Ethernet) during the summer of 2007 and for the Virginia Bioinformatics Institute where Phase I and II were upgraded to 1000BaseT Ethernet. Outside fiber to the Brooks Center was upgraded, and wireless access was provided to three adjoining buildings as a result.

Smaller projects completed in 2007–2008 include the following:

- 4Help move to University Mall
- Institute for Distance and Distributed Learning and Pamplin Business Extension offices were relocated to the University Gateway Center
- Kent Square II
- Storage Network Project in the Andrews Information Systems Building
- Aquatics and Fisheries Building at the Brooks Center

Moves associated with construction projects and renovations affected the following departments:

- Art and Art History
- Theater Arts
- Interior Design
- Landscape Architecture
- College of Architecture
- Pesticide Programs
- Office of Sponsored Programs
- Services for Students with Disabilities

Other high-impact projects involving significant O&P coordination included the following:

Norris Hall-related moves. The Department of Engineering Science and Mechanics moved back to Norris Hall and expanded into space formerly occupied by the Dean of Engineering. The offices of the dean of the College of Engineering moved into renovated space in Torgersen Hall in Spring 2008.

Classrooms. Additional university classroom renovations were completed during Summer 2007.

ESPN GameDay. A special ESPN GameDay broadcast in early September and coverage of the game itself kept O&P busy fulfilling requests with short turnaround intervals.

New York Yankees. In March 2008, Virginia Tech hosted the New York Yankees at English Field for an exhibition game. O&P coordinated with the Yankees Entertainment Sports Network to provide needed telecommunications services.

Concert for Virginia Tech. In September 2007, the Dave Mathews Band and others joined to perform "A Concert for Virginia Tech" at the university's Lane Stadium. O&P coordinated with the event planners and promoters to provide an array of telecommunications services required for the concert.

Riverside Center. O&P worked with Human Nutrition, Exercise, and Foods Department as they prepared to occupy new space at the Riverside Center in Roanoke, Va. The location will serve as the first site of a joint medical school to be created and operated by Virginia Tech and Carilion Medical Research.

ELAN. O&P staff worked with three departments to install Ethernet over local area network (ELAN) service at several locations in the National Capital Region. The unique ELAN service, available on the NetworkVirginia contract, was developed by Virginia Tech to serve as a model for future, advanced, network services. The fiber-based service provides 100 MB service connections—terminating in the Northern Virginia Aggregation Center—to entire buildings and provides interconnections to many research and advanced networks as well as the commodity Internet. A fourth location, the Equine Medical Center in Leesburg, is slated to be connected in Fall 2008.

For more information, contact Bill Blevins, blevins@vt.edu.

Professional development

In addition to regular job responsibilities, many Network Infrastructure and Services staff members participate in professional pursuits including presentations at university-based and regional or national conferences, teaching seminars or class sessions, and outreach activities. The list below reflects some of these activities for the period from July 1, 2007 through June 30, 2008.

Seminars and academic course support

Eric Brown, April 2008, presentation at DCSS on IPv6

Eric Brown, Ed Holohan, and Andrew Olson, October 2007, campus network update presentation at DCSS

Patsy Galliher, Ludwig Gantner, Nancy Gibson, Mark Harden, and Taikara Peek, Virginia Tech/Wake Forest School of Biomedical Engineering & Sciences Videoconference Tech Support Team

Ludwig Gantner, Nancy Gibson, Mark Harden, and Taikara Peek, June 2008, technical support for Commonwealth Graduate Engineering Program annual conference

Ludwig Gantner, November 2007, technical support/advisor at Virginia Tech for Megaconference; July 2007/December 2007/June 2008 SANS conferences at Virginia Tech, primary technical support and advisor
 Carl Harris, April 2008, presentation at DCSS on proposed long-term upgrades, including infrastructure replacement, gig to desktop, and IP telephony
 Steven Lee, April 2008, presentation at DCSS on proposed 802.1x rollout
 Bill Sanders, January 2008, "Risk Analysis," two class presentations for the Pamplin College of Business, Information Systems Audit class for Professor Sam Hicks
 Systems Support Staff, August 2007, support for High Performance Parallel Computing Boot Camp held at the University of Virginia

Degrees/certifications/classes and training

Six University Computing Support student consultants, December 2007 and May 2008, graduated from Virginia Tech.
 18 staff members, October 2007/March 2008, completed Portable Fire Extinguisher II training.
 Four staff members, November 2007, completed Rigging Safety Awareness training.
 Five staff members, December 2007 and March 2008, completed Electrical Safety training.
 18 staff members, January–June 2008, completed Fall Protection training.
 11 staff members, February 2008, completed Hearing Preservation training.
 Six staff members, February–April 2008, completed Respiratory Protection training.
 19 staff members, May 2008, completed Commonwealth of Virginia Asbestos Awareness Training Course.
 19 staff members, May 2008, completed Commonwealth of Virginia Lead Awareness Training Course.
 Joseph Agnew and Steve Gordon, November 2007, completed Adult CPR training.
 Morgan Allen, May 2008, Java SPRING Framework Training by Accelebrate
 Morgan Allen, Jason Christian, Dan Cook, Brian Early, Carl Harris, Joe Hutson, Mathew Mathai, Richard Phipps, Robert Roberts, Ray Stell, and Luke Ward, December 2007, attended SANS GIAC Web Application Security Workshop (SEC 519).
 Morgan Allen, Dan Cook, Brian Early, Eric Fischer, Valdis Kletnieks, Ted Leinhardt, David Martin, Chris McNabb, Richard Phipps, Bill Ranck, Luke Scharf, Joe Schottman, Robert Roberts, Luke Ward, and Danny Wright, March 2008, attended SANS-EDU training courses:

- Audit 521: Meeting the Minimum Standard for Protecting Credit Card and Other Private Information PCI CISP: The Visa Digital Dozen
- Security 514: Advanced Network Worm and Bot Analysis—Hands On
- Security 531: Windows Command-Line Kung Fu In-Depth for Info Sec Pros
- Security 601: Reverse-Engineering Malware: The Essentials of Malware Analysis

Morgan Allen, Dan Cook, and Ray Stell, October 2007, attended Virginia Oracle Users Conference.
 Wanda Baber, Valdis Kletnieks, Eliza Lau, Roy Vickers, and Eric Wonderley, Cisco training on 9509 Storage Switch
 Jeff Bevis, Eric Brown, Patsy Galliher, Mark Harden, Ed Holohan, and Steven Lee, September/October 2007, Information Technology project management training

Eric Brown, Ed Holohan, and Ray Stell, February 2008, Cisco MDS 9500 Fiber Channel Equipment Training

Eric Brown and Steven Lee, July 2007, attended Internet2 Joint Techs Workshop, Batavia, Illinois.

Eric Brown, Garry Goad, Steve Gordon, Ed Holohan, and Steven Lee, February 2008, Asbestos Operations and Maintenance recertification

Eric Brown, Garry Goad, and Steve Gordon, February 2008, Asbestos Inspector recertification

Dan Cook, Richard Phipps, Joe Schottman, and Luke Ward, September 2007, SANS GIAC Certified Forensic Analyst

Dan Cook, Eric Fischer, and Danny Wright, October 2007, attended VASCAN Conference in Richmond, Virginia.

Dubby Charlton, Dan Cook, Dan Joyce, John Lawson, and Diane Whitlock, April 2008, Emergency Action Plan Committee training and certification in Basic CPR and First Aid

Kevin Cook, Spring 2008, Adobe After Effects and Apple Final Cut Pro training

Jeff Dalton, Spring 2008, Adobe Photoshop and Flash training

Doug Edmonds and Ted Leinhardt, Microsoft "Sharepoint" product training

Eric Fischer, Microsoft Certified Systems Administrator 2003 Certification, and Microsoft Certified Systems Engineer 2003 Certification

Mark Gardner, May 2008, "Grants 101: Professional Grant Proposal Writing," The Institute for Communication Improvement–The Grant Institute in Richmond, Virginia

Carl Harris, October 2007, Sun Certified Web Component Developer (SCWCD), and October 2007, Recertification under the Cisco Certified Internetwork Expert (CCIE) program

Ed Holohan, September 2007, participated in Cisco "Virtual Worlds and their Impact on the Network" virtual seminar, and April 2008, Ceragon FibeAir Technical Training

Ed Holohan, Steven Lee, and Andrew Olson, April 2008, attended FCC Rural Broadband Educational Workshop held on the Virginia Tech campus.

Ron Jarrell, completed three-course introduction sequence–Emergency Incident Management training from FEMA.

Cindy Kelley, completed 31 hours of Continuing Professional Education classes for renewal and maintenance of CPA license.

Bruce Kemp, March 2008, SANS certification in PCI (Payment Card Industry) compliance standards

Steven Lee, December 2007, participated in "Managing EBS Spectrum for Maximum Benefit" audio seminar.

Brian Maloney, Luke Sharf, and Eric Wonderley, Winter 2008, attended SANS workshops on Power Search with Google; First Responder–Windows; and First Responder–UNIX.

John Nichols, Certified Master Telecommunications Engineer by iNARTE (The International Association for Radio, Telecommunications and Electromagnetics)

Robert Rankin, April 2008, Commonwealth of Virginia Master Electrician License

Robert Roberts, November 2007, Ensemble CMS Train the Trainer

Luke Scharf, November 2007, attended SC07 in Reno, Nevada.

David Schuh, May 2008, graduated with Bachelor of General Studies, concentration in Educational Technologies, from Radford University.

Clay Scott, November 2008, completed Confined Space Entrant/Attendant/Supervisor training.

Anne Sheppard, August 2008, Information Technology Networking and Technical Support AAS, Summa Cum Laude, New River Community College

Roy Vickers, EMC Control Center Management training
VBS Whittemore and VNOC Staff, October 2007, Fire Extinguisher Training
Luke Ward, March 2008, GIAC Web Application Security certificate
Danny Wright, Certified Internet Webmaster v5 (CIW v5) Foundations Certification
Laurie Zirkle, August 2007, Tomcat Administration Training by Accelebrate; August 2007,
SANS GIAC Certified Forensics Analyst, Silver; December 2007, SANS GIAC Security
Essentials Certification, Gold; May 2008, SANS GIAC Certified Unix Security
Administrator, Gold

Military service

Ron Keller, active member, Army National Guard
Robert Roberts, Active member, United States Army Reserve; July 2007, graduated US Army
Drill Sergeant School

Presentations/papers/publications

Jeff Crowder

April 2008, authored successful petition to the Federal Communications Commission requesting
an extension of time for build-out requirements for LMDS license renewal. The petition was
cited in FCC Order DA 08-867.

Summer 2007, coordinated the Telecommunications Infrastructure Report to President Steger.
This report was requested in the aftermath of the April 16th tragedy. The report provided a
comprehensive review of internal and external communications infrastructure including a
qualitative assessment and recommendations for near-term and long-term strategies. The
report addressed prospects for leadership in communications research and innovation for
emergency response, security, and cyberforensics.

November 2007, presented at half-day seminar and workshop for Virginia High- Performance
Research Networks for Virginia Higher Education CIO group, James Madison University
December 2007, presented at workshop on research and education networking at Virginia
Department of Education “Educational Technology Leadership Conference,” Roanoke,
Virginia

January 2008, led Information Technology Infrastructure panel discussion for Common
Solutions Group Winter 2008 workshop, “Technology Issues and Implications around VT
Shootings”

William Dougherty, Richard Hach, Pat Rodgers, and Mike Dame (University Relations), May
2008, presented the audio seminar: “Emergency Notification at Virginia Tech,” for the
Association for Communications Technology Professionals in Higher Education. The
seminar was joined by 310 people at 79 locations including Canada and New Zealand.

William Dougherty

May 2008, presented “Collecting and Preserving Data in the Wake of a Tragedy” at EDUCAUSE Security Professionals Conference, Arlington, Virginia

August 2007, member of a panel discussing campus security/alert systems and gave presentation on features for an emergency notification system at Governor’s Campus Security Conference, Richmond, Virginia

October 2007, presentation on VT Alerts and its implementation at VASCAN, Richmond, Virginia

January 2008, invited presenter on “Data Collection and Preservation Efforts at Virginia Tech in the Wake of 4-16-07,” Common Solutions Group, Blacksburg, Virginia

March 2008, member of a panel discussing campus security and gave presentation on features for an emergency notification system at American Society of Public Administrators Annual conference, Dallas, Texas

June 2008, presentation on e-discovery practices and procedures at Information Technology Professional Forum, part of the NewVA Corridor Technology Council

Mark K. Gardner and Wu-chun Feng, May 2008, presented "Towards a Virtual Ecosystem for K–8 Education," 2nd International Conference on the Virtual Computing Initiative (ICVCI 2)," Research Triangle Park, North Carolina

Richard Hach

February 2008, participated in a presentation and panel discussion on “Emergency Communications Management” at the Net@EDU Annual Meeting in Tempe, Arizona

January 2008, an Information Technology Infrastructure Panel member related to Emergency Response and Resolution Support, Common Solutions Group, Blacksburg, Virginia

July 2007, invited presenter and panel member related to Emergency Response/Notification Presentation and Roundtable discussion, Sprint Higher Education Advisory Board, Washington, D.C.

November 2007, with staff, supported Erv Blythe with the delivery of EDUCAUSE Live! Webinar on “Lessons Learned from the April 16th Tragedy at Virginia Tech”

Richard Hach and Carl Harris, November 2007, conducted a Web and audio conference for the Sprint Higher Education Advisory Board regarding “Lessons Learned from the April 16, 2007 Tragedy at Virginia Tech.”

Joyce Landreth, March 2008, presented “Choosing an Emergency Notifications System: VT Alerts,” for the Association of Collegiate Computing Services (ACCS) of Virginia conference, Charlottesville, Virginia.

Steven Lee, April 26, 2008, guest panelist for an Airwave, Inc. webinar entitled "802.11n in Higher Education—Expert Panel discusses Pros and Cons"

Julia Mays (with Karen McDowell of the University of Virginia), March 2008, co-presented “Knowledge Bases: Technological Self-Help,” for the Association of Collegiate Computing Services (ACCS) of Virginia conference, Charlottesville, Virginia.

Consultation and outreach activities

Wanda Baber and Roy Vickers, members, NetApp Users Group of Roanoke and NRV

Dan Cook and Jerry Surface, alternates, Staff Senate

Dan Cook

Member, Advisory Committee on Security and Infrastructure

Member, GIAC Advisory Board

Member, Data at Rest (DAR) security committee

Member, Judy Albert Scholarship Criteria Committee

Member, InfraGard (Richmond Chapter) www.infragard.net

Judge for Academic Fair at Eastern Elementary (VT Engage)

Cubmaster, Pembroke Scout Troop 460

Kevin Cook, consulting projects for Virginia Tech Police Department and Roanoke City Police Department including surveillance tape duplications, image captures from tape, and assistance reviewing spec sheets for surveillance cameras

Jeff Crowder

Served as National LambdaRail administrative point of contact for the mid-Atlantic region

Served as Mid-Atlantic Terascale Partnership/Virginia Tech representative for the National LambdaRail TransitRail Project

Participated in the National LambdaRail Valuation Workgroup

Directed the “National LambdaRail and Internet2 Virginia K–20 SEGP” program

Expanded the Northern Virginia Aggregation Facility Commodity Internet Service (CIS) with increased capacity for Old Dominion University and added access for Virginia Commonwealth University

Negotiated a Settlement-Free Peering Agreement between Mid-Atlantic Terascale Partnership and Mid-Atlantic Crossroads to provide transit access to Internet2 and PacketNet

Negotiated a new bilateral Connector Agreement with the Mid-Atlantic Crossroads which significantly expands National LambdaRail participation in the region

Appointed to Board of Directors for Quilt Inc.

Coordinated LMDS license extension and renewal application request activities with Virginia Tech Foundation counsel. Negotiated an amendment to the Operating License and Lease Agreement between Virginia Tech and the Virginia Tech Foundation.

Negotiated major addenda to the NetworkVirginia agreements with Verizon and Sprint

Provided support to Virginia Commonwealth University to connect the INOVA medical facility to the Northern Virginia Aggregation Facility

Jeff Dalton, Mark Harden, Joe Schottman, Sam Tressel, and Doug Whorley, served on Video Work Group of Telecommunications Infrastructure Committee researching Emergency Alert Systems

William Dougherty

Member, Advisory Committee on Human Dimensions chaired by Vice President Zenobia Hikes

Member, Project Management Standard Development Committee; preparing Information

Technology-related project management guidelines.

Member, PMA; Policy Management Authority for the PKI Infrastructure

Chair, Data Center Futures Committee

Chair, CC-CNS Roundtable

Eric Fischer, Coach, New River Valley Lacrosse

Richard Hach

Member, Sprint Higher Education Advisory Board

Member, Net@EDU Converged Communications Working Group (formerly Wireless Working Group and Integrated Communications Services Working Group)

Member of Converged Communications Working Group steering committee;

developed conference programs for EDUCAUSE 2007 in Seattle, Washington and Net@EDU 2008 in Tempe, Arizona

With the Net@EDU Converged Communications Working Group (CCWG), worked on a Peer Survey on Emergency Communications Notification and Management in Higher Education as part of EDUCAUSE's Net@EDU Policy Initiative

Consulted with peer institutions regarding best practices, service, policies, procedures, and regulatory issues including colleagues at Texas Christian University, Radford University, Lehigh University, University of Connecticut, Cornell University, University of Mary Washington, Radford University, University of Louisville, Ohio University, University of North Texas, Drexel University, Morrisville State College (part of SUNY), University of Missouri-Rolla, Colorado State University, University of Maryland Eastern Shore, University of Kentucky, Georgia Gwinnett College, Park University, American University, University of Minnesota, University of Texas, Washington State University, University of Michigan, Suffolk University, DePaul University, Illinois Institute of Technology, University of Nebraska, and the University of Central Florida.

May 2008, participated in the Mid-Atlantic Terascale Partnership (MATP) Member Meeting, in Charlottesville, Virginia

Participated with Internet2 as a Research and Education Network Member

Assumed the role of Program Director for NetworkVirginia and member representative to the Quilt on behalf of NetworkVirginia. Served as primary point of contact for vendors regarding contract management.

Member, Network Infrastructure and Services Advisory Board of the Information Technology Advisory Committee, Commission on University Support

Participated in a "Strategic Planning" videoconference arranged by Vanderbilt University and hosted by the University of Kentucky

September 2007, participated in the Virginia Interoperable Communications Conference in Roanoke, Virginia

Mark Harden, David Mattox, and Sam Tressel, equipment purchase consultations with College of Engineering, School of Biomedical Engineering & Sciences Program, and College of Agriculture and Life Sciences

Mark Harden, Planning Committee Member, April 16, 2008: A Day of Remembrance

Kathy Kobza, Texas Future Problem Solving Program

Joyce Landreth, Member, Staff Senate

Steven Lee, May 2008, consultation with faculty members from the British Columbia Institute of Technology about supporting collaborative classroom tools over wireless networks in large lecture halls

Judy Lilly, November 2007, recipient, Department of Defense Employer Support of the Guard and Reserve (ESGR) Patriot Award

John Nichols

Chaired working group to review and report on Virginia Tech's First Responder Radio Communications Systems

Lead, Local Multipoint Distribution Service broadband wireless planning, which involves outreach for Southside and Southwest Virginia areas

Chair, Telecommunications Infrastructure Executive Committee

Chair, Telecommunications Outside Plant Infrastructure Planning

Member, GIS Systems Advisory Group

Member, Space Facilities System Working Group

Member, Network Infrastructure and Services Advisory Committee

Member, Net@EDU Converged Communications Working Group

Bill Sanders

Ex officio member, Blacksburg Telecommunications Advisory Committee

Member, Town of Blacksburg Planning Commission, Long Range Planning Subcommittee

Member, New Century Technology Consortium CIO Forum Steering Committee

Vice President, Mental Health Association of the New River Valley: Board of Directors;

Member, Finance Committee

Board of Directors, the Community Foundation of the New River Valley (CFNRV); Member, Development Subcommittee

Member, Community Impact Program Committee: helping to promote philanthropic giving among companies and residents of the Corporate Research Center

Liaison from BEV and Virginia Tech Information Technology to Blacksburg Electronic Village, Inc.

Member, H.E.R.E (Honoring Experience, Response, & Expression), an arts-based community support effort in the wake of April 16th. BEV will provide their website.

Member: Business and Information Technology Curriculum Advisory Committee, Woodrow Wilson Rehabilitation Center

New River Valley Coalition for Children and Families; helping with analysis of the economic state of childcare providers in the region
New River Community Services; preparation of proposal to provide low-cost automobile purchases for low-income/Temporary Assistance for Needy Families (TANF) workers
Dabney S. Lancaster Community College; institutional website planning
Virginia Tech Arts Initiative; community envisioning and planning
Center for Technology Impact on Families; assisted with NSF grant preparation and vendor interviews
Town of Blacksburg; assisted with GIS mapping of fiber/telecommunications assets

Anne Sheppard, March 2008, served on the Board of the Association of Collegiate Computing Services (ACCS) of Virginia and collaborated with other Board Members to produce and host the annual ACCS conference in Charlottesville, Virginia

David Schuh, Second Lieutenant in the Civil Air Patrol
Director of Aerospace Education for the entire Virginia wing (group)
Trained with the Virginia Department of Emergency Management (VDEM) and now qualified as a Search and Rescue Field Team Leader
Qualified for Emergency Radio Network Operations and Emergency Locator Radio Direction Finding

Doris Stock
Consulted with peer institutions including colleagues at Lehigh University, Ohio State University, Wellesley College, Emory University, and the University of Southern Florida regarding service, policies, procedures, and regulatory issues
Member, Legislative and Regulatory Committee, Association for Communications Technology Professionals in Higher Education (ACUTA)

Diane Whitlock
Member, NI&S Commonwealth of Virginia Campaign Committee
Member and Chapter Officer, National Society Daughters of the American Revolution
Member, P. Buckley Moss Society
Researcher and transcriber for the Montgomery Museum & Lewis Miller Regional Art Center (VT Engage)

Laurie Zirkle
Member, SANS Institute Advisory Board
Information Technology Security Task Force

Research Computing

Research Computing provides an innovative and interdisciplinary environment advancing computational science, engineering, and technology. Its mission is to:

- provide leadership, advanced infrastructure, and support to invigorate computational science and engineering at Virginia Tech;
- provide partnerships and support for joint faculty appointments in the university's academic departments, building areas of excellence in computational science and engineering across disciplines, and providing opportunities for new innovation in scientific computing;
- offer educational programs and training on scientific computing, encouraging the development of knowledge and skills in computational tools and techniques for undergraduate and graduate students and for the faculty and staff;
- offer programs to stimulate and expand interdisciplinary and computational-driven research activity at Virginia Tech, including visiting researcher, travel, events, distinguished postdoctoral fellow and graduate student programs that provide new sources of support for collaboration, research, and development;
- affiliate with business, industry, and government to help drive economic development growth in Virginia by building connections between research and applications for emerging tools and techniques in computational science and engineering, and by establishing research agreements that facilitate knowledge creation and application in industry;
- collaborate with other computational science and engineering driven research centers in advancing knowledge and leading the evolution of scientific computing tools, techniques, and facilities that accelerate scientific discovery.

The primary activities for Research Computing include:

- reviewing and evaluating of research computing, including visualization/visual computing, needs (support services, hardware and software) of the research faculty and graduate students;
- assisting faculty members in proposal development, focusing on research computing support for research grants/contracts;
- seeking opportunities to work with Virginia Tech research faculty members, other universities, national and international computing centers, and industries and others on basic research and research computing projects.

During this fiscal year, Research Computing focused on providing additional storage for System X and other platforms, developing a vision for the unit, increasing the number of full time research computing support services staff members, developing close and valuable working relationship with Oak Ridge National Laboratory, creating a cost center structure for System X, developing an intern program, and working closely with the Research Division.

Highlights

Research Computing storage. To make System X a more stable production platform, we proposed adding 100TB of research computing storage. Colleges, departments, research centers and other units were asked to contribute to the \$540,000 required to purchase this storage. Although we had been successful in efforts to provide a research computing hardware budget through such requests for the past four years, our attempts with units other than the Research Division and Information Technology were not successful this time. The Research Division and Information Technology put together \$475,000 allows us to purchase 67TB of research computing storage. The storage was delivered and installed by SGI in May 2007. Select users were invited to test out the new storage system in September 2007. All of the System X users were moved to the new storage system by June 2008.

Information Technology undertook an initiative to provide a large-scale centrally managed storage system for organizations needing research computing storage. Input for the new storage system was solicited from the Virginia Tech Transportation Institute and the Virginia Bioinformatics Institute (VBI). Based on their requirements select vendors provided proposals to provide approximately 1 PB of storage.

Support services. Dr. John Burkardt joined the team in August as a computational science specialist. John's past positions included the School of Computational Science at Florida State University and the Pittsburgh Computing Center. John was able to obtain external funding of 100% of his salary for 3 months during the fall term and has been awarded a \$50,000 Sandia grant for 2008. John has worked with several research computing researchers in advancing their research programs through optimization of code, parallelization of code, transporting the researcher's code to System X, overcoming issues with the message-passing interface (MPI), and contributing to the basic research.

We have implemented a policy of housing departmental and research groups' computational systems in the Andrews Information Systems Building (AISB). The agreement includes offering a percent of the time to other university researchers. We met with Lay Nam Chang, dean of the College of Science, on June 18 to discuss several of the college's research clusters locating in the AISB.

High Performance Computing Bootcamp. Throughout the spring, Research Computing worked closely with colleagues at the University of Virginia to organize an intensive course on parallel computation and visualization skills for Virginia researchers. The bootcamp addresses a pressing need to educate researchers in the skills needed to exploit high-performance computing resources such as System X. This collaboration between the information technology and computer science personnel of the two institutions is a significant positive development and promises to improve the capabilities of many faculty members and graduate students. The camp consists of morning lectures and afternoon hands-on labs where attendees learn about

supercomputing architectures, code parallelization, and performance benchmarking, as well as analysis and communication of results through visualization. The 9-day course was held at the University of Virginia, August 8–17, 2007. The training course has now become an annual summer event alternating between the University of Virginia and Virginia Tech campuses.

Shared memory hardware. Over the past three years, we have been able to put together a funding package involving several units to purchase SGI hardware—20p Altix 3400, 128p Altix 3700, and 64p Altix 4700. All of these systems are heavily used and get excellent reviews from the research computing faculty and graduate students. During May 2008, the SGI systems were put under control of the System X queuing system, enabling more efficient use of the machines, and allowing users to run larger jobs on these resources.

Also in the spring, newly hired Professor Chester Wiess acquired two used SGI machines from BP. These machines are 64 CPUs each with 512 GB of memory. Research Computing provides system administration support for these machines in exchange for 10% of the CPU cycles to offer to other researchers.

Research Computing/visualization support. Robert Walters, vice president for research, and Erv Blythe, vice president for information technology, have assumed the lead in presenting the proposal for research computing support within the university through a newly established presidential committee on high performance computing.

The Research Division and Information Technology put together \$475,000 that allowed us to purchase 67TB of research computing storage in June 2007. The storage was installed and operational in August 2007. The primary need for this additional storage was System X; we have experienced several System X failures due to the lack of sufficient storage. Since this storage came on line last August, we have had zero System X failures due to storage-related problems. During this reporting period, we have worked with VBI to identify the research computing needs of their researchers. This effort lead to the preparation of several draft reports and resulted in preparing, with VBI's Guy Cormier, an "extended executive summary" on Information Technology/VBI research computing and middleware issues and needs.

Robert Graybill accepted an invitation to visit Virginia Tech and provide advice and guidance on projects and directions in the high performance computing (HPC) arena. Mr. Graybill, University of Southern California Information Sciences Institute (ISI), is, in cooperation with the Council of Competitiveness, fostering the development of advanced national HPC collaborative environments that will help companies, universities, and national laboratories share high performance computing systems and computational science expertise. Mr. Graybill has an extensive background in embedded and high performance computing with over 30 years of experience in the defense, government, and commercial industries. Prior to joining ISI, he spent six years at the Defense Advanced Research Projects Agency (DARPA), where he designed, developed, and implemented six new transformational programs in high-end computing architectures and responsive embedded computing hardware, software, and network systems. He was a member of the Senior Science Team, leading a number of government-sponsored studies in high-end computing, including the Defense Science Board task force on DoD Supercomputing Needs and the High-End Computing Revitalization Task Force. Mr. Graybill received the Secretary of Defense Medal for Outstanding Public Service while at DARPA.

We have had several meetings with University of Virginia officials—Vice President and Chief Information Officer James Hilton, Associate Vice President and Deputy Chief Information Officer Michael McPherson, and Dr. Mitch Rosen, School of Engineering and Applied Science—to discuss joint research computing projects/programs. We jointly organized the Virginia Tech/University of Virginia HPC Bootcamp, August 2007. This bootcamp was extremely successful and will be offered again in August 2008.

National networks. We continue to encourage Virginia Tech researchers to find ways that reliable high-speed networks can advance their research programs. Dr. Mark Gardner, Information Technology network research manager, has worked with several research faculty members to make networked computing accessible for their research programs. As an example, Dr. Gardner worked with Dr. Danesh Tafti, Mechanical Engineering, to allow him high-speed reliable access to his data store at the National Center for Supercomputing Applications (NCSA). Dr. Tafti stores his data at NCSA since Virginia Tech does not have the necessary storage capacity for his research data.

National Capital Region. We continue to seek ways to assist with Virginia Tech initiatives for the National Capital Region (NCR). We have worked with Dr. Jim Bohland's team on several NCR issues and projects. Our NCR effort includes the design and management plans for the research computing and visualization facilities for the proposed research building. We are currently evaluating our needs for space and personnel for the NCR site. We have talked with the Institute for Critical Technology and Applied Science (ICTAS) and the College of Science (COS) on possible shared space. It was unclear at the time this report was prepared what the cost will be for space in this building.

Oak Ridge National Lab (ORNL). We have made progress on our desire to develop partnerships with ORNL. Dr. Nicholas Polys has worked with ORNL researchers in scientific and visual computing and has identified a joint visualization project. There have been several meetings and interactions between Dr. Ken Ball and Dr. Mark Pierson with ORNL researchers concerning both educational and research projects in nuclear energy. John Nemeth, vice president of Oak Ridge Associated Universities (ORAU), visited Virginia Tech during the fall and met with several faculty members and administrators who had interests in learning more about ORAU/ORNL opportunities. Blake Thompson, Director of University Partnerships, ORNL, visited Virginia Tech, and met with several Virginia Tech research groups (energy, physics, geosciences, research computing, and others). We are working with the ORNL Computational Science group to define programs that allow our researchers access to the computational facilities and support services of ORNL. The ORNL computational support services staff worked with our support services staff to successfully address a problem we were having running VASP on System X.

Internships, graduate research assistantships (GRAs) and post-doc positions. Although we have not developed or defined a formal Information Technology internship program, we have put in place an initial effort in research computing and visualization. We currently have two interns in research computing and visualization. Information Technology funded three GRAs for research computing and visualization. We were not able to fill any post-doc positions due to lack of funding for such positions.

User Advisory Board. The user advisory board was formed in April 2008. This group will provide guidance and input on the following topics:

1. Input on hardware
 - a. Requirements/expenditures
 - b. Compute systems (processors, memory, disk, interconnects)
 - c. Storage systems (latency, throughput, size, backups)
 - d. Grid infrastructure (applications, local/global access)
2. Input on software
 - a. General audience (queuing, compilers, debugging, parallel)
 - b. Narrow audience (domain specific packages)
3. Input on allocation of resources
 - a. Hardware (cycles)—Allocation Board
 - b. Software (floating licenses)
 - c. Personnel (time)
4. Input on allocation of funds
5. Acquisition of funds
 - a. Grants, contracts, lobbying

The first meeting was held Monday, April 21, 2008.

MidAtlantic Petascale Partnership—Virginia Tech, an HPC leader. In January 2008, we began discussions with the University of Maryland, Pennsylvania State University, Georgetown University, George Washington University, Johns Hopkins University, the University of Maryland and others to create an HPC consortium. We met several times during this period. One joint effort that was identified was to develop a National Science Foundation (NSF) Petascale proposal (Track 2d, Data Intensive Computing). On June 25, 2008, NSF announced an update (revision) for the Petascale Program that we had targeted. The revision led to our decision to target the data intensive component of the NSF Petascale program. After several meetings and discussions on the management of the joint proposal the group that has interest in the NSF center proposal is now down to the University of Michigan, Johns Hopkins University, and Virginia Tech.

HPC FDI course. For the Faculty Development Institute (FDI) 3-day workshop in June on parallel computing, Research Computing personnel prepared lectures with slides, sample programs, and lab sessions. This workshop was attended by about 20 faculty members.

2008 High Performance Computing Bootcamp. The next bootcamp will be held from July 27 to August 1. Research Computing personnel have been preparing lectures and writing programs for exercises for the afternoon lab sessions. Attendees will run programs on System X and the SGI systems. A reserved set of nodes will allow the students to get quick turnaround and work through all the exercises. We expect 60 people, roughly half from Virginia Tech, with sizable components from the University of Virginia and other Virginia institutions.

Research Computing Advisory Committee. The following individuals have agreed to serve on the Research Computing Advisory Committee

Nancy Ross, associate dean for the College of Science
Calvin Ribbens, associate head, Computer Science

Guy Cormier, chief information officer, VBI
David Bevan, the Department of Biochemistry
Glenda Scales, associate dean, College of Engineering

Research Computing continues to represent Information Technology as invited participants at workshops and conferences, in outreach activities, and through service to the university and to professional organizations.

Conferences

Supercomputing 2007—SC07. The Supercomputing Conference 2007 was held November 10–16 in Reno, Nevada. This is the premier conference on high performance computing and related technologies. Information Technology provided funding for the booth and for personnel to staff the booth. This year we had a 42-inch widescreen television for in-booth presentations and a four-screen visualization panel. Dell loaned the equipment to us for use at the conference.

Presentation were given by Ali Butt (Computer Science), Keith Bisset (Virginia Bio-Informatics), Kirk Cameron (Computer Science), Dimitrios Nikolopoulos (Computer Science), Nicholas Polys (Information Technology), and Wu Feng (Computer Science) on research conducted on Virginia Tech's computational resources.

In partnership with Argonne National Laboratory, Virginia Tech was selected to participate in the Storage Challenge 2007. The team was led by Wu Feng from the Department of Computer Science at Virginia Tech and Pavan Balaji from Argonne National Laboratory. The work was awarded first place in the Storage Challenge.

The Green-500 benchmarks were presented in our booth, attracting a large crowd.

Also this year, we had non-disclosure meetings with IBM, Sun Microsystems, SGI, DataDirect, and BlueArc Corporation.



Virginia Tech booth at Supercomputing 2007



Virginia Tech booth at Supercomputing 2007

HPC User Forum. The fall forum was held September 25–27, 2007, in Santa Fe, New Mexico. The panel “HPC at Major Universities” included Kevin Shinpaugh

At the April 14–16, 2008, meeting in Norfolk, Virginia, presentations included Wu-chun Feng on green computing and the Green 500. Also attended were Terry Herdman, Kevin Shinpaugh, and Mark Gardner.

Collaborations

Laboratory for Advanced Scientific Computing and Applications. Information Technology has continued to work with the Laboratory for Advanced Scientific Computing and Applications (LASCA) and has provided funds to support graduate research assistants. The LASCA graduate assistants work with Research Computing to provide resources to help resolve more complex issues for the users of System X.

Geosciences. Research Computing worked with two new faculty members in Geosciences, Ying Zhou and Scott King, to identify and configure hardware for a 96-node cluster. Research Computing would provide system and application administration of the cluster. The cluster would also be housed in the research computing area of the Andrews Information System Building's Data Center. In return for these services, the principal investigators (PIs) would allow Research Computing to offer 10% of the system and unused cycles to other researchers.

The cluster was purchased from Dell and was installed in August 2007. This cluster will have more than one-third of the computing power of System X.

Virtual computing laboratory. Research Computing is assisting Dr. Mark Gardner (Network Infrastructure and Services) and Professor Wu Feng (Computer Science) in developing a virtual computing laboratory (VCL) for Virginia Tech. The VCL will bring the advantages of server consolidation afforded by rapid advances in virtualization technologies to the greater university community by providing the faculty, the staff, and students with access to virtual computing environments customized for their specific needs.

The following scenario illustrates one way in which the VCL can provide the tools for enhanced learning opportunities at the university. The VCL staff works with a bioinformatics professor to create a customized virtual environment containing the specific software required for a class. The professor calls up the environment during a lecture to demonstrate how to infer the characteristics of an unknown protein by comparing it to all known sequences. Because the students are able to use the same virtual environment to follow along during the lecture, learning is enhanced. The students are better able to understand the lecture because they no longer have to wait until they get to the computer lab before they can try it for themselves. The same virtual environment is available on the machines in the computing labs during lab hours so they can broaden their understanding with help from the teaching assistants. Instead of being available only during lab hours, however, the virtual computing environment is also available 24 hours a day so students can continue working when it is convenient for them.

Among the expected benefits of the VCL is greater flexibility in providing specific tools to enhance learning, "any time, any where" access to the customized computing environments,

greater reliability and availability of the customized environments through centralized system administration, a potential for cost savings through centralized management and through higher utilization of computing resources due to consolidating the virtualized computing environments on fewer enterprise-grade physical servers.

Campus research computing meetings. Research Computing meets twice each year, spring and fall, with the campus research computing group. The group consists of faculty members and departmental support staff interested in research computing. Topics include:

- Planned changes/upgrades to current systems
- New equipment/software plans
- Discussion of concerns/issues of users
- Solicitation of for their input

American Society of Heating, Refrigerating and Air-Conditioning Engineers. Kevin Shinpaugh served as a voting member on the Technical Committee.

Acquisitions, upgrades, and new personnel

Viz 3d visualization wall. An immersive 3D stereo wall was purchased from Cyviz, headquartered in Richmond, Virginia, and installed in room 119 of the Andrews Information Systems Building. The system provides

- passive 3D stereo using polarization;
- high resolution, 1400 x 1050;
- high contrast, 2500:1;
- Linux or Windows based presentations;
- availability to faculty members and researchers.

Research computing website. In the summer of 2006, a committee was formed to evaluate the status of information available describing research computing at Virginia Tech and begin development of a new website to consolidate this information. The name "ARC," for "Advanced Research Computing" was selected.

Areas currently under development include the following:

1. Conversion of the "AIX Users Guide" into a generic "Unix Users Guide," applicable to all of the research computing systems
2. Updating the research pages with information to describe current research being performed using research computing resources
3. Updating the ARC webpages as new information and corrective feedback are received

Linux for System X. In an effort to improve reliability, software availability, and maintainability Research Computing has been exploring Linux on System X. The only truly supported Linux version for the Apple G5 Xserves is YellowDog Linux from Terra Soft Solutions. Demo licenses were secured and testing was performed on our 24-nodes test cluster.

In March, we negotiated a license for System X. The Research Computing staff had to port OpenIB drivers, OpenMPI, and MVAPICH to this Linux platform.

Currently 196 nodes are available to users of System X to port and test their programs on Linux. Our plan is to convert the majority of System X to Linux.

PlanetLab. PlanetLab is a global research network that supports the development of new network services. Since the beginning of 2003, more than 1,000 researchers at top academic institutions and industrial research labs have used PlanetLab to develop new technologies for distributed storage, network mapping, peer-to-peer systems, distributed hash tables, and query processing.

In January, Bill Marmagas and Bill Sydor registered to be Virginia Tech's PlanetLab technical contact and principal investigator respectively. PlanetLab summarizes these responsibilities: "The technical contact is the person we should contact when a node goes down or when an incident occurs; the principal investigator is the person who accepts responsibility for researchers at your site."

In March, we received word that the university's application to join the PlanetLab Consortium had been approved and on May 2nd, the Virginia Tech PlanetLab site was established. On May 4, Bill Marmagas completed the setup and configuration of the two nodes required for our participation in the program.

On June 13, we received word that Dr. Butt in the Department of Computer Science had signed up for a PlanetLab account. Later in June and in early July, we received word that Dimitris Krallis and NarcotiX SMP signed up for PlanetLab accounts.

Queuing software for research computing platforms. Research Computing negotiated a contract with Cluster Resources, Inc., for queuing and cluster management software to be used on our computational platforms. The Torque and Moab software products are used by the national supercomputing centers.

SGI network-attached storage. One of the biggest issues facing the users of the centrally provided compute resources is the lack of a common storage system. System X has also suffered from the lack of a high performance file system; most of our system refunds are due to the storage system failing to keep up under the high I/O load. Research Computing has been in discussion with some of the major high performance storage providers, seeking a workable solution.

The requirements for our storage solution include the following:

1. Sustain high I/O rate from 1200+ clients
2. High bandwidth for read and write operations: 2–3 GB/sec
3. Large initial storage size with Fiber Channel drives: 50+ TB
4. Long-term connectivity option with Infiniband

Based on our requirements and discussion with vendors, we choose SGI to provide the storage system. SGI was able to deliver the performance we required and was one-third the cost of the solutions offered by other vendors. The SGI storage system currently provides

- 53 TB of storage for /home directories;
- 12 Gigabit Ethernet and 2 Infiniband (IB) connections;
- NFSv4 with RDMA and future support for IB.

The storage system was made available to select user in September and to all System X users in June.

System X

System X is Virginia Tech's supercomputer that provides up to sixteen million CPU-hours per year for high-end scientific computing.

Hardware details

Compute nodes: 1100 Apple Xserve G5 cluster nodes (previously Power Mac G5s) with the following specifications:

- Dual 2.3 GHz PowerPC 970FX processors
- 4 GB ECC DDR400 (PC3200) RAM
- 80 GB S-ATA hard disk drive
- One Mellanox Cougar InfiniBand 4x HCA

Compile nodes: 3 Apple Xserve G5 nodes with the following specifications:

- Dual 2.3 GHz PowerPC 970FX processors
- 4 GB ECC DDR400 (PC3200) RAM
- 3x250 GB S-ATA hard disk drive

Network

Primary:

- 4 SilverStorm Technologies 9120 InfiniBand core switches
- 4X InfiniBand, 10 Gbps bidirectional port speed
- Each switch populated with 11 leaf modules and 3 spine modules
- Total 132 InfiniBand ports per core switch

64 SilverStorm Technologies 9024 InfiniBand leaf switches

- 4X InfiniBand, 10 Gbps bidirectional port speed
- Total 24 InfiniBand ports per leaf switch

InfiniBand fabric management by SilverStorm Technologies (formerly InfiniCon Systems)

Secondary:

6 Cisco Systems 240-port 4506 Gigabit Ethernet switches

Software

Operating system: Apple Mac OS X 10.3.9 and YellowDog Linux
 Message passing: MVAPICH
 Compilers: IBM XL Fortran for Mac OS X
 IBM XLC for Mac OS X
 gcc 3.3 for Mac OS X
 Queue and scheduler: Torque (OpenPBS)
 Moab (Maui)

Application software

AMBER	molecular dynamics
ARPREC	high-precision numerical methods
ARPS	weather modeling
CHARMM	molecular dynamics
FASTEST	fluid dynamics
GAMESS	quantum chemistry
Global Arrays	shared memory-programming interface
LAMMPS	molecular dynamics
METIS/ParMETIS	sparse matrix suite
mpiBLAST	mpiBLAST segments the BLAST database and distributes it across cluster nodes
NWChem	molecular dynamics
PETSc	partial differential equation suite
ScaLAPACK	dense and band matrix software
UPC	Unified Parallel C—C programming extensions
VASP *	molecular dynamics
VecLib	(BLAS, LAPACK, FFT, DSP)
WRF	weather modeling

Storage

Mobybits is a SGI NAS 4550 that provides approximately 50 TB of high performance storage for users' HOME directories. The storage is accessible to all Research Computing platforms. Mobybits is connected to the Data Center network by 12 one-gigabit Ethernet connections and additionally to System X by 2 single-data-rate InfiniBand links. Storage is shared to the other system using NFS-RDMA.

Allocation process and awards

The allocation policy is based on existing internal resource policies and those used for similar resources at other organizations. Simply put, users are asked to submit a modest proposal whose length and detail are dependent on the number of hours being requested. Allocations less than 10,000 hours are asked to describe their research and their resource needs (storage, CPU time, etc.) usually constituting less than a page of information. Users requesting 10,000 to 99,999

hours are asked for a research description, application(s) being used, parallel systems experience, and resource needs. These requests are anywhere from a full page to two pages in length. Users wishing to request 100,000 hours or more are asked for the same information as the previous category, but with more detail about the research, applications, and experience with parallel systems. These vary in length, usually two or more pages in length.

An allocation committee consisting of Cal Ribbens, Daniel Crawford (Chemistry) and Danesh Tafti (Mechanical Engineering) makes recommendations regarding allocations. Final allocation approval now falls to Terry Herdman, Associate Vice President for Research Computing.

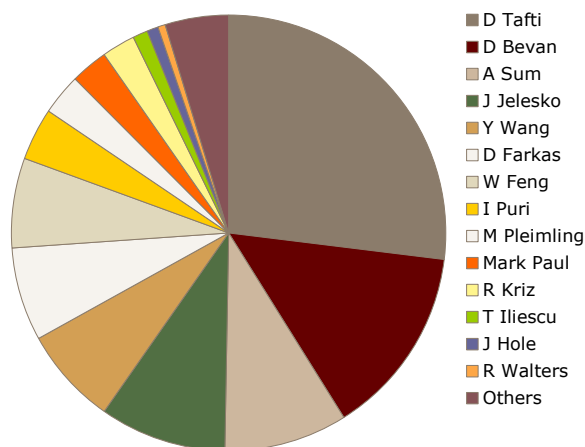
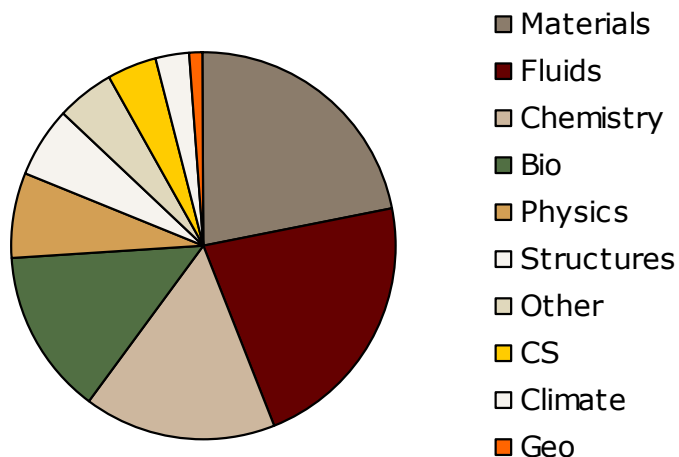
The table shows the distribution of total allocations through June 2007 by college and department. Through June 2007, over 25 million CPU-hours have been allocated and over 15 million CPU-hours have been used.

Cumulative allocations by principal investigator for System X

Name	College	Department	Hours
Amadeu Sum	COE	CHE	2684615
Andrew Duggleby	COE	ME	10000
Andrew Kurdila	COE	ME	9000
Beate Schmittmann	COS	PHYS	320000
Cal Ribbens	COE	CS	145000
Chris Wyatt	COE	ECE	30000
Christopher Roy	COE	AOE	200000
Clark Gaylord	VBI	VBI	10000
Clint Dancey	COE	ME	170000
Craig Mattocks		GEOS	5000
Danesh Tafti	COE	ME	7633000
Daniel Crawford	COS	CHEM	15000
David Bevan	COS	BIOCHEM	2754999
David Cox	COE	CHE	250000
Diana Farkas	COE	MSE	5345000
Diego Troya	COS	CHEM	100000
Donald Leo	COE	ME	20000
Ed Addison			5000
Elisa Sotelino	COE	CEE	384615
Gary Brown	COE	ECE	300000
Ge Wang	COE	BIOME	10000
Gene Cliff	COE	AOE	50000
Ina Hoeschele	VBI	VBI	14000
Ishwar Puri	COE	ESM	660000
Jacob Sewall	COS	GEO	133000
James McGrath	COS	CHEM	10000
James Turner	COS	MATH	90000
Jaroslav Sobieski		External	10000
Jean Peccoud	VBI	VBI	333333
Jeff Borggaard	COS	MATH	370000
Jianhua Xing	COS	BIO	50000
Joe Schetz	COE	AOE	50000
John Hole	COS	GEO	200000
John Jelesko	COS	PPWS	2400000
John Tyson	COS	BIO	510000

Joseph Wang	COE	AOE	55000
Ken Ball	COE	ME	510000
Kevin Shinpaugh		IT	105000
Khidir Hilu	COS	BIO	50000
Kirk Cameron	COE	CS	100000
Kyungwha Park	COS	PHYS	340000
Layne Watson	COE	CS	505000
Levon Asryan	COE	MSE	246154
Linbing Wang	COE	CEE	246154
Linsey Marr	COE	CEE	75000
Liqing Zhang	COE	CS	15385
Luke Achenie	COE	CHE	1000000
Madhav Marathe	VBI	VBI	100000
Manuel Bautista	COS	PHYS	100000
Mark Paul	COE	ME	984615
Mark Stremmler	COE	ESM	50000
Matthias Imhof	COS	GEO	120000
Michael von Spakovsky	COE	ME	20000
Michel Pleimling	COS	PHYS	1000000
Mike Cliff	BUS	FIN	10000
Naren Ramakrishnan	COE	CS	1200000
Nicholas Polys		IT	10000
Patrick Koelling	COE	ISE	2500
Robert Calloway		External	10000
Robert Clauer	COE	ECE	100000
Robert Karp	COS	PHYS	100000
Robert Walters	COE	AOE	200000
Roe-Hoan Yoon	COE	MME	100000
Romesh Batra	COE	ESM	500000
Ron Kriz	COE	ESM	750000
Sarah-Jane Frankland		External	25000
Scott King	COS	GEO	500000
Sean Corcoran	COE	MSE	212000
Srinidhi Varadarajan	COS	CS	200000
Sucheta Tripathy	VBI	VBI	10000
Suqin Ge	BUS	ECON	35000
Terry Herdman		IT	300000
Traian Iliescu	COS	MATH	200000
Uwe Tauber	COS	PHYS	200000
Wu Feng	COE	CS	1250000
Yilu Liu	COE	ECE	76000
Ying Zhou	COS	GEO	1000000
Yu Wang	COE	MSE	1758154
Zhijian (Jake) Tu	COS	BIOCHEM	100000
Total			40912524

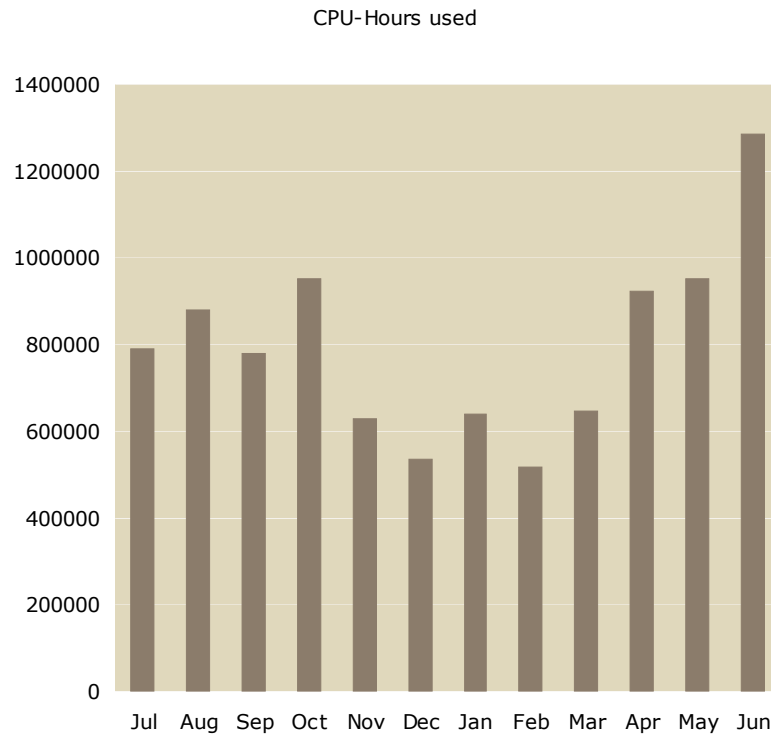
Allocation hours by discipline



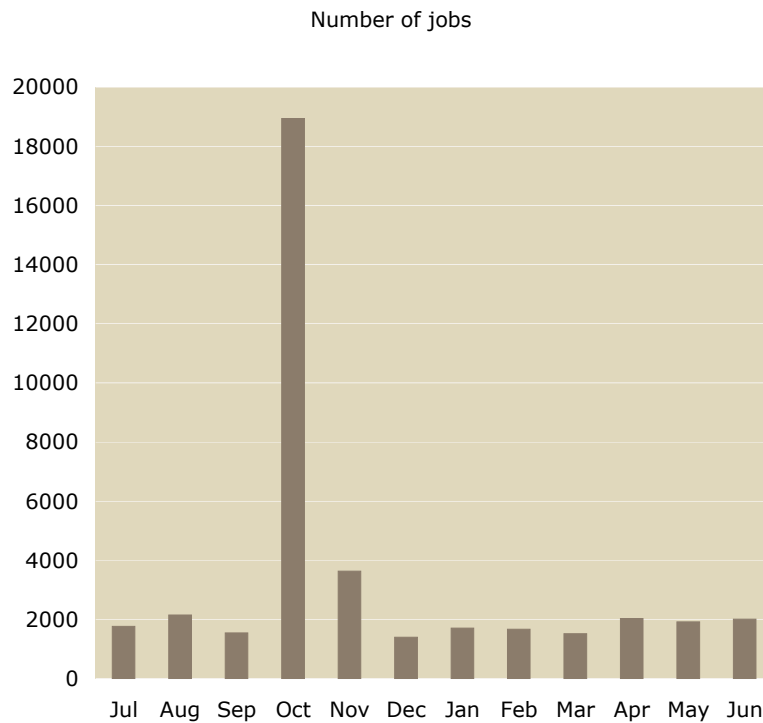
System X usage by PI for the 2007–2008 fiscal year

System utilization

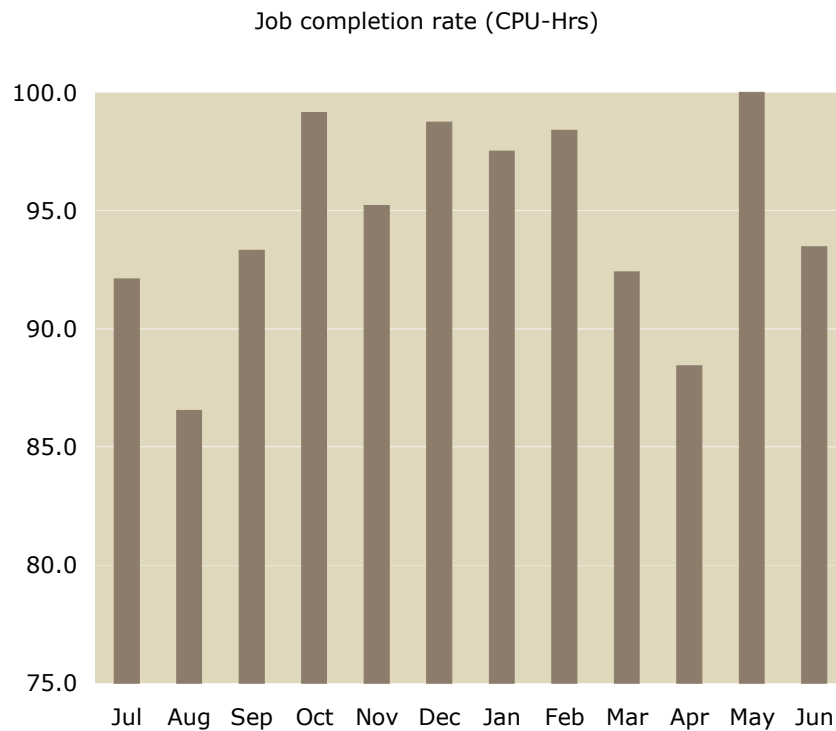
The following graphs and tables show how System X was being used during the production period from July 2007, to June 30, 2008. Utilization is generally highest in mid-semester and in the summer. The spike in the number of jobs in October reflects jobs needed for the Storage Challenge for SC08. The team was lead by Wu Feng from Computer Science at Virginia Tech and Pavan Balaji from Argonne National Laboratory. The work was awarded first place in the Storage Challenge.



Monthly CPU-hours used on System X



Monthly number of jobs submitted on System X



Percent of CPU-hours that resulted in successful jobs



Percent of jobs that resulted in successful jobs

SGI Systems

Virginia Tech's Research Computing currently operates three SGI Enterprise ALTIX 3700 Superclusters, which provide university researchers with access to high performance computing on SGI hardware.

Hostname	CPUs-speed	Memory	Operating system	Internal storage
inferno.cc.vt.edu	20-1.3 GHz	32 GB	SLES10—ProPack5	36 GB
inferno2.cc.vt.edu	128-1.6 GHz	512 GB	SLES9—ProPack4	72 GB
cauldron.arc.vt.edu	64-1.5 GHz	320 GB	SLES9—ProPack4	
charon1-3.arc.vt.edu	2-1.5 GHz	4 GB	SLES10—ProPack5	250

The Inferno systems contain Itanium processors, each with 3 MB cache, and the Cauldron system contains Itanium 2 CPUs, each with 4MB of cache. ch provides Virginia Tech researchers with access to high performance computing on an SGI hardware platform.

Note: Cauldron was purchased using by contributions from the Research Division, Information Technology, and the College of Science (the departments of Mathematics, Geosciences, and Chemistry, and principal investigators).

Charon1/2/3 are front-end systems that will serve as compile and job submission nodes for the bigger SGI systems.

Installed software applications. ABAQUS is a software application used for advanced finite element analysis (www.arc.vt.edu/arc/sgi/abaqus.php).

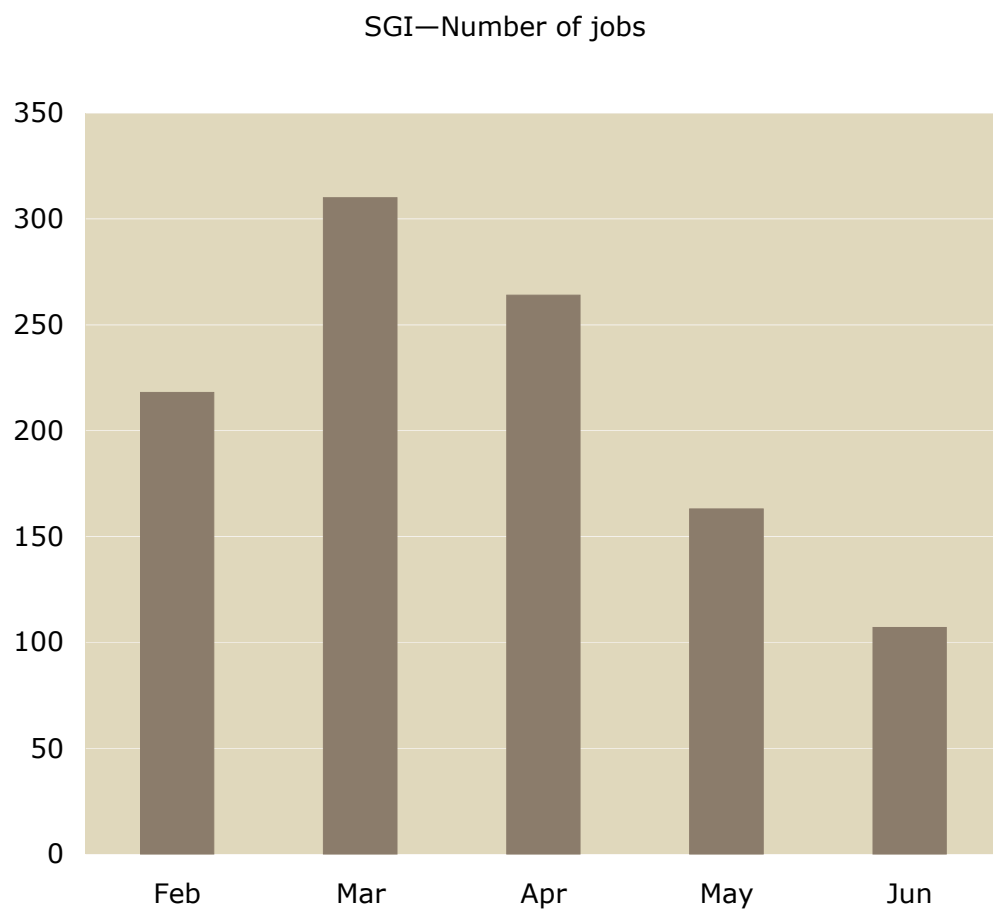
Mathematica provides an environment and collection of tools for visualization, computation, and mathematical analysis (www.arc.vt.edu/arc/sgi/mathematica.php).

Gaussian is an interconnected system of programs used for performing molecular orbital calculations. Gaussian 03 is now available for your use on Inferno (www.arc.vt.edu/arc/sgi/Gaussian.php).

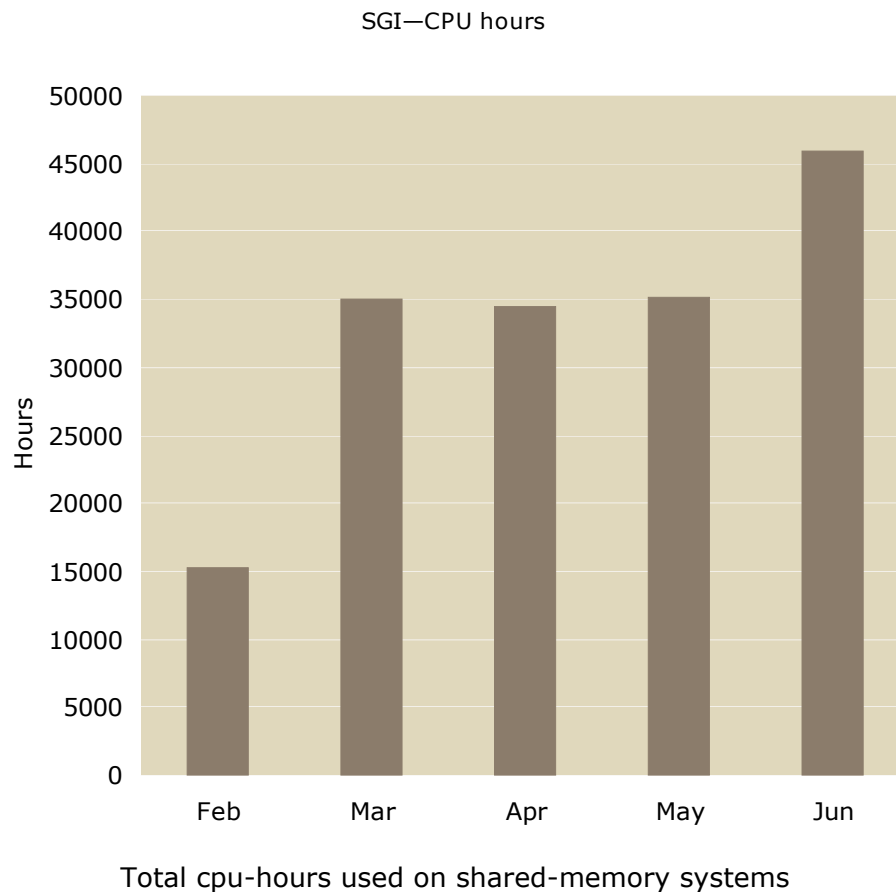
GASP AeroSoft's GASP (General Aerodynamic Simulation Program; version 4.2) has been ported to the SGI Altix platform and is available on Inferno (www.arc.vt.edu/arc/sgi/Gasp.php).

R provides tools for graphics and statistical analysis.

Utilization information for Inferno2, our 128-processor SGI Altix shared-memory system, is shown in the following figures. In general, the SGI machines are near-full utilization and are often over-subscribed. We have had requests from researchers for larger memory on these systems. Also, a queuing system will be integrated with these systems in September 2007.



Number of jobs run on shared-memory systems



Sun systems

Dante, a Sun Fire v480 system running Solaris 9, provides Virginia Tech researchers with access to high performance computing on a Sun Microsystems hardware platform and supports IMSL, SAS, MATLAB, and R which are not currently available on the compute server Inferno. The Dante system currently contains

- four 900 MHz CPUs;
- 16 GB memory;
- two 36 GB fiber-channel drives;
- external storage on the central network-attached storage.

Styx is a Sun Fire v490 system running Solaris 10 and provides researchers with access to high performance computing on a Sun Microsystems hardware platform and supports SAS, MATLAB, and R that are not currently available on the compute server Inferno.

- Four 1.5 GHz UltraSparc IV+ CPUs
- 16 GB memory

- Two 146 GB fiber-channel drives
- 1.5 TB external storage shared from Inferno

Installed software applications. MATLAB provides an environment and collection of tools for visualization, computation, and mathematical analysis (www.mathworks.com/products/).

SAS System Version 8 (<http://filebox.vt.edu/cc/sas/sas.html>) is a comprehensive collection of data analysis and report generation products produced by SAS Institute Inc. in Cary, North Carolina (www.sas.com/).

Gauss provides tools for mathematical and statistical analysis (www.aptech.com/).

R provides tools for graphics and statistical analysis (www.r-project.org/).

Costs

System	Hardware	Maintenance	Comments
System X	\$7,000,000	\$350,000	One time maintenance cost
Dante	\$24,000	\$2,520	
Styx	\$24,000		
Charon (s)	\$36,000		SGI head nodes
Inferno	\$150,000	\$20,205	
Inferno2	\$625,000	\$123,216	
Cauldron	\$150,000	\$62,943	
Spectra			Part of Cauldron purchase
Mobybits	\$375,000		
Discovery	\$2,500	\$810	

Software	License/maintenance
SAS	\$3,920
IMSL	\$6,800
SuSE/Propack	\$6,412
ClusterResources	\$12,500
Gaussian	
YellowDog Linux	\$12,500

Selected project summaries

System X

PI: Adrian Sandu, Computer Science

Allocation history: 5,000 (1/10/05), 300,000 (8/26/05)

Project title: High Resolution Atmospheric Simulations

Project description: developing algorithms and codes to model the physical and chemical processes that influence air quality over thousands of square miles.

PI: Diana Farkas, Materials Science and Engineering

Allocation history: 5,000 (1/10/05), 240,000 (2/11/05), 500,000 (10/18/05), 800,000 (2/16/06), 500,000 (5/29/07), 500,000 (9/3/08)

Project titles: Mechanical Behavior of Nanocrystalline Materials; Virtual mechanical testing of materials; compression of Au asperities on thin films; Modeling materials behavior under extreme environments

Project description: studying mechanical properties and deformation behavior of metals and alloys using atomistic simulations involving millions of atoms.

PI: Danesh Tafti, Mechanical Engineering

Allocation history: 5,000 (1/10/05), 20,000 (1/24/05), 608,000 (2/10/05), 500,000 (8/26/05), 500,000 (1/31/06), 500,000 (6/9/06), 750,000 (8/31/06), 750,000 (12/18/06), 1,000,000 (8/8/07), 1,000,000 (1/7/08), 2,000,000 (6/4/08)

Project titles: Advanced Cooling of Turbine Blades for Power and Propulsion; Simulation of Complex Turbulent Flow and Heat Transfer

Project description: developing algorithms and codes, and doing large-scale simulations, to study complex airflows and heat transfer in turbomachinery.

PI: Alexey Onufriev, Computer Science

Allocation history: 5,000 (1/10/05), 250,000 (6/7/05), 500,000 (6/18/07)

Project titles: Insights into the Primary Level of DNA Packing from Novel Computational Methods; Ligand Diffusion in Myoglobin

Project description: molecular dynamics simulations to study the details of DNA packing within the nucleosome.

PI: Joe Wang, Aerospace and Ocean Engineering

Allocation history: 5,000 (1/10/05), 50,000 (4/29/08)

Project title: Space Propulsion and Power

Project description:

PI: David Cox, Chemical Engineering

Allocation history: 50,000 (2/3/05), 200,000 (8/19/08)

Project title: Electronic Structure Calculations of Inorganic and Organic Systems

Project description: using first principles (density functional theory) methods to study the atomic arrangements and electronic structure of systems arising in surface chemistry, bulk minerals, and polymer composites.

PI: Sean Corcoran, Materials Science and Engineering

Allocation history: 20,000 (3/8/05), 192,000 (1/30/06)

Project title: Mechanical Behavior of Bicontinuous Nanoporous Gold

Project description: studying fracture mechanisms of nanoporous metals using atomistic simulations.

PI: Ken Ball, Mechanical Engineering

Allocation history: 10,000 (3/28/05), 200,000 (6/10/05), 200,000 (10/26/05), 100,000 (10/12/07)

Project titles: Direct Numerical Simulation of Turbulent Pipe Flow Drag Reduction through Spanwise Wall Oscillation; and Dynamic Eigenfunction Decomposition of Drag Reduced Wall-Oscillated Turbulent Pipe Flow; Drag Reduction in Turbulent Pipe Flow

Project description: using spectral-element code to study complex flows in pipes.

PI: Michael von Spakovsky, Mechanical Engineering

Allocation history: 20,000 (4/13/05)

Project title: Nano-/Meso-Scale Analytical/Numerical Modeling with Experimental Validation of Fuel Cell Membranes and Electrode/Catalyst Layers

Project description: developing new models of the complex interactions between gaseous mixtures and porous electrodes in fuel cells, using molecular dynamics and lattice Boltzmann methods.

PI: Ishwar Puri, Engineering Science and Mechanics

Allocation history: 50,000 (7/14/05), 70,000 (9/4/07), 100,000 (2/22/08)

Project title: Multiscale Simulations of Complex Fluids Flowing in the Presence of Electric and Magnetic Fields

Project description: using the lattice Boltzmann method to simulate multiphase multicomponent fluid flow, where the fluid contains solid microscale ferrous particles and where fluid-particle and inter-particle interactions are modeled.

PI: Ron Kriz, Engineering Science and Mechanics

Allocation history: 100,000 (9/6/05), 250,000 (5/24/06), 400,000 (6/18/07)

Project titles: Deformation Behavior of Gold Nano-Pyramids; Deformation Behavior of Nickel; Dynamic Nanoindentation of Thin Films

Project description: using atomistic simulations to study the response of gold and nickel nanoscale structures to compression.

PI: Naren Ramakrishnan, Computer Science

Allocation history: 100,000 (12/24/05), 500,000 (3/7/06), 500,000 (6/26/06)

Project title: Chemical Space Exploration

Project description: collaborating with the National Centre for Biological Sciences (NCBS, Banalore, India) on a project whose aim is to qualitatively and quantitatively characterize the chemical space of biologically plausible reaction systems. The work involves defining a basis set of chemical reactions, combining these reactions into stoichiometrically valid reaction networks, understanding the behavior of these systems by numerical solutions of systems of ODEs as well as enumerating their steady states via homotopy continuation methods, studying the stability properties of these steady states by linear system analysis, and organizing a database of reaction networks and their properties.

PI: Kirk Cameron, Computer Science
Allocation history: 100,000 (1/30/06)
Project title: Improving High-End System Effectiveness
Project description: computer science research on power-efficiency of applications and systems, performance measurement and analysis, and performance improvement of large-scale systems and applications.

PI: Gary Brown, Electrical and Computer Engineering
Allocation history: 300,000 (4/20/06)
Project title: Small Period Rough Surface Scattering
Project description: simulating electromagnetic scattering caused by rough surfaces such as sea foam.

PI: Christopher Wyatt, Electrical and Computer Engineering
Allocation history: 10,000 (5/24/06); 20,000 (6/25/08)
Project titles: Deformation Based Morphometry of Human and Non-Human Primate Brains; Study of Age-Related Brain Changes using Tensor Based Morphometry
Project description: developing algorithms and software in the area of computational neuroinformatics, focusing on image registration and segmentation to study variations in functional and structural properties of brains.

PI: Ali Nayfeh, Engineering Science and Mechanics
Allocation history: 100,000 (5/24/06)
Project title: Development of a Parallel 3-D CFD Code to Analyze Vortex-Induced Vibrations
Project description: developing codes to simulate fluid flow over a cylinder. The Reynolds-Averaged Navier-Stokes equations are discretized using finite differences. Results are used to develop reduced-order vortex-induced vibration models for offshore structures.

PI: Diana Farkas, Materials Science and Engineering
Allocation history: 500,000 (8/30/06)
Project title: Twin Structures in Metallic Nanowires
Project description: using LAMMPS to study nanocrystalline wires that generate so-called five fold twins, or star structures. The research question is at what size do such structures cease to form. This work is in collaboration with Sandia National Labs.

PI: Wu Feng, Computer Science
Allocation history: 250,000 (9/29/06)
Project title: Large-Scale Molecular Simulation of the Ribosome in Motion
Project description: extremely large-scale molecular simulation of the ribosome. Collaboration with Los Alamos National Laboratory.

PI: Ishwar Puri, Engineering Science and Mechanics
Allocation history: 40,000 (9/29/06), 200,000 (8/30/07), 200,000 (3/26/08)
Project titles: Molecular Dynamics Simulations of Transport inside Carbon Nanotubes; Molecular Dynamics Simulations for Research and Training; Molecular Dynamics Simulations for Investigation of Growth and Transport Phenomena at the Nanoscale.
Project description: using molecular dynamics (LAMMPS) to simulate fluid flow at the nanoscale, with focus on transport phenomena inside and around carbon nanotubes.

PI: Donald Leo, Mechanical Engineering
Allocation history: 20,000 (10/12/06)
Project title: Monte Carlo Simulation of Ion Transport of High Strain Ionomers

Project description: multiscale modeling of ionic polymer transducers, a device that exhibits coupling between the electrical and mechanical domains, i.e., applying voltage causes the device to bend, and when the device is suddenly bent, a voltage is produced.

PI: Mark Stremler, Engineering Science and Mechanics

Allocation history: 50,000 (11/3/06)

Project title: Computational Analysis of Mixing in Laminar Flows

Project description: studying transport and mixing in laminar flows – both theoretical properties and applications to problems such as lab-on-a-chip development, DNA analysis, and materials processing.

PI: Andrew Kurdila, Mechanical Engineering

Allocation history: 9,000 (11/3/06)

Project title: Morphing Wing Micro Air Vehicle

Project description: using FUN3D (unstructured Navier-Stokes flow solver) to model the aerodynamics of micro air vehicles with actuators that can be used to morph the wing surface.

PI: Patrick Koelling, Industrial and Systems Engineering

Allocation history: 2,500 (1/2/07)

Project title: Distributed Integer Program Solver

Project description: evaluating suitability of System X for solving integer and mixed-integer programming (optimization) problems.

PI: Yilu Liu, Electrical and Computer Engineering

Allocation history: 76,000 (1/23/07)

Project title: Massive US Power Grid Operation Data Analysis

Project description: analyzing massive data sets produced by a nationwide GPS/Internet based frequency-monitoring network.

PI: Linsey Marr, Civil and Environmental Engineering

Allocation history: 75,000 (3/19/07)

Project title: Air Quality Modeling with CMAQ

Project description: using the Community Multiscale Air Quality (CMAQ) model, which simulates atmospheric chemistry and transport to predict air pollutant concentrations, to develop a system that can support air quality management for the Shenandoah Valley.

PI: Naren Ramakrishnan, Computer Science

Allocation history: 100,000 (5/10/07)

Project title: Discovering the Neural Code

Project description: developing temporal data mining algorithms to mine massive time stamped datasets and applying these algorithms to datasets arising in functional neurobiology. This is a collaboration with General Motors Research.

PI: Andrew Duggleby, Mechanical Engineering

Allocation history: 10,000 (6/5/07)

Project title: Local Proper Orthogonal Decomposition of Subgrid Scale Near-Wall Turbulence

Project description: improving the accuracy of large eddy simulation (LES) of turbulent flows by using proper orthogonal decomposition of the near-wall turbulence computed by direct numerical simulation.

PI: Linbang Wang, Civil and Environmental Engineering

Allocation history: 80,000 (8/30/07)

Project title: Unified approach for Multiscale Characterization, Modeling, and Simulation for Stone-based Infrastructure Materials

Project description: large-scale molecular dynamics simulations to study the 3D microstructure of steon-based materials at multiple scales, from nano to centimeter.

PI: Roe-Hoan Yoon, Mining and Minerals Engineering

Allocation history: 100,000 (9/24/07)

Project title: Molecular dynamics simulation of water between thiolated gold surfaces.

Project description: molecular dynamics simulations to better understand hydrophobicity of minerals.

PI: Christopher Roy, Aerospace and Ocean Engineering

Allocation history: 200,000 (10/12/07)

Project title: Large CPU Allocation Request for Computational Fluid Dynamics Simulations.

Project description: various CFD-based investigations, including a study of numerical error in large-scale turbulence simulations and optimization of base drag for tractor-trailers.

PI: Clint Dancey, Civil and Environmental Engineering

Allocation history: 95,000 (12/10/07)

Project title: CFD Study of Turbulent Fluid-Sediment Interaction in Open-Channel Hydraulic Flows

Project description: CFD simulation (OpenFOAM) of fluid-sediment interaction in the context of river-way erosion.

PI: Ge Wang, Biomedical Engineering

Allocation history: 10,000 (12/10/07)

Project title: Theoretical Studies of the Spectral Shift in Luciferase Bioluminescence Caused by Mutation

Project description: molecular dynamics simulations (AMBER and CHARMM) used to study the bioluminescent behavior of fireflies.

PI: C. Robert Clauer, Electrical and Computer Engineering

Allocation history: 100,000 (12/21/07)

Project title: Space Plasma Simulation

Project description: investigating how solar activity affects Earth's electromagnetic and plasma environment, using the Space Weather Modeling Framework (SWMF).

PI: Romesh Batra, Engineering Science and Mechanics

Allocation history: 500,000 (2/18/08)

Project title: Characterization of plastic deformation in amorphous metals and grain boundaries by molecular dynamics (MD) simulations

Project description: using molecular dynamics code (LAMMPS) to study irreversible processes at grain boundaries in nano-crystalline metals and the nucleation and evolution of shear transformation zones in amorphous metals.

PI: Clint Dancey, Civil and Environmental Engineering

Allocation history: 75,000 (9/3/08)

Project title: High Resolution Simulation of Transitional Flow in a Mixing Vessel

Project description: CFD simulations to study fluid mixing in a Rushton Turbine research reactor (mixer)

PI: Amadeu Sum, Chemical Engineering

Allocation history: 384,615 (1/10/05), 800,000 (3/28/06), 1,500,000 (2/12/07)

Project titles: Probing the Interactions, Structure, and Dynamics of Phospholipid Bilayers for Drug Design and Biological Preservation; and Molecular Modeling of Biomolecular Systems and Complex Fluids

Project description: developing and applying molecular modeling methods to study the structure and dynamics of cell membranes and clathrate hydrates.

PI: Yu Wang, Materials Science and Engineering

Allocation history: 246,154 (1/10/05), 512,000 (6/24/07), 1,000,000 (1/29/08)

Project title: Computational Studies of Microstructure Evolution; Nanodomain Microstructures and Mechanisms for Advanced Physical Properties in Phase Transforming Materials

Project description: Meso-scale and nano-scale simulations of piezoelectric materials and phase transforming materials.

PI: Mark Paul, Mechanical Engineering

Allocation history: 384,615 (1/10/05), 600,000 (6/24/07)

Project title: Spatiotemporal Chaos and Nonlinear Dynamics of Fluids; Open Challenges in Spatiotemporal Chaos, Symmetry Breaking Bifurcations, and Nonlinear Dynamics at the Nanoscale

Project description: using partial differential equations and spectral solution methods to model the complex spatiotemporal dynamics of fluids at macroscopic and microscopic scales.

PI: Levon Asryan, Materials Science and Engineering

Allocation history: 246,154 (1/10/05)

Project title: Computational Materials Science

Project description: first principles simulations of semiconductor materials and devices. nano- and microelectronics, optoelectronics and photonics.

PI: Elisa Sotelino, Civil and Environmental Engineering

Allocation history: 384,615 (1/10/05)

Project title: Computational Structural Dynamics

Project description: nonlinear finite element analysis of structural properties of steel/concrete systems.

PI: Luke Achenie, Chemical Engineering

Allocation history: 1,000,000 (7/26/07)

Project title: Multi-Scale Modeling of Selected CVD Processes

Project description: studying the chemical vapor deposition (CVD) growth of zinc sulfide and carbon nanotubes.

PI: Layne Watson, Computer Science

Allocation history: 5,000 (1/10/05), 200,000 (4/12/05), 300,000 (6/10/05)

Project titles: Global/Local Algorithms for Composite Material Structural Design; and Eukaryotic Cell Cycle Modeling

Project description: developing algorithms and software, and doing large-scale simulations, in support of two applications: structural analysis and design of aircraft wings made from composite materials, and differential equation based modeling of the cell cycle of budding yeast.

PI: Cal Ribbens, Computer Science

Allocation history: 5,000 (1/10/05), 100,000 (5/13/05)

Project title: Tools and Algorithms for Improving Performance and Utilization on Terascale Clusters

Project description: developing algorithms and software to improve performance of individual codes, and the utilization of entire clusters, by exploiting common characteristics of large-scale simulations.

PI: David Bevan, Biochemistry

Allocation history: 5,000 (1/10/05), 99,999 (3/23/05), 200,000 (1/24/07), 200,000 (6/5/07), 750,000 (10/11/07), 750,000 (4/25/08), 750,000 (9/1/08)

Project titles: Computational Studies of Protein Structure and Function; Molecular Modeling of Protein Structure and Dynamics <http://128.173.49.4/tcfalloc/downloadfile.php?resID=12>

Project description: molecular dynamics simulations to allow atomic-level analysis of protein structural features.

PI: John Tyson, Biology

Allocation history: 10,000 (6/10/05), 500,000 (4/29/08)

Project titles: Benchmarking of Electrostatic Interactions in Biomolecular Systems; Stochastic Models of Cell Cycle Regulation

Project description: testing the performance of molecular dynamics codes used to simulate the properties of cellular membranes; and developing and applying high-performance codes for cell cycle modeling.

PI: Uwe Tauber, Physics

Allocation history: 200,000 (6/10/05)

Project title: Vortex Motion in Anisotropic Type II Superconductors

Project description: using nonequilibrium Monte Carlo Metropolis simulations to study properties of superconductors containing defects.

PI: Kyungwha Park, Physics

Allocation history: 340,000 (9/22/05)

Project title: Computational Study of Magnetic and Transport Properties of Molecular Nanomagnets and Related Systems

Project description: studying magnetic and electronic structure properties of nanomagnets using density functional theory (DFT) quantum mechanics. Potential applications include ultra-high density storage devices and single-molecule electronic devices.

PI: Ina Hoeschele, Virginia Bioinformatics Institute

Allocation history: 9,000 (2/23/06), 5,000 (1/8/07)

Project title: Evaluation of the statistical properties of multivariate estimation of genetic parameters for categorical, continuous, and molecular genetic data with application to radiographic findings in the limbs of horses; Selection for QTL traits using multivariate prediction of breeding values in mixed-linear-threshold models for phenotype and genotype data with Gibbs sampling

Project description: using multivariate linear-threshold models and Gibbs sampling to study multivariate estimation procedures used to guide genetic evaluation and selection schemes for the horse industry.

PI: Jean Peccoud, Virginia Bioinformatics Institute

Allocation history: 333,333 (9/11/06)

Project title: Caligene: A Computing Infrastructure to Calibrate Genetic Parts

Project description: building computational tools to estimate the kinetic parameters of DNA fragments combined in vitro to assemble large synthetic DNA molecules. System X will be

used for the large-scale stochastic optimization aspect of this work. The project is a collaboration with UIUC.

PI: Suqin Ge, Economics

Allocation history: 10,000 (9/27/06), 25,000 (12/21/06)

Project title: The College, Employment, and Marriage Decisions of Young Women

Project description: investigating college attendance, labor supply, and marital status decisions of high school females. The computations involve parameter estimation for economic models and the solution of dynamic programming problems.

PI: Mike Cliff, Finance, Insurance, and Business Law

Allocation history: 10,000 (6/18/07)

Project title: Comparison of Daytime and Nighttime Stock Returns

Project description: examining the statistical properties of high-frequency stock returns.

PI: Jianhua Xing, Biological Sciences

Allocation history: 50,000 (12/10/07)

Project title: Internal dynamics of the hammerhead ribozyme

Project description: molecular dynamics (AMBER) simulation of the nonequilibrium dynamics of the hammerhead ribozyme

PI: Diana Farkas, Materials Science and Engineering

Allocation history: 1,000,000 (6/13/06), 800,000 (1/23/07), 500,000 (6/25/08)

Project titles: Supersonic Dislocations; Dislocation dynamics in Fe-Cr alloys; Dislocation motion in Cu

Project description: collaborating with colleagues at LLNL to try to answer an old issue in materials science—whether dislocations (agents of plastic deformation) in metals actually travel faster than the speed of sound.

PI: Scott King, Geosciences

Allocation history: 500,000 (6/24/07)

Project title: Mantle Convection on Mercury and Mars

Project description: using a finite element code for creeping viscous flow to study mantle convection on nearby planets.

PI: Matthias Imhof, Geosciences

Allocation history: 5,000 (1/10/05), 100,000 (11/3/05), 15,000 (12/6/06)

Project title: Preparing the Next Generation Synthetic Seismic Research Dataset; and Quantitative Stratigraphic Inversion

Project description: developing models and codes as part of a consortium (led by the Society of Exploration Geophysicists) to do full 3-dimensional seismic simulations, with applications in oil and gas recovery. Also studying quantitative stratigraphy that predicts the geometry and petrophysical properties of geologic strata using mathematical models of geological processes.

PI: T. Daniel Crawford, Chemistry

Allocation history: 5,000 (1/10/05), 10,000 (9/7/06)

Project title: Development of Parallel Quantum Chemistry Programs for the Properties of Large Molecules

Project description: developing a suite of parallel codes (PSI3, www.psicode.org) to do first-principles simulation of chemistry, including molecular structure, spectroscopy, thermodynamics, and reactions.

PI: Diego Troya, Chemistry

Allocation history: 100,000 (4/5/05)

Project title: Benchmark Electronic-Structure Calculations for Accurate Molecular Dynamics Studies

Project description: doing highly accurate quantum mechanical simulations of chemical reactions, to help develop and validate molecular dynamics approximations to these processes, with applications in atmospheric chemistry and combustion.

PI: Beate Schmittmann, Physics

Allocation history: 250,000 (4/18/05)

Project title: Transport in Quasi One-Dimensional Models

Project description: studying fundamental questions in non-equilibrium statistical mechanics using one-dimensional transport models. Applications include molecular motor processing and vehicular or pedestrian traffic.

PI: Beate Schmittmann, Physics

Allocation history: 70,000 (5/6/05)

Project title: Phase Transitions in Two-Species Model

Project description: using Monte-Carlo techniques to study problems in non-equilibrium thermo-dynamics and driven diffusive systems.

PI: Robert Walters, Aerospace and Ocean Engineering

Allocation history: 100,000 (8/26/05)

Project title: Stochastic CFD Simulations of Complex Aerodynamic Flows

Project description: using computational fluid dynamics simulations to model realistic, complex aerodynamics problems. Stochastic approach requires many runs to study the sensitivity of the models to problem parameters.

PI: Madhav Marathe, VBI

Allocation history: 100,000 (10/17/05)

Project title: Epidemiological Modeling

Project description: developing models and software to simulate information diffusion in large populations, with current application to modeling the spread of infectious diseases.

PI: Joseph Schetz, Aerospace and Ocean Engineering

Allocation history: 50,000 (12/6/05)

Project title: Detached Eddy Simulations of Scramjet Engines

Project description: using computational fluid dynamics simulations to study the highly unsteady and turbulent flow inside the combustion chamber of Scramjet engines.

PI: Clark Gaylord, Virginia Bioinformatics Institute

Allocation history: 10,000 (11/3/06)

Project title: VBI Core Computation Support

Project description: supports exploratory work of information technology personnel in VBI.

PI: Traian Iliescu, Mathematics

Allocation history: 200,000 (2/12/07)

Project title: Direct Numerical Simulation of Stratified Mixing in a 3-D Dam-Break Problem

Project description: studying large-eddy simulation (LES) models of oceanic mixing processes using the nonhydrostatic high-order spectral element code Nek5000.

PI: James McGrath, Chemistry

Allocation history: 10,000 (3/29/07)

Project title: Molecular Dynamics Simulations of BPSH-35
Project description: using molecular dynamics (GROMACS) to study structural and dynamic properties of the hydrated DPSH-35 copolymer, a material that can function as a proton exchange membrane in fuel cells.

PI: John Hole, Geosciences
Allocation history: 200,000 (5/10/07)
Project title: Imaging Fault Zone Structure Using Seismic Guided Waves
Project description: modeling 3-D elastic wave propagation and trapping in fault zones.

PI: Jacob Sewall, Geosciences
Allocation history: 8,000 (6/5/07), 50,000 (6/25/08)
Project titles: Porting the NCAR Community Climate System Model v3 (CCSM3) to System X; Reconstructing Eocene Arctic conditions during the Azolla event using proxy and model data
Project description: investigating suitability of System X as platform for widely used general circulation mode (GCM); and applying the Community Atmosphere Model v. 3 (CAM3) to make a quantitative reconstruction of Eocene Arctic sea surface salinity.

PI: John Jelesko, Plant Pathology, Physiology and Weed Science
Allocation history: 100,000 (7/12/07), 2,300,000 (2/18/08)
Project title: Analyzing the impact of horizontal gene transfer in the evolution of the plant genome and metabolome
Project description: using molecular evolution programs to identify extant plant genes that may have originated from bacteria.

PI: Sucheta Tripathy, Virginia Bioinformatics Institute
Allocation history: 10,000 (7/19/07)
Project title: Peronospora sequence jamboree
Project description: using BLAST to do a first-pass machine annotation of the newly sequenced peronospora genome.

PI: Gene Cliff, ICAM
Allocation history: 50,000 (9/28/07)
Project title: Modeling energy flow in a thin-walled cylinder
Project description: model development (ODEs and PDEs) and parameter identification for thermal transients in a thin-walled cylinder

PI: Jacob Sewall, Geosciences
Allocation history: 25,000 (4/18/08), 50,000 (8/18/08)
Project title: Climate of southwestern North America during the Little Ice Age and the sensitivity of precipitation patterns to changes in Arctic sea ice.
Project description: using NCAR CAM3 code to model the sensitivity of storm tracks in the northern hemisphere to the greater sea ice extent during the little ice age (1350-1850 AD).

PI: James Turner, Mathematics
Allocation history: 90,000 (6/4/08)
Project title: Modeling drug delivery to the human brain
Project description: using Diffpack to simulate and study the effectiveness of different infusion parameters on drug penetration depth.

PI: Robert Karp, Physics
Allocation history: 100,000 (6/25/08)

Project title: Numerical Predictions from String Theory
Project description: using Monte Carlo methods and non-linear PDE solvers to pursue a connection between string theory and the real world.

PI: Khidir Hilu, Biological Sciences
Allocation history: 50,000 (8/19/08)
Project title: Assembling the Tree of Life for flowering plants
Project description: Using Mr. Bayes to use sequence information from gene and genomes of flowering plants to assess species biodiversity and extract evolutionary history.

PI: Manuel Bautista, Physics
Allocation history: 100,000 (9/16/08)
Project title: Large-scale RMATRIX computations for iron-peak elements
Project description: modeling the spectra of active galactic nuclei.

PI: Zhijian (Jake) Tu, Biochemistry
Allocation history: 100,000 (9/16/08)
Project title: Whole-genome comparisons of transposable elements (TEs) in mosquito genome
Project description: using MPIBlast to sequence a few mosquito genomes that carry infectious diseases such as malaria and dengue fever.

PI: Michael Pleimling, Physics
Allocation history: 1,000,000 (11/22/06)
Project title: Aging Processes Far From Equilibrium
Project description: new faculty startup allocation.

PI: Ying Zhou, Geosciences
Allocation history: 1,000,000 (1/2/07)
Project title: High Resolution Mantle Structure Based on 3-D Wave Propagation
Project description: using spectral element method to carry out simulations of surface waves to study the earth's upper mantle and body waves to study the earth's core-mantle boundary.

Shared-memory systems

Name: David Bevan
Department: Biochemistry
Research abstract: Projects in my lab apply computational methods to simulate the structure and dynamics of proteins and nucleic acids. Much of our current work involves studies of beta-glucosidases. In particular, we are trying to understand the determinants of substrate specificity in these enzymes using homology modeling, molecular dynamics, and molecular docking. These methods also are being applied to investigate the mechanism of inhibition of Eg5, a human kinesin motor protein involved in mitosis. Of particular interest is identifying potent inhibitors that might be potential drug candidates as anti-cancer agents.

Name: David F. Cox
Department: Chemical Engineering
Research abstract: Electronic Structure Calculations of Inorganic Clusters, Surfaces and Defects Density functional theory is used to investigate the electronic structure of large-

scale (> 150 atom) inorganic systems. The bonding in inorganic systems, and the electronic structure associated sites of potential electrophilic and nucleophilic attack are detailed by examining the spatial characteristics of the valence electron charge density, and the Electron Localization Function (ELF). We are investigating the electronic and chemical differences between the bonding of protons around bulk and surface point defects, and the electronic structure of semiconducting nanoparticles. The investigation of point defect properties requires large-scale systems to isolate the defect in our periodic DFT calculations.

Name: Vijay Singal

Department: Finance

Research abstract: Continuing research work with large financial databases. My research spans three areas: Anomalies related to market efficiency, International finance (currencies, emerging markets, ADRs, and investments), and resolving finance-related issues using data from one industry but from both financial and product markets.

Name: David Notter

Department: Animal and Poultry Sciences

Research abstract: Research is being conducted on genetic evaluation of livestock using data from the U.S. National Sheep Improvement Program. The objectives of the research are to develop methodology for simultaneous genetic evaluation of large numbers of breeding animals on many farms across the U.S. and to provide U.S. sheep breeders with estimates of the genetic merit of their animals for economically important traits.

Name: Gertraude Freyer

Department: Dairy Science

Research abstract: Further Investigations on Inbreeding in Dairy Cattle

The negative consequences of inbreeding on fitness and related traits is known. Many investigations led to and increased understanding in detail. In animal breeding, the use of reproductive technologies and statistical approaches made a directed selection efficient. Recent studies (e.g. Cassel, Adamec and Pearson, 2003 in JDS 2967-2983) focused on maternal and fetal inbreeding depression for fertility and calving traits in Holsteins and Jersey, and on the effect of incomplete pedigrees on estimates of inbreeding and inbreeding depression on milk traits. This was a population analysis. A next step will be testing and adapting a new method including genetic markers to make inferences about inbreeding and their effects on complexes of traits.

Name: Quinton Nottingham

Department: Business Information Technology

Research abstract: Managers of all types of business processes are interested in both monitoring and controlling the behavior of those processes. One typical reason for closely monitoring the behavior of a process is to determine the expected quality of the finished product, based upon the measured values of intermediate process variables. This research presents a framework for a data driven nonparametric process classification tool that allows managers to predict the classification of a finished product as "acceptable", "unacceptable", or "inconclusive", based on operating conditions of the process at different phases.

Name: Christine Blinn

Department: Forestry

Research abstract: Increasing the Precision of Forest Area Estimates through Improved Sampling for Nearest Neighbor Satellite Image Classification The impact of changes in training data sample size and sampling method on the overall classification accuracy and precision of forest area estimates obtained from forest/non-forest satellite image classifications will be explored. Simulation techniques will be used to create distributions of

classification accuracy, forest area estimates and precision of forest area estimates from one hundred image classifications created with training data sample sizes ranging from 25 to 500 pixels. A simple minimum distance to means classification with single pixel training will be used to create forest/non-forest classifications of three mosaicked Landsat ETM+ images covering a majority of Virginia.

Name: Greg Hensley

Department: Civil Engineering

Research abstract: The purpose of this research is to examine the dynamic behavior of guyed towers utilizing synthetic ropes. It is part of a National Science Foundation Grant designed to investigate the potential use of synthetic ropes to dissipate energy in structures. These synthetic ropes as the guy wires in guyed towers. The focus is to examine the theoretical behavior under seismic load, and the research primarily consists of computer modeling with the finite element program, ABAQUS.

Name: Florian Bleibinhaus

Department: Geosciences

Research abstract: A seismic 2D survey across the San Andreas Fault (SAF) near Parkfield provides a characterization of the subsurface structure at the location of the San Andreas Fault Observatory at Depth (SAFOD). 4 GB of acoustic wavefield recordings are inverted for a 2D model of the complex acoustic velocity/damping structure using a method after Pratt (1999). The most expensive part of the non-linear iterative inversion procedure is the FD forward modelling of the wavefield in the frequency-space domain. The optimization of parameters controlling the inversion requires that this process be repeated several times.

Name: Landon Sego

Department: Statistics

Research abstract: Continuously monitoring a small incidence rate a number of methods have been proposed to detect an increasing shift in the incidence rate of a rare health event, such as a congenital malformation. We compare the performance of the Sets technique and its modifications to the Bernoulli CUSUM chart under a variety of circumstances.

Name: Uros Tasic

Department: Chemistry

Research abstract: Polymer films acting as thermal blankets of spacecrafts operating in low-Earth orbit (200–700 km altitude) erode under the action of highly oxidizing environment of that region of space. Our research is aimed at providing molecular insight into degradation mechanisms of polymers coating satellites and spacecrafts through high-energy collisions with the gaseous species of the natural low-Earth orbit atmosphere.

Visual Computing Group

High Performance Computing Bootcamp. Throughout the spring, Research Computing worked closely with colleagues at the University of Virginia to organize the second intensive course on parallel computation and visualization skills for Virginia researchers. The bootcamp addresses a pressing need to educate researchers in the skills needed to exploit high-performance computing resources such as System X. This collaboration between the Information Technology

and Computer Science personnel of the two institutions is a significant positive development and promises to improve the capabilities of many faculty members and graduate students.

In 2008, the six-day workshop was held July 28 through August 2 in Torgersen Hall with over 65 participants attending from all over the commonwealth. Faculty members and graduate students had lecture and hands-on sessions, which gave them the skills to address the computational science and engineering problems that require high performance: how to run faster, complete sooner, and tackle problems previously thought too computationally difficult. The sessions were taught by Dr. Nicholas Polys, Dr. John Burkardt, and Dr. Cal Ribbens (CS); select meals were underwritten by SGI, Sun Microsystems, and IBM.

Visualization. The Visual Computing Group has continued to support a wide range of faculty members, students, and community activities in research, education, outreach. Through our support efforts in Torgersen and around campus, we have provided software and facilities for a wide range of faculty research projects—evaluation of novel visualization techniques, new tracking methodologies, physical simulation, autonomous vehicle design and simulation, geo-mapping, and mine safety training just to name a few. We continue to engage and deliver visual communications solutions for the many disciplines around campus.

Multiple class projects and graduate researchers have kept the labs buzzing and productive; in addition, the undergraduate interns and researchers are producing improved visualization test beds and systems. There are, however, some limitations to the aging equipment and we continue to pursue internal and external funding sources to upgrade the VT CAVE to a more modern, capable and compelling ‘Visionarium.’

Mission

The mission of the Visual Computing Group is to undertake the following activities:

- Provide education, outreach, and consulting to faculty members and researchers regarding the value of visualization and HPC for their research (for example, workshops and colloquia)
- Provide expert staff to
 - consult with researchers and educators about applications of HPC and visualization technology;
 - develop visualization tools and collaborative infrastructure for domain experts and HPC users;
 - develop additional grants and funding streams with domain experts to include visualization tools and HPC;
- Continue a robust research program in human-computer interaction (HCI) and information architectures
- Provide world-class visualization facilities for university researchers

Initially, the group has worked with the university’s computational scientists to devise and deliver solutions for scientific visual analysis. This effort has led to a number of grant proposals

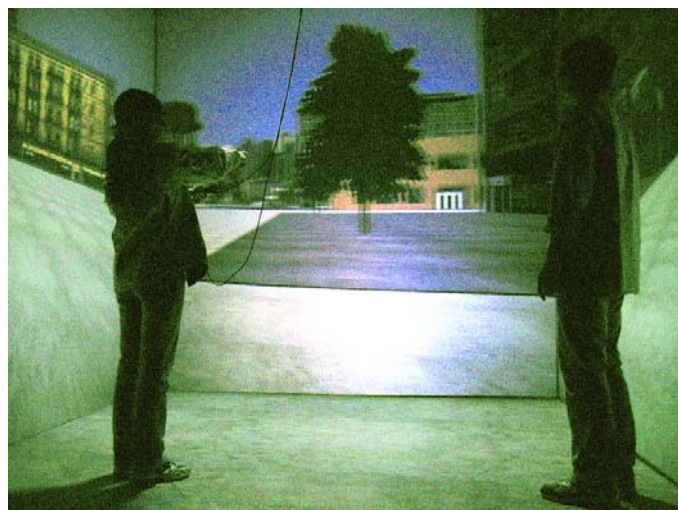
to fund post-docs who will continue to develop domain-specific applications. The CAVE will continue to serve as the flagship immersive venue on campus. The deployment of stereo walls around campus will increase faculty and student access to these visualization tools and computing resources. The group will collaborate with the Department of Computer Science and the Center for Human-Computer Interaction to design and evaluate these initial projects.

In the interest of connecting desktops, the CAVE, satellite sites, and HPC resources, the group will continue to the development of open-source solutions for information management, delivery, and visualization. This development includes informatics gateways and lab management software as well as visualization components and Web services for individual or collaborative use. The group will actively participate in the development of international standards—International Organization for Standardization (ISO), Web3D, World Wide Web Consortium (W3C), Digital Imaging and Communications in Medicine (DICOM), Open Geospatial Consortium (OGC)—for networked 3D graphics and visualization systems, further establishing Virginia Tech as a leader in visual computing technology.

Visual computing

Across domains, researchers, engineers, and designers are faced with large volumes of data that are heterogeneous in nature. While computers can provide excellent memory and computational prostheses for solving complex problems, they are unable to match the human's abilities for pattern-recognition, creative reasoning, and insight. It is imperative that next-generation interfaces leverage the strengths of the human operator to create useful and economical tools for analysis and decision-making. In order to investigate and communicate complex phenomenon in science and education, visual computing is essential.

“Visual computing is computing that lets you interact with and control work by manipulating visual images either as direct work objects or as objects representing other objects that are not necessarily visual themselves” (www.whatis.com). Visual computing tools facilitate analytical reasoning on large heterogeneous data sets through interactive visual interfaces. Visual computing tools include graphical user interfaces, virtual environments, information visualization, and augmented reality. Such tools are also known as visual analytics tools and complement data-mining and statistical as well as high-performance computing systems such as simulation and numeric computation.



Visual computing research activities include visualization, computer graphics, image processing, medical imaging, virtual reality, user interfaces, computer-supported collaborative work, computer-aided design, multimedia, and computational geometry, as well as numerous applications of these areas. The Visual Computing Group provides the dedicated staff and infrastructure support required to fully realize the potential of visual tools for computational science and education at Virginia Tech.

The group represents an important element of advancing university leadership in research and education through visual communication. Through faculty and graduate education and development support, Visual Computing enables more productive scientists and more competitive researchers. We continue to proliferate visual computing solutions around colleges and classrooms. The Visual Computing Group anchors university efforts to maintain visual computing as a core competency and world-class resource of Virginia Tech.

Capabilities and services

VT-CAVE. The VT-CAVE is a large-scale immersive virtual reality facility driven by open-source software on a Linux cluster. The VT-CAVE consists of three back-projected 10' x 10' walls and one floor where 1280x1024 active stereo images are rendered. The CAVE system provides a unique capability for surround, presence, and embodied (natural) interaction. Head and interface tracking is accomplished with a high-accuracy, low-latency ultrasound Intersense IS-900 VET tracking system. In addition, a Moog, Inc. motion platform embedded into the floor of the CAVE provides a 6-degree-of-freedom hydraulic floor frame that can be synchronized with the CAVE graphics system.

Stereo walls. Research Computing administers a number of large format, non-surround stereo visualization venues in Torgersen Hall and Andrews Information Systems Building. Both are bright DLP projectors projecting 1440 x 1050 pixels at 6' x 8' large. In the Torgersen lab, there is the Fakespace ROVR system, which is back-projected, has active stereo and head and input tracking via an Intersense IS-900. In Andrews, the CyViz Vis3D passive stereo projection system is front-projected in a conference room.

Torgersen lab. A number of Linux, Mac, and Windows workstations are available for use in Torgersen 3050. These workstations provide the all programs in the Visual Computing software stack as well as licensed seats of commercial software. For example, Okino's PolyTrans/NuGraf system provides a wide variety of file conversions and 3D Studio Max provides advanced modeling and rendering capabilities.

Support

The twenty-first century has opened a new paradigm for science and research. With the increase in affordable technology, the computational sciences are contributing more and more to our understanding of the world around us. This trend impacts many fields and adoption must be fostered with hardware and software infrastructure as well as education and training. The software stack supported by the Visual Computing Group has continued to expand with better support for data from art, architecture, fluid dynamics, CAD, and geospatial domains.

Specific, high-impact projects were also targeted to demonstrate the technology and value of visual computing in the research enterprise. Through a series of project-consultations and development, the Visual Computing team has delivered solutions for cutting-edge computational scientists in domains as varied as molecular dynamics to space energetics to spatial statistics analysis.

Through consultation and project development, we have provided expertise and solutions for projects in the following departments: Computer Science, Mathematics, Physics, Biochemistry, GeoSciences, Building Construction, Architecture, and Art and Art History. We have also provided expertise to graduate students and their projects from Computer Science, Civil Engineering, Mechanical Engineering, Materials Science and Engineering, and Engineering Science and Mechanics. Student groups such as IEEE have also capitalized on access to the facilities.

Our initial successes provide guidance as to how we may meet the multiple requirements of world-class research, education, and outreach. Transferring technology insights from computer science and HCI research into applied solutions for scientists, students, and citizens. We hope to forge stronger partnerships and networks of support within the university, the commonwealth, and national agencies. With the common goals of enabling knowledge and discovery, Visual Computing will continue to advance the program and grow the vibrant and innovative environments of next-generation communication. The future of visualization at Virginia Tech depends sustained commitment from the community and the administration for personnel, equipment, and software resources.

Education

Faculty Development Institute courses

Deep Media for Research and Education. Dr. Nicholas Polys taught this seven-session course on the production and deployment of Deep Media. "Deep Media" refers to interactive 3D virtual spaces that may include rich media types such as images, sound, video and animation. Attendees critically examine the features and methods of different publishing approaches and will leave

with the knowledge and skills to translate and publish their content in next-generation information spaces.

Parallel Programming. Dr. John Burkardt taught this course on OpenMP and MPI programming for HPC research machines.

Strengthening Your Grant Proposal II: Adding High-Quality Computer Visualization. With Robert Porter of the Research Division and Dr. Chris North of the Department of Computer Science, we presented two sessions on the many guidelines, gotchas, and angles for successfully integrating a visualization component in grant proposals.

High Performance Computing Bootcamp, Summer 2008

This summer, Dr. Nicholas Polys, Dr. John Burkardt, and Dr. Cal Ribbens (CS) led a six-day workshop hosted at Virginia Tech. The bootcamp introduced the attendee to the basics of high-performance parallel computing. The course was targeted at graduate students, staff members, and faculty members with computational science and engineering problems that demand high performance. Attendees learned how to: 1) optimize sequential applications, 2) understand the basics of parallel computing, 3) write basic MPI and OpenMP applications, and 4) understand the opportunities and challenges of data visualization tools and display technologies. Attendees also used queuing systems such as PBS and use existing high-end resources at UVA and Virginia Tech. The bootcamp was organized in collaboration with the University of Virginia and sponsored by SGI, Sun, and IBM; over 65 participants attended from all over the commonwealth.



HPC Bootcamp lecture session

Topics covered included:

- Performance measurement and optimization
- Parallel computing concepts
 - Interconnection networks
 - Vector processors and multiprocessors
 - Multi-computers and clusters
 - Tightly coupled MPP's
 - Limits to parallelization
- Distributed memory computing: MPI

- Simple stencil problems (e.g., explicit methods)
 - More complex irregular structures
- Shared memory computing: OpenMP
- Graphics and visualization
 - Design effective visualizations
 - Manipulate heterogeneous data with common visual analytic tools
 - Produce visualizations for collaboration or publication



HPC Bootcamp hands-on session

Outreach

Facility tours. While the current mandate and budget for the CAVE facilities does not include outreach activities, we have done our best to meet the communities' needs on this regard. In any given week, there are multiple requests from all over campus and the state and, with current resources, we cannot accept them all. Based on case-by-case judgment, we have provided a number of tours including current and prospective faculty members and students. In March 2008, we assisted in hosting the Structural Biology Symposium at Virginia Tech and included CAVE tours for attendees.

We have also notably contributed to numerous well-regarded international conferences as General Chair, workshop organizer, paper presenter, panelist, and exhibiter. We have continued to further the university's leadership and recognition in enabling visualization tools and technologies. For example, Visual Computing has actively engaged in the specification of

international standards for networked interactive 3D media and user interfaces (Web3D/ISO www.web3d.org/x3d) as well as 3D medical imaging (<http://medical.nema.org/>).

Conferences

The IEEE VR 2007 Workshop on Future Standards for Immersive VR was held in Charlotte, North Carolina, March 10–14. Nicholas Polys was the publicity chair, and organized and led the workshop. The workshop brings together the virtual reality (VR) and Web3D communities, communities that have many of the same requirements regarding virtual world content—modeling, lighting, animation, interaction, and direct manipulation. This workshop focused on common interests regarding the seamless access and delivery of interactive, network-based VR content and resources. Presentations and discussions looked at the philosophies and feature sets of various scene graph tools, including ISO-based scene-graph standards such as X3D/VRML in immersive contexts. The principal thematic question examined involved the common requirements for a data archive format that provides expressive run-time application behavior. Through multiple tool and application examples, contributors examined commonalities and differences between these two important communities, and developed a workable roadmap of cross-community education and common effort.

Director Nicholas Polys co-chaired the program committee for the 2007 Web 3D meetings at the University of Perugia, Umbria, Italy, on April 15–18, 2007. Dr. Polys is also the general chair for the 2008 meeting.

Other conferences with participation by the Visual Computing Group include the Workshop on Scientific Visualization with X3D, and Supercomputing 2007 where the group we provided demos in the Virginia Tech booth and in the Argonne National Laboratory booth using a visualization tool we developed for MPIBlast, the 2007 Storage Challenge winner.

Projects and grants

National Science Foundation. Dr. Polys is the co-PI responsible for a Web-based visualization service in the recently funded NSF CCLI Phase 2 proposal: “Integration of Visualization with Structural Systems Understanding to Improve Technical Education of Architects.” The PI is Dr. Medhi Setareh from Architecture and Co-PIs include Brett Jones, associate professor in the School of Education; and Michael Ermann, associate professor and architecture professional program chair in the School of Architecture + Design; three years, \$500,000.

Oak Ridge National Labs. The Research Computing Visual Computing Group is working with ORNL to benchmark various remote visualization systems for quality of service handling large supercomputer data. The scalability and performance characteristics of new remote visualization

architectures are still not known. This project will provide numbers and guidance to Information Technology and HPC managers regarding investments and configurations to serve distributed scientists.

NSF Center for eDesign. To build more momentum behind the use of 3D visualization in research and education, we initiated and completed the relocation of Dr. Janis Terpenney and her NSF Center for eDesign (www.e-design.iems.ucf.edu/area.html) to the CAVE lab in Torgersen Hall. Dr. Terpenney's research in design process and prototyping strongly complements the capabilities of the Visual Computing Group. Her collaborators, industry contacts and students continue to drive innovative applications of visual methods in engineering.

VaCAS—A Visual Interface for Autonomous Vehicle Rehearsal and Replay. This project, funded by the Institute for Critical Technology and Applied Science, has provided a fruitful collaboration between Research Computing and the departments of Computer Science and Aerospace and Ocean Engineering. The project addresses data interoperability, presentation quality, and interface usability issues for researchers in the Center for Autonomous Systems. We have improved the available tools to the state of the art and integrated them with active Navy systems including the underwater robotics group at the Naval Postgraduate School. We continue to investigate the HCI challenges for this class of system.

National Capitol Region. A crucial component in the success of Virginia Tech's presence in the NCR is visual computing and communication. The top national agencies, labs, and universities recognize the importance of visualization support for scientists through their hardware and software infrastructure and application development. In order to be competitive in this space, Virginia Tech must make a commitment to build this program and enable the community with cutting-edge capabilities and expertise.

By building up the visual computing program at the main campus, the university will be well positioned to present its best and brightest to the NCR. For example, with infrastructure, staffing, and tools in place on the main campus, Virginia Tech scientists and educators will be enabled with visual tools for analysis, insight, and communication. These assets will be especially beneficial for visual presentations of their research results on big science problems to funding agencies and industry. In addition, these tools can be the basis for workshops and training sessions held for local industry.

We have provided specifications for a large-format, high-resolution visualization venue in the NCR in the new building in Ballston. This venue would provide an arena for demonstrations for the public, officials, and sponsors. It will also serve as an immersive, interactive visual interface to any HPC systems resident there or on the high-speed network. Plans for budget, space, and support are pending approval.

Testimonials for visual computing as a critical university resource

"As a scientist and educator in Computer Science and Human Computer Interaction, I am especially familiar with the value of visual computing tools for analysis, insight, and communication. Much of my research is in this area and it is an important concern for funding agencies such as NSF, NIH, DHS. By supporting improved visualization facilities and software infrastructure, we will have more opportunities for research funding and more members of the Virginia Tech community will benefit from these modern technologies.

For example, our recent \$0.5M grant from DTO/NGA is a direct result of NSF and Virginia Tech investments in new visual display technologies at our university such as the GigaPixel Display (\$200k GigaPixel, \$400k CRI). Our research has shown that such advanced displays and visualizations can provide an analytic workforce multiplier of up to 10x. As a result, federal intelligence agencies have begun to install advanced display equipment for their own analysts and are seeking our help in design. Given our initial successes, Virginia Tech has a unique opportunity to *invent the future* of visual computing and guide such agencies for many years to come. Through strategic investments in advanced equipment, research, and applications that augment our existing strengths in this area, Virginia Tech can be a world leader in advanced visual computing." Chris North, Associate Professor, Computer Science and Center for HCI

"As a scientist and educator in Computer Science and Human Computer Interaction, I am entirely convinced of with value of visual computing tools for domain-specific problems. Much of our success in the development of Virtual Environment and 3D interface tools comes from 'user-centered' design where the requirements are the result of extensive user interview and analysis. I support the university initiative to expand visualization activities through the improvement of the CAVE facilities and the addition of staff members to enable new tools through development and consultation. In this way, we can realize the benefits of visual computing for many groups on campus." Doug Bowman, Associate Professor, Computer Science and Center for HCI

"In many complex systems, dynamic properties are best modeled with their spatial and structural aspects—spatial relationships are important when structure, location, and function are related. Indeed, this is the case in many domains where complex systems are designed, simulated, or analyzed. Complex systems such as epidemiology, social networks, and transportation may be clearly apprehended when visual analysis tools are developed through user-centered methods. I support the university initiative to expand visualization activities through the improvement of the CAVE facilities and the addition of staff members to enable new tools through development and consultation. Open access to modern facilities such as large-format and high-pixel displays will improve our success as researchers." Madhav Vishnu Marathe, Deputy Director for Simulation and Computer Science, Virginia Bioinformatics Institute

"In the domain of Materials Science and Engineering, we study the relationships between structure and properties of materials. In particular, my research involves these relationships at the nano and atomistic scales. Our work typically involves the simulation, and analysis of complex crystal structures with features at the nanoscale, atom by atom. Three-dimensional

visual analyses are essential to provide insight into the structure property relationships that are the main issues in materials design. The CAVE and improved visual computing tools are essential to my research. The CAVE provides the unique three-dimensional environment for this purpose. Specific software for doing this research both in the CAVE and my desktop is of great importance. For example, AMIRA software is in use in my laboratory as well as in the new Materials Characterization Facility. The same software running on the CAVE will greatly enhance our research capabilities." Diana Farkas, *Professor, Materials Science and Engineering*

"In the domain of Biochemistry, we are concerned with the structure and dynamics of molecules as well as their interactions with one another, with an ultimate goal of gaining new insights into function. Our work typically involves the design, simulation, and analysis of complex compounds and visual computing tools are important to my success as a scientist and educator. Many commercial and open-source tools exist for visual communication and analysis, but fall short in providing the features needed for insight into my specific research problems. I support the university initiative to expand visualization activities through the improvement of the CAVE facilities and the addition of staff members to enable new tools through development and consultation. Open access to modern facilities such as large-format and large-pixel displays will improve my success as a researcher and teacher." David R. Bevan, *Associate Professor, Biochemistry*

"As a scientist and educator in the field of Engineering, I have observed the continued development and value of visual digital tools for prototyping, analysis, and communication. I support the university initiative to expand visualization activities through the improvement of the CAVE facilities and the addition of staff members to enable new tools through development and consultation. Open access to modern facilities such as large-format and large-pixel displays will improve my success as a researcher and as an educator.

Further, these technologies would allow those of us devoted to reversing trends of under representation to develop initiatives that build on the well documented studies of the positive impacts that visualization has on engaging girls and women in science and engineering at all levels (K-12, undergraduate and graduate students). Finally, visualization is one of the key research thrust areas for the NSF Center for e-Design. Improving the infrastructure at Virginia Tech for visualization is very likely to dramatically improve our ability to expand our industry membership in the Center, distinguishing Virginia Tech as a national resource in the country for the use of visualization in the design of products and systems." Janis Terpenney, *Associate Professor, Dept. of Engineering Education*

"As a scientist and educator in Gerontology, I have been involved in visual computing and the CAVE in a variety of exciting ways. For example, through support from the Virginia Tech-UVA-Carilion Biomedical Institute initiative, Virginia Tech researchers affiliated with the Center for Gerontology have collaborated with colleagues from UVA Neurorehabilitation to construct a virtual tool to assess older adults' memory skills for everyday tasks. This work would not have been possible without open access and support for the CAVE facility. As we continue to think about innovated ways to study and address issues facing our aging nation, open access to modern facilities such as large-format and high-pixel displays will enhance both gerontology research and practice." Karen Roberto, *Professor and director of the Center for Gerontology*

"The VT CAVE facility provides a unique and immeasurable benefit to the University community. In my research, the ability to implement and test software algorithms on the 6DOF motion platform prior to costly sea trials allows me to develop robust, effective, and affordable deliverables for my sponsors." Leigh McCue, *Assistant Professor, Aerospace and Ocean Engineering*

"In the artistic enterprise, we are constantly looking for new avenues of expression and design. Venues such as the CAVE and stereo walls provide exciting opportunities for artists to experiment with rich media in immersive forms. By supporting improved visualization facilities and software infrastructure, more members of the VT community will be able to benefit from these modern technologies. Open access to modern facilities such as large-format and high-pixel displays will continue to drive VT's innovation and creativity in the digital arts." Truman Capone Head, Art and Art History, College of Architecture and Urban Studies

"As a practitioner and educator in Architecture, we make extensive use of visual computing tools for design and communication. Through modern databases and graphics, architects are empowered to envision new spaces and guide them into reality. In the future, we look forward to connecting our desktop tools, stereo walls, Gigapixels, and the CAVE into a seamless workspace for innovation and insight. Open access to modern facilities such as large-format and high-pixel displays will improve our success as both researchers and teachers." Robert Schubert, Professor/Associate Dean of Research, College of Architecture and Urban Studies

"The VT CAVE facility provides an important service to University and its research, educational, and outreach goals. For two years, I had my office in the VT CAVE space and can testify first hand how important that facility is for many of my colleagues. The accessibility of the CAVE and other equipment helped me tremendously to do research in tangible user interfaces and visual analytics, as well as to support NIH and DARPA funded research. The proposed upgrade and expansion of VT CAVE is long overdue. I will be happy to help that expansion and I am looking forward to use the new capabilities once they become available." Denis Gracanin, Associate Professor, Computer Science and Center for HCI

Goals for fiscal year 2009

Research Computing/visualization funding. Information Technology has provided the majority of the university funds for research computing and visualization. We are seeking a more sustainable university funding model.

Support services. We must continue to increase our research computing support services. The visualization effort has had a lot of success this past year but we need to increase our efforts here. The new MPI position should help our research computing researchers advance their research programs; but again we need to create more new positions here. Funding for the two new positions after next year and funding for additional positions must be identified. We must define procedures and requirements and possibly costs for housing department and research group's computational systems in Andrews Information Systems Building and for systems administration support.

Virginia Tech, an HPC leader. We must begin to identify our next big effort in research computing. Decisions on the next system for Virginia Tech need to be made. It is not clear whether we will submit a new NSF proposal for a petascale system. We must evaluate all options and make a decision. We will continue to investigate other possibilities for Virginia Tech to

build and manage a petascale system. We need to identify and hire more domain experts to assist our researchers.

National networks. We will continue to encourage Virginia Tech researchers to find ways that reliable high-speed networks can advance their research programs. We need to build on the success of the past efforts of Mark Gardner to provide reliable high-speed network for research faculty members.

National Capital Region. We will continue to seek ways to assist with Virginia Tech initiatives for the National Capital Region.

Oak Ridge National Laboratory. Continue to work with ORNL and hope to identify new joint projects. We now have a solid foundation for future joint efforts; we need to devote time and effort to establishing a well-defined joint project.

Internships, graduate research assistantships and post doc positions. We will continue to develop an intern program for research computing. Information Technology funds for this program have been identified. Adding post-doctoral and graduate research assistantships (GRA) positions to research computing will impact our research computing support services. We will explore ways that we can add such positions to our research computing team. We will have at least one intern in each of research computing and visualization for the next academic year. We expect to have two GRAs in research computing; we are hoping that the graduate school will provide at least two more GRAs. Establishing the proposed Information Technology internship program requires more attention in the coming year.

Research Computing personnel

Dr. Terry Herdman, Associate Vice President Research Computing. Terry L. Herdman was appointed to the position of Associate Vice President for Research Computing at Virginia Tech, August 2005. He reports directly to Erv Blythe, Vice President for Information Technology, and Robert Walters, Vice President for Research.

Dr. Kevin Shinpaugh, director of High Performance Computing. Kevin Shinpaugh manages and directs Research Computing activities for faculty members and students across campus. These activities include education and training, support and development services, as well as research and outreach. Crucial to success is the continued development and deployment of research computing systems that enable computational science and engineering at Virginia Tech. These systems include large-scale shared memory systems, small- and large-scale clusters, and associated storage systems.

Dr. Nicholas F. Polys, director of Visual Computing. Deployment and adoption of advanced visualization techniques and technologies is essential to Virginia Tech's international competitiveness. The director of visual computing manages and innovates these diverse visualization activities for faculty members and students across campuses. These activities

include education and training, support and development services, as well as research and outreach. Crucial to success is the continued design, development, and deployment of software technologies that enable researchers to analyze massive data sets (e.g. System X) as well as portability of and access to data using clients ranging from PCs to immersive visualization environments such as the CAVE. Particular emphasis for scientific visualization activities on campus include problem-solving interfaces, large-scale data analysis and feature detection, advanced visualization hardware technologies, immersive visualization techniques, and grid-enabled multi-user visualization.

Mehmet Belgin (Computer Science), Graduate research assistant. Mehmet is a PhD candidate with the Computer Science department at Virginia Tech. He assists users in porting and running parallel applications.

Dr. John Burkardt, Computational science specialist. John Burkardt is a computational science specialist. He has an extensive background in algorithm development, and programming in C, FORTRAN, and MATLAB. He has experience in parallel programming with OpenMP and MPI. He expects to be available to consult or collaborate with faculty members on computational research projects.

Jeffery Nelson. Jeffrey Nelson has been working with Research Computing as a student worker for the past three years. He is a senior this year, majoring in computer science. He has accepted employment with Northrop-Grumman in the Washington, D.C., area.

Undergraduate visualization intern, Nikita Sharikhov. This 20-hour per week internship position assists in building an interactive 3D content repository. The content repository will include a range of visual and interaction techniques that can be used as conformance and demonstration content for Visual Computing applications. New software, standards, and I/O devices are constantly emerging and there is a need for content that can test interoperability of the various tools in the Visual Computing software stack. The student will learn and improve valuable skills such as 3D modeling and digital asset management. The student will also be trained on technical aspects of running immersive visualization venues and may run tours of the facility.

Patrick Shinpaugh, Visualization Engineer and System Administrator. The vis engineer and administrator is responsible for development, deployment, and maintenance of Visual Computing facilities and software. These activities include development of visualization and immersive virtual reality applications, collaborating with Virginia Tech researchers and partners to utilize leading-edge visualization techniques and technologies in their computational research, and operation of stereo wall, CAVE, and lab machines. This position provides expertise to assist in writing the technical elements of funded project proposals and supervise graduate and undergraduate student accounts.

Dr. Bill Sydor, User relations. Bill Sydor has been at Virginia Tech since 1978 and joined the Research Computing group in October of 2005. He provides consulting support for research applications, subroutine libraries, and programming languages. He is also responsible for HPC documentation and manages the website.

Vivek Venugopal. Vivek Venugopal was selected to work with Research Computing as an intern as part of Information Technology's pilot internship program. Vivek won the first prize for a poster in the engineering category at the recently held 23rd GSA Research Symposium 2007. The poster, "Reconfigurable FPGA-based Clusters: next Step in Supercomputing," addresses the requirement of a reconfigurable framework for high performance computing systems for better performance.

Geoff Zelenka, HPC application developer. Geoff Zelenka is responsible for developing and porting applications to computational resources. He also assists users with running code on these resources. Geoff also manages the queuing systems on these machines.

In addition to personnel reporting to Research Computing, the System Administration group within Network Infrastructure and Services supports the efforts of research computing. These team members include the following:

William Dougherty, Assistant director for Systems Support. William C. Dougherty, a Virginia Tech alumnus, is the Assistant director for Systems Support in Network Infrastructure and Services. Systems Support is responsible for hardware and system administration for many of the centrally provided systems including e-mail systems, backup and storage systems, and Banner-related systems. Production control for research systems became part of Systems Support's responsibilities in December 2005.

Tim Rhodes, Technical Team manager. Tim Rhodes has 23 years of systems administration experience and has lead systems administration groups since 1998. These groups have supported systems that range from Virginia Tech's IBM mainframes to Unix systems that host administrative, academic support and research computing applications. He reports to William Dougherty, Assistant director for Network Infrastructure and Services Systems Support.

Luke Scharf, Systems Engineer. Luke is primarily responsible for system administration on System X and associated hardware

Bill Marmagas, Senior Systems Engineer. Bill Marmagas is a senior systems administrator who has administered a variety of UNIX and Linux operating systems since 1993. He has worked with hardware platforms ranging from the small to the very large. He specializes in high availability, SAN storage, and systems and network management. He joined Virginia Tech in 2006. He is primarily responsible for system administration of the SGI hardware.

Professional activities

Highlighted activities for Terry Herdman, Associate Vice President for Research Computing

Contributions to diversity. Activities included recruitment of female undergraduates into science, technology, engineering, and mathematics by hosting visits for potential students; advising international students; and mentoring new faculty members.

Graduate education. Activities included chairing three student advisory committees, and working with over a dozen additional students.

Undergraduate student advising. Dr. Herdman advises ACM Mathematics students.

Course and program development. I continue to develop and administer the applied and computational mathematics option (ACM) with Bill Greenberg, Mathematics.

Grants

Principal investigator, Research on Mathematical and Computational Tools for Analysis, Design and Optimization of Very Large Membrane Structures with Advanced Material Models, with J. A. Burns, E. M. Cliff and D. Inman, \$1,870,000 for 3 years, DARPA/NASA LaRC/NIA 2535. This grant ended December 2007.

Principal investigator Investigation and Implementation of Sparse Grids, with John Burkardt, Sandia National Laboratories. \$50,000

Principal investigator, Research Collaboration and Program Development, ORNL/UT Battelle LLC, \$220,000, (\$16,000 for this reporting period)

In addition to the projects listed above, ICAM and Information Technology were invited to team with SAIC on a Defense Intelligence Agency (DIA) proposal. SAIC was awarded the prime (ID/IQ) contract to support DIA's UFAC (Underground Facility Analysis Center). Dr. Terry Herdman is the Virginia Tech PI. Terry Herdman and Joe Guerci, NCR, have been working with SAIC (Richard (Rick) Raftery, VP SAIC, Jonathan D Michel PhD, CTO, Operational Intelligence Solutions BU, Charlottesville, Kathy Terlesky PhD, Senior Scientist, Executive Diversity Fellow, Charlottesville, and others) to generate a task order (TO) proposal to bring forth to the client. In particular, we are trying to carve out a portion of this contract for basic research which can be accomplished with the expertise of the ICAM researchers. Not sure that this effort will be successful. I included below the SAIC announcement of this award.

SAIC Award Announcement: San Diego and McLean, Virginia, April 7, 2008/PRNewswire-FirstCall—Science Applications International Corporation today announced it was awarded a prime contract in December by the Defense Intelligence Agency (DIA). This multiple-award, indefinite-delivery/indefinite-quantity contract will support the Solutions for Intelligence

Analysis (SIA) program. The maximum dollar value for all task orders that can be awarded to prime contractors, including SAIC, under this five-year contract is \$1 billion. Work may be performed at DIA locations nationally and overseas, and will be issued by DIA out of the Washington metropolitan area. Under the contract, SAIC will support the DIA mission with services in areas including foreign cultures, regional dynamics, illicit drugs, infectious disease and health, and emerging and disruptive technologies to provide effective analysis for the Defense Intelligence Enterprise.

Publications

Results on Transversal and Axial Motions of a System of Two Beams Coupled to a Joint through Two Legs, (with J. A. Burns, E. M. Cliff, Z. Y. Liu and R. D. Spies), ICNPAA 2006, Mathematical Problems in Engineering and Aerospace Sciences, Cambridge Scientific Publishers, p. 85–98.

On Numerical Solutions of a Class of Singular Integro-Differential Equations, with Shihchung Chiang, Proceedings of the 2007 International Conference on Scientific Computing (CSC 2007), CSREA Press, p. 279–283.

Well Posedness and Exponential Stability of a Thermoelastic Joint-Leg-Beam System with Robin Boundary Conditions", with E. M. Cliff, B. I. Fulton, Z. Liu and R. Spies, Mathematical and Computer Modeling, accepted Feb. 2008.

Generalized Qualification and Qualification Levels for Spectral Regularization Methods, with R. D. Spies, and K. G. Temperini, JOTA, accepted Feb. 2008.

On Minimum Angular-Impulse Control for ISAT, (with E. M. Cliff and Z. Y. Liu), AIAA, to appear.

Parameter Identification in SNFDEs, (with J. Turi), IEEE, CDC Submission 632, March 2008.

Awards. Dr. Eugene Cliff and I are members of the NASA LaRC Large Space Systems Team that received a Langley Center Team Award, May 2008. This was for work that we did on the DARPA ISAT program.

Conferences/workshops. I participated in the HPC User Forum, Santa Fe, NM, Sept 2007; DARPA's Large Space Systems Workshop, Hampton, Virginia, August 2007; the Super Computing Conference, SC2007, Reno, Nevada, November 2007; and helped develop the HPC Bootcamp held August 2008.

Highlighted activities for Kevin Shinpaugh, director, High Performance Computing

- Attended HPC User Forum Fall 2007 Idaho
- Lead Virginia Tech's booth at SuperComputing 2007, Reno, Nevada
- Attended HPC User Forum Spring 2008 Norfolk, Virginia
- Worked with SGI to design our HPC storage system. Delivered June 2007
- Advisor Ph.D. committee for Vivek Venugopal
- Worked with Geosciences to attract key new faculty members, also to design new cluster to be housed in AISB.
- Conducted two meetings (fall and spring) with the Campus Research Computing group.
- New www.arc.vt.edu website for Research Computing (lead by Bill Sydor).
- Inferno2 upgraded to 128 CPUS and new SGI 4700.

- Negotiated 98% discount on ClusterResources products to use on System X and SGI machines.
- Negotiated with TerraSoft to get Linux on System X for \$12,500.
- Loaner IBM BladeCenter-H from IBM. IBM gift of LS-21 blade to Virginia Tech.
- Purchased and installed the Vizwall in 119 AISB.
- Worked with VBI on specification for large cluster, potentially to be housed at AISB. Project is not funded at the time this report was prepared.
- Courses Taught for AOE
 - Fall 2007: AOE 4065 “Space Design”
 - Spring 2008: AOE 4066 “Space Design.” 32 Students.
 - University Service: Advise students working on Lunar Mission. Project with NASA Wallops.
- Outreach: Worked with Senior from Hollins University to generate Julia sets with MATLAB and on System X for her senior project.
- Professional Service: Technical Committee ASHREA, American Society of Heating, Refrigeration and Air-conditioning Engineers

Highlighted activities for Nicholas Polys, Director, Visual Computing Group, and Affiliate Research Professor, Department of Computer Science

- Successfully re-factored Vis/UVAG management and lab space in Torgersen
- Vis3D wall installation and graphics workstation online in Andrews Information Systems Building
- Repaired CAVE projectors (back to full functionality)
- Implemented and Documented Visual Computing Software Stack v1 [Domains: Molecular Dynamics, Computational Fluid Dynamics, CAD, Geospatial, General 3D]
- FDI classes (7 session track) in spring, summer and fall, GEDI pilot course
- Published 4 papers of original research on visual computing and applications; 3 additional are submitted and under review
- Co-principal investigator on 3 submitted NSF grants
- Software feasibility study with Naval Postgraduate School (\$5,000)
- Enabling Art and Architecture Department with projection screens and stereo mounts
- Collaboration and consultation with faculty members and grad students on projects in: Computer Science, Mathematics, Biochemistry, Physics, Plant Pathology, Building Construction, Fisheries and Wildlife Science, Engineering Science and Mechanics, Civil Engineering, Mechanical Engineering, and Aerospace and Ocean Engineering
- Organized and developed courseware for the visualization component of the HPC Bootcamp jointly sponsored by Virginia Tech and the University of Virginia; hosted logistics for the camp’s visit to Virginia Tech

Participation and presentations

- Medical Imaging and Biomarkers (NIST, NSF, NIH)
- SuperComputing
- IEEE VR (Workshops co-chair, workshop organizer and presenter)
- Web3D Symposium (Program co-chair, paper presenter and referee)
- Numerous Vis Lab tours and for faculty members, classes, and external groups

- NSF Center for eDesign Industry Advisory Board

Publications

- Polys, Nicholas and Brutzman, Don and Steed, Anthony and Behr, Johannes. Report from: Future Standards for Immersive: Report on the IEEE VR 2007 Workshop. *IEEE Computer Graphics and Applications* Vol. 28, Number 2, IEEE Computer Society, 2008.
- M. Shapiro, K. A. D., K. Lee, E. Delgado-Eckert, A.S. Jarrah, R. Laubenbacher, N.F. Polys, V. Hadinoto, D. Thorley-Lawson, “A Virtual Look at Epstein-Barr Virus Infection: Simulation Mechanism,” *Journal of Theoretical Biology* 252 (4): 633–648. June 2008.

Conferences

- Visamsetty, S. S., Bhattacharjee, P., and Polys, N. 2008. Design patterns in X3D toolkits. In Proceedings of the 13th international Symposium on 3D Web Technology (Los Angeles, California, August 09—10, 2008). Web3D '08. ACM, New York, NY, 101–104.
- N.W. John, M. Aratow, J. Couch, D. Evestedt, A.D. Hudson, N. Polys, R.F. Puk, A. Ray, K. Victor, Q. Wang, “MedX3D: Standards Enabled Desktop Medical 3D.” Medicine Meets VR (MMVR) 2008.

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Highlighted activities for John B Burkardt

- Faculty Development Initiative, June 2008, 3-day workshop on Parallel Computing—prepared eight lectures with slides, sample programs, and lab sessions; attended by about 20 faculty members
- Responsible for two days of the 2008 HPC Bootcamp for about 60 people from Virginia Tech, the University of Virginia, and other Virginia institutions
- Working with several post-docs and graduate students
- Contacts with researchers through the TCF mailing list
- Prepared a lecture on the use of mathematical modeling in relation to a cholera epidemic in nineteenth century London for students visiting from Hollins University
- Working closely with several ICAM researchers
- Working on a research grant related to the development of sparse grid algorithms, and their implementation, for Sandia National Laboratories. This grant was awarded in the fall of 2007.

Secure Enterprise Technology Initiatives

Secure Enterprise Technology Initiatives (SETI) develops secure applications, middleware, and interfaces to support the university's computing and network services. SETI works closely with the Information Technology Security Office to ensure that security is properly considered during development cycles. Programming code developed by SETI is offered to the Open Source community. The SETI department includes eProvisioning, the Microsoft Implementation Group, Middleware, and Test and Deployment. Each unit contributes to the strategic goals of the Information Technology organization by providing secure, robust and highly functional enterprise systems that support teaching, learning, research and outreach while protecting access to university data.

Teaching and learning

During the 2007-2008 reporting period, Middleware developed an infrastructure for guest accounts. The guest accounts provide a way to give non-Virginia Tech affiliates access to Virginia Tech online services, including those used for instruction. The Shibboleth service was put into production, enabling federated identity management through InCommon (www.incommonfederation.org/). Using Shibboleth, Virginia Tech students can authenticate to the DreamSpark site (<https://downloads.channel8.msdn.com/>) to download Microsoft developer and designer tools at no charge to the student. Shibboleth also gives Virginia Tech affiliates a way to authenticate to gain access to the streaming video collections of the Virtual Library of Virginia (<http://pbsvid.itc.virginia.edu/>).

Research

The Microsoft Implementation Group (MIG) investigated using Active Directory Federated Services to provide researchers in the College of Veterinary Medicine a way to use their Hokies credentials to access services at Wake Forest University. The MIG team leader assisted an associate professor in the department of Computer Science with his research into power-aware computing. The Office of Research Compliance expressed interest in using the Virginia Tech personal digital certificates (PDCs) to digitally sign research proposals once the PDCs are available to all university employees.

Outreach

For many years, Virginia Cooperative Extension offices have needed a way to authenticate non-Virginia Tech affiliates who use an online system to answer questions from the general public. The guest accounts provided by Middleware offer a potential solution.

Secure access to university data

The MIG, Middleware, and eProvisioning groups support the secure infrastructure for digital identities that are used to access university online services. With a growing emphasis in levels of assurance in digital identities used by online university processes, the infrastructure SETI supports becomes ever more strategic in managing secure access to university data. The PID and Hokies IDs offer a level of assurance based upon knowledge of a password. The personal digital certificate issued on the Aladdin eToken increases the level of assurance in the digital identity by implementing multifactor authentication; i.e., something you know and something you have. The SETI Test and Deployment team provides an extra measure of security and quality assurance by testing all software and services deployed by SETI and, as workload allows, by other Information Technology units.

eProvisioning

The eProvisioning unit has continued its work to provide technical support for the Virginia Tech Certification Authority (VTCA) and to promote the use of public key technology at the university. During the past fiscal year, the benefits of using public key technology have been demonstrated by the successful integration of public key infrastructure (PKI) to support digital signatures and approval of university leave reports (approximately 500 clients). As a result, eProvisioning is planning the next phase of their deployment to extend the use of PKI to the remaining faculty and staff members (approximately 6500 clients). With this objective in mind, the efforts by the eProvisioning unit have been largely focused on improving the university's public key infrastructure to support scalability and enhanced usability. These efforts are summarized in the following projects.

Certification authority. In order to extend the deployment of public key technology campus wide, the eProvisioning unit has recognized the need to provide enterprise-level certificate

authority service. Although the current Open Certification Authority (OpenCA), implemented in the fall of 2003, has performed well to meet current certificate needs, it is not well suited to meet the high campus-wide certificate demands that are anticipated in the future. After extensive research and evaluations of alternative certification authority software, eProvisioning has decided to migrate from OpenCA to Enterprise Java Beans Certificate Authority (EJBCA). EJBCA is an open source, robust, high performance, and scalable certificate authority based on J2EE technology, which will enable the university to provide enterprise level certificate offerings. Tentatively, the eProvisioning unit is planning to make the new EJBCA certificate services available sometime during the first quarter of 2009.

Root key signing. At the request of Internal Audit, the eProvisioning unit conducted a cost benefits analysis to determine if there was a business case for extending the trust of certificates issued by the VTCA. After analyzing university SSL certificate needs and investigating the costs of enhancing the VTCA to provision globally trusted certificates, the eProvisioning unit concluded that there were significant cost-saving benefits that could be realized by pursuing a root key signing solution. As a result of this analysis, the vice president for information technology has approved a recommendation from the eProvisioning unit to implement root key signing.

PKI website updates. The eProvisioning unit completed its work to update the VTCA website (www.pki.vt.edu) to make it compliant with university “Guidelines and Procedures,” “Best Practices,” and “Content Recommendations” (www.unirel.vt.edu/web/). This enhancement helps to provide a look and feel consistent with other Virginia Tech websites and enables users to navigate the site more effectively by improving how information is organized and presented. The site is now in compliance with university Web publishing guidelines.

VTCA backup facility. The eProvisioning unit completed a key project to upgrade the encrypted backup services for the VTCA offline certification authority servers. The upgrade replaces an antiquated, locally developed backup facility with a new commercially purchased product from Storix, a leader in backup solutions. The new Storix backup facility eliminates the need for manual operator intervention to mount/dismount DVD RAM backup media by providing fully automated and encrypted backup of the VTCA offline servers. It is a less labor-intensive and more cost-effective solution for performing VTCA backups.

TAS 2.0 release. The eProvisioning unit completed the development of an enhanced version of Token Administration System (TAS) v2.0, an administrative application that provides full life-cycle management of PDCs issued onto eTokens. The new TAS 2.0 release elevates certificate and eToken provisioning to the enterprise level by providing eToken inventory control, a user-friendly administrative interface and numerous reporting capabilities. TAS 2.0 will allow the university to extend its certificate services by making PDCs and eTokens available to all faculty and staff. The eProvisioning unit is planning to make TAS v2.0 available for production use during the third quarter of 2008.

Digital signature. In order to help enhance performance when using digital signature in the Leave Entry and Reporting Web System and the IRM Workflow applications, the eProvisioning unit has updated its Web services that provide PKI integration to use PD4ML. PD4ML is a

commercially purchased HTML to PDF converter utility implemented as a Java library that makes it possible to create PDF documents from Java and JSP applications. This update streamlines the HTML to PDF conversion step in digital signature applications by replacing the previous, less efficient method using disk I/O with a high performance memory resident conversion process. The enhanced Web services will be implemented in the production environment during the third quarter of 2008.

Token middleware installation support. During the past fiscal year, the eProvisioning unit has updated its locally developed software installers to incorporate the latest eToken 4.55 middleware available from Aladdin Knowledge Systems. These software installers are used to automatically install and configure the necessary middleware required to use eTokens and PDCs on a user's workstation. The new 4.55 version of the eToken middleware provides users with an improved and consistent GUI interface for Windows, Linux, and MacOS platforms.

Full disk encryption research. eProvisioning summarized the work of the Encrypted Data Storage workgroup during a presentation to the Security Task Force meeting on December 4, 2007. The workgroup has setup a wiki at <https://webapp.neo.cns.vt.edu:8083/x/hoo> to publish its research for those interested in learning more about full disk encryption (FDE) technology. The methods available for implementing FDE are well understood and the group has developed a set of technical and functional requirements for evaluating and comparing FDE products. Although the group has evaluated several commercial and open source solutions, there is no single product that can be recommended for purchase at this time. The eProvisioning unit will continue its work to lead research efforts in this area.

eToken self-service password reset. eProvisioning realizes that in order to facilitate the deployment of eTokens university wide, it will be necessary to provide secure and convenient options for users to reset their eToken passwords. Currently users must bring their eTokens in person to the Student Telecommunications office to have their eToken passwords reset. Although this process works adequately with a client base of 500 eToken holders, it does not scale well as we make plans to extend the use of eTokens to all faculty and staff. To help address this problem, the eProvisioning group has participated in several meetings to discuss the needs to development a self-service password reset service for eToken users. To prepare for a future implementation, the eProvisioning group has developed a prototype to demonstrate the benefits of a self-service eToken password service.

Microsoft Implementation Group

The Microsoft Implementation Group (MIG) supports the Hokies Active Directory (AD) infrastructure, from the Windows operating system through integration of the Active Directory with end-user applications. During this reporting period, MIG virtualized the AD testing environment while working on the following projects.

E-mail Preference Project. Many e-mail clients allow users to set a return address of their choice, but that ability did not exist for Virginia Tech Outlook/Exchange e-mail users until MIG

added the capability to the Active Directory. The E-mail Preference Project involved replicating valid e-mail aliases from the Enterprise Directory to the Active Directory. Hokies Self Service (<http://selfservice.w2k.vt.edu>) was modified to allow an Exchange user to select one of the e-mail aliases to be used as a return address in the “reply-to” field for the Outlook e-mail client. So far, 75 people have used the new features developed in this project.

My Store 2. Hokies Self Service (<http://selfservice.w2k.vt.edu>) provides a tool for Hokies account owners to request and manage personal network attached storage as a Windows share at storage.vt.edu\mystore. By 2007, the service had become so popular that all the storage capacity was depleted. The necessary hardware was purchased to expand capacity, but due to the separation of the new storage device from the old, work had to be done to allow users to access the new storage. With MIG’s completion of My Store 2, personal network-attached storage can be allocated on either the old or new hardware. By the end of fiscal year 2008, 283 people had used the new features developed in this project.

April 16 SharePoint server. Information Technology was asked to provide a secure system for storing and tracking documents related to recommendations that emerged from the tragedy of April 16, 2007. In response, MIG implemented and now maintains a highly customized Microsoft SharePoint system that provides secure, fine-grained access to the documentation.

Wake Forest University ADFS. MIG investigated Active Directory Federated Services (ADFS) to support Virginia Tech Active Directory authentication and authorization to a Microsoft SharePoint system hosted by Wake Forest for collaboration on a three-university Clinical Translation Science Award funding project. It is necessary to extend the current AD infrastructure to support a cross-forest authentication format called ADFS. This service will allow authorized Virginia Tech faculty and staff members to use their Hokies credentials to log into the Wake Forest SharePoint site.

AD Admin. Much of the day-to-day creation and management of Active Directory objects is manually done by Information Resource Management (IRM) staff and Exchange administrators. The Admin project provides a Web-based interface for IRM, 4Help and departmental OU administrators to manage their constituents’ Active Directory objects. MIG has installed the Microsoft Identity Lifecycle Management service in a virtual server environment for this project to provide synchronization to the development and test Active Directory environments from production. Exchange 2003 was deployed in both of these environments. Documentation and business logic is being developed to provide programmatic validation and verification of existing objects in the production Active Directory.

Virtual Windows servers. MIG virtualized its development and testing environments using supported Microsoft technology to consolidate multiple servers onto a single hardware footprint. The environment offers a secure, efficient, and economical way to manage Windows servers that do not require large CPU or storage resources. A project to offer virtual Windows servers to other university departments is under investigation.

Office Communication Server and Windows Rights Management Server for Business and Management Systems. MIG collaborated with staff from the Business and Management

Systems (BAMS) group that supports the university's executive offices. MIG installed, integrated, and tested a pilot Microsoft Office Communication Server (OCS) and a Windows Rights Management Server (WRMS) with the university's pilot Active Directory server. OCS allows people to confer while on the road and away from physical conference rooms while WRMS provides technology that safeguards digital information from unauthorized use. The OCS and WRMS services are both in production now. The applications are supported by BAMS, with MIG supporting the Active Directory extensions for the services.

Consulting and testing for other departments

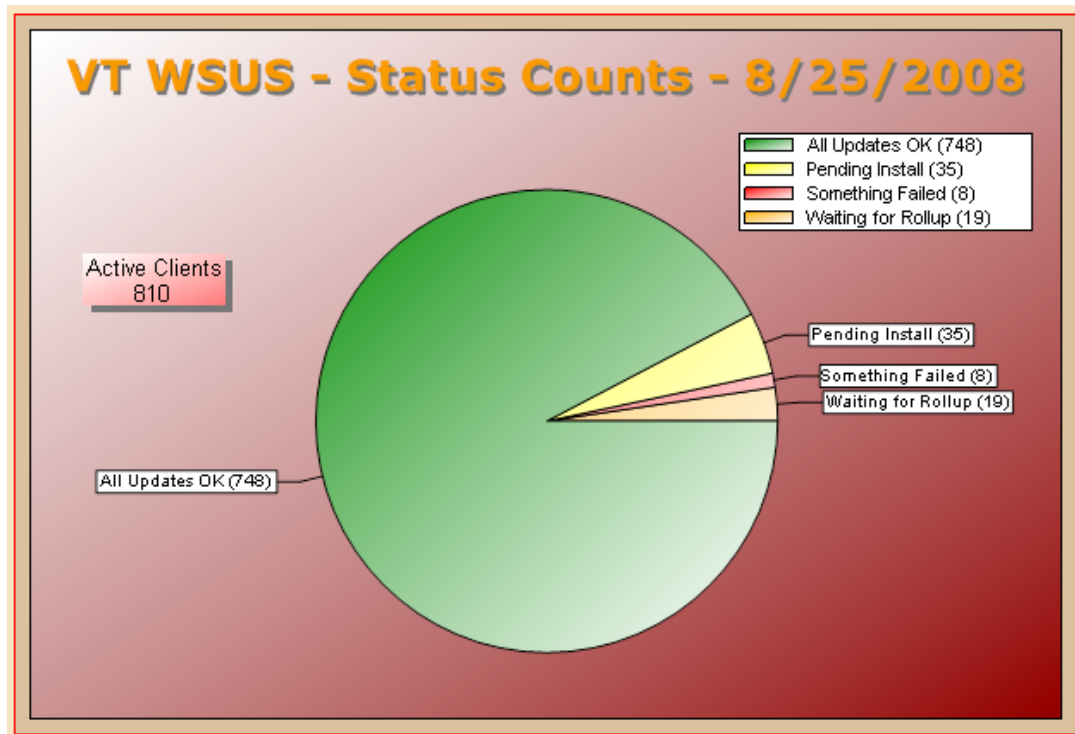
- Collaborated with Communication Network Services (CNS) and Business and Management Systems to explore solutions for Vista/VPN issues
- Supported Network Infrastructure and Services (NI&S) storage group and Mechanical Engineering discussions
- Assisted University Development and University Library with child domain issues
- Counseled Information Technology Acquisitions on Interactive Voice Response System Purchase Order, documentation and security concerns
- Assisted Application Information Systems with Leave Reporting and IE7/.NET issues
- Assisted NI&S Systems Support Exchange mail team in Exchange 2007 testing and upgrades
- Offered three Microsoft Premier Support incidents and follow-up for university departments
- Audited child domain controllers based on security patching issues
- Supported CNS in 802.1x testing
- Assisted with Apple iPhone 2.0 software beta project (802.1x and Exchange support)
- Liaison to computer science professor and company Miserware project

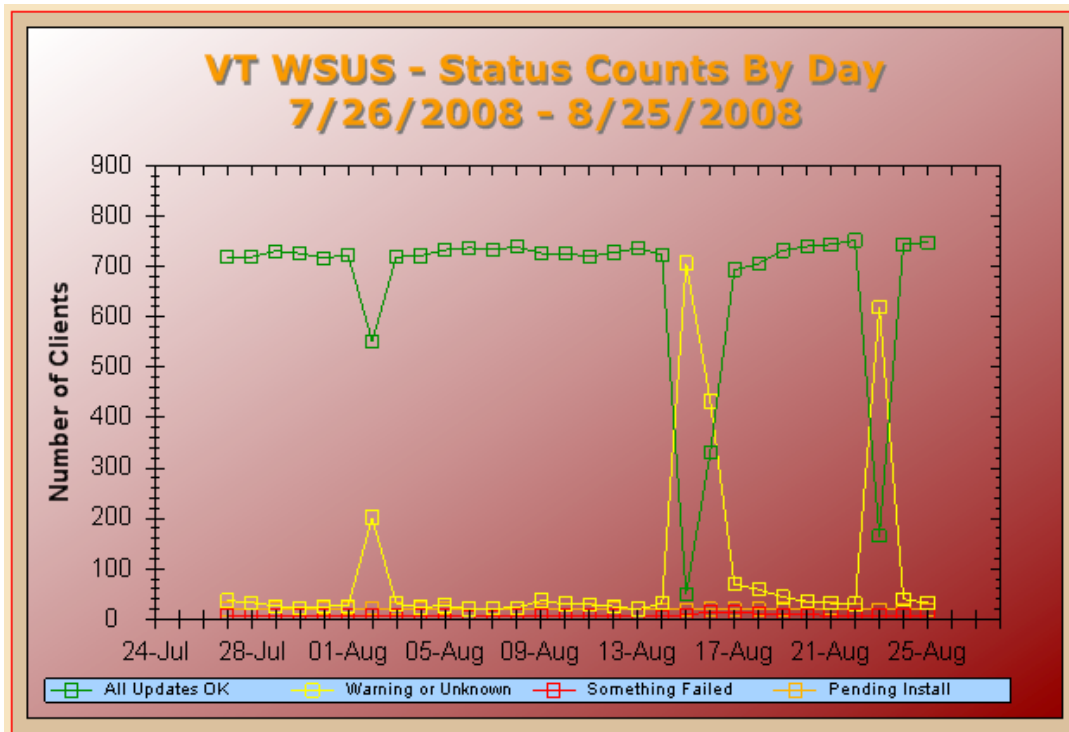
Contributions to meetings and constituent groups

- Information Technology Project Planning Management group
- SETI representative to Disaster Recovery group
- Information Technology Acquisitions Campus Agreement meetings
- Self-service password reset meetings
- CNS/CC monthly meeting
- Chair Vtwug (MIG hosts this group.)
- Chair Microsoft's Premier meetings with Information Technology
- Conference call monthly with MS PSS Technical Account Manager
- McQ sensor discussion related to 4/16
- Discussions on RFID with IBM

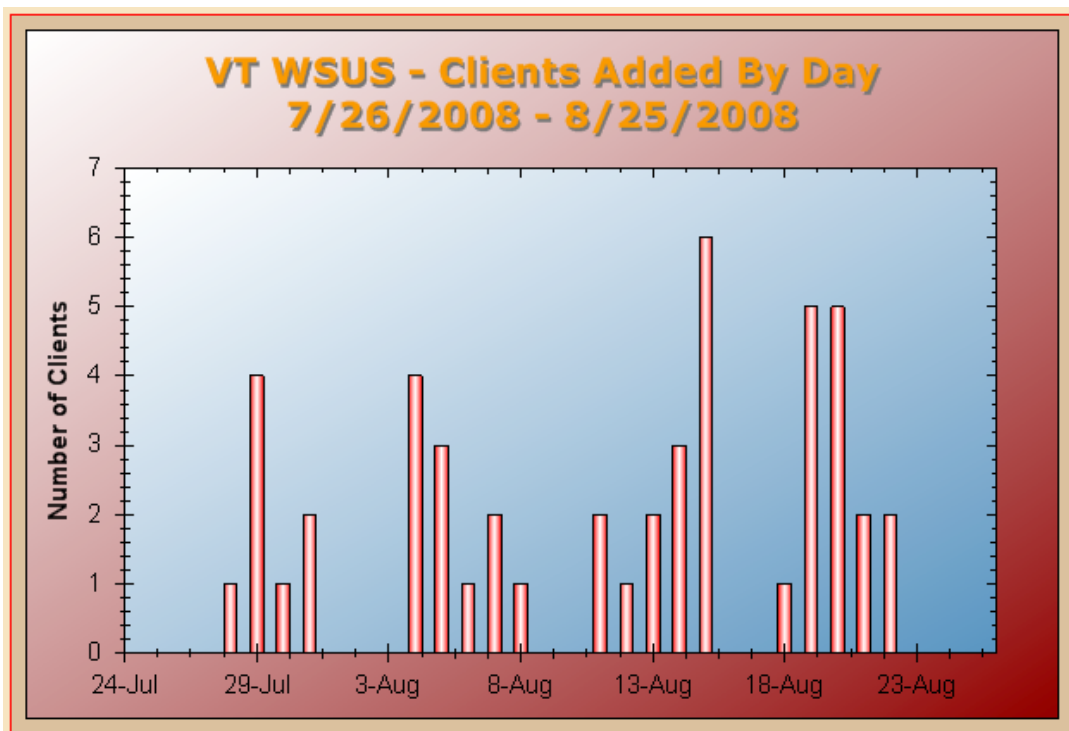
Utilized services

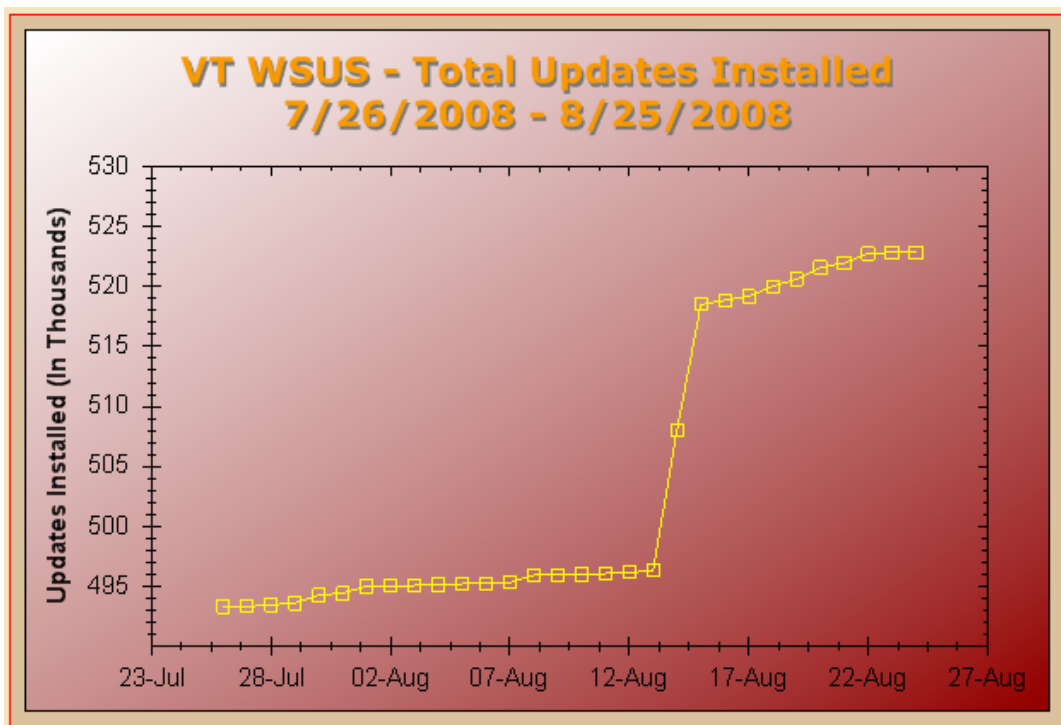
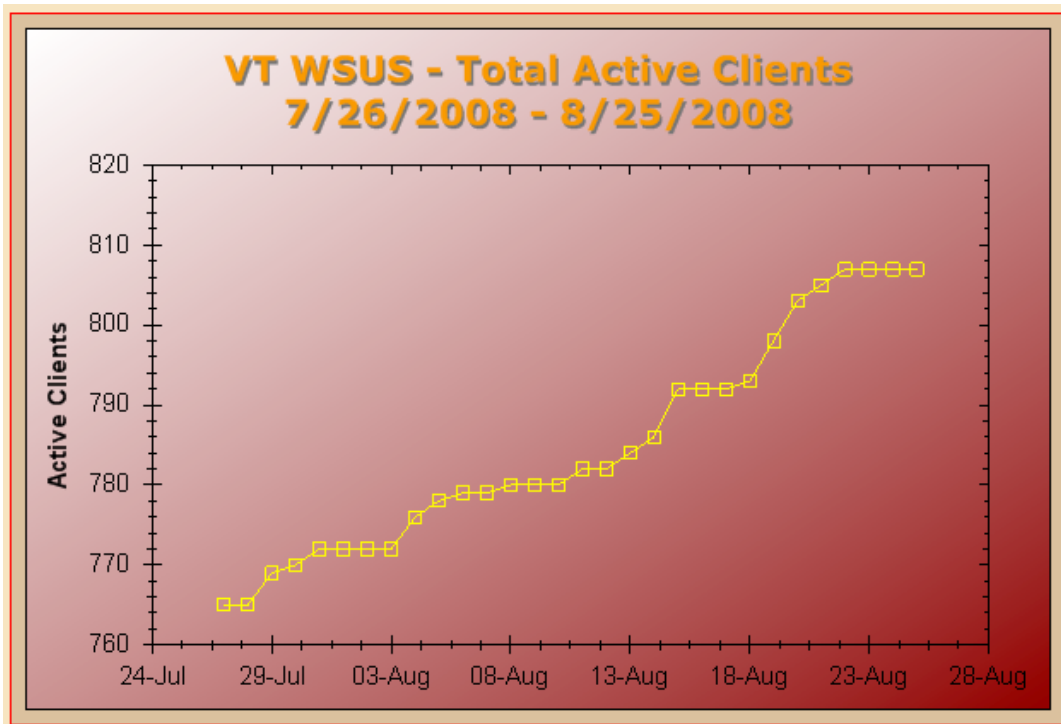
The services developed by MIG are monitored for usage. More people are adopting Virginia Tech's Windows Software Update Service (VT WSUS), and MIG's open source packages continue to be downloaded.





(Most clients patched within 3 days)





Open source downloads

authad_v1.4	173
daisy_v2.2	3225
DictionaryFilter_v2.1	669
Faith_v1.01	471
Ivy_v1b22	223
OUadmin_v1.0	146
Portinator_v1.0	182
SafetyNet_v1.0	627
SelfService_v2.3	412
VTwsus_v1.0	93
Win32_perms_v0.2	60

Middleware Services

The Middleware Services (Middleware) group is responsible for research, development, and implementation of infrastructure components to support identifiers, and authentication and authorization services. Some of these infrastructure components include directories, directory-enabled applications, and messaging systems. Projects focus on creating, maintaining, and enhancing the Enterprise Directory (ED), a key infrastructure component that serves as a repository for much of the person, group, and service information required by applications. Among other things, the Enterprise Directory contains the Personal Identifier (PID) for Virginia Tech affiliates. This year's Middleware projects included Shibboleth, guest access and entitlements, and group management tools.

Shibboleth. The Shibboleth service interfaces with the Virginia Tech Enterprise Directory to enable identity management through federations such as InCommon (www.incommonfederation.org/). InCommon membership allows Virginia Tech students and faculty and staff members to use their PIDs and passwords to access services provided by InCommon service providers, eliminating the need for multiple user accounts and passwords. Shibboleth is currently being used with DreamSpark (<https://downloads.channel8.msdn.com/>) and VIVA (<http://pbsvid.itc.virginia.edu/>) services.

Guest access and entitlements. Middleware provided the LDAP support and development work to provision and de-provision guest accounts and to allow guests to change their passwords. A guest is a person who is identified using only a third party e-mail address. Middleware collaborated with IRM and Application Information Systems to provide an infrastructure that multiple applications can use to allow a Virginia Tech affiliate to invite a person to create a guest account. The Virginia Tech affiliate can also allow a guest to view their information by using an entitlement. The entitlements are contained in the Enterprise Directory.

Group management tools. A group is an arbitrary collection of people who are identified in the Enterprise Directory. Groups allow services to make authorization decisions based upon something other than a person's ED affiliation. Formerly, IRM managed all groups, adding and

deleting members upon request. Middleware developed group management tools to move group management into the hands of the owners and administrators of the groups, relieving IRM of this burden.

Detailed Middleware activities

LDAP

- Upgrade to Open LDAP version 2.3.39
- Overlays can be configured with cn=config
- Services now use serviceDN, making certificate revocation easier
- cn=monitor ORCA graphing now in place
- Hardware upgraded to 64bit, 8G machines
 - All of the database now runs in memory.
- Improved employee confidentiality implementation

Software development

- Upgraded from EJB2 to EJB3 for all entity beans and session beans
 - added unit tests to all EJB3 beans which greatly improved quality assurance
- Added entitlement functionality
- Added guest access functionality
- Updated group implementation to support additional features
 - group member suppression
 - person and service managers
 - service administrators
- Added person delete and archive functionality
- Updated mail functionality to support local mail delivery and multiple forwards
- Updated services to support multiple contacts and certificates
- Refactored scheduled tasks to support new features, such as guests, entitlements, tickets, and person archiving
- Created new library to support contract first Web service development
 - Exposed group management Web services
 - Exposed entitlement management Web services
 - Exposed guest management Web services
- Developed Spring Web application for group management
- Developed Spring Web application for guest access validation and management

Replication

- Performance improvements increased speed by a factor of three
- Removed dependency on Oracle database triggers for Registry replication

Directory Administration Tool

- Added entitlement management
- Added guest management
- Updated group management to support new features
- Added name reservation management interface
- Improved query performance
- Added sorting to many multi-value fields

Central Authentication Service (CAS)

- Collaborated with CNS to add support for mobile devices in CAS UI
- Ported the VT CAS project to the Maven 2 build system

Shibboleth

- Deployed Shibboleth 2 IDP in standard 3-tier fashion on ASH platform
- Contributed several bug fixes to the Shibboleth 2 project
- Developed wiki documentation for Shibboleth IDP including high-level overview and technical details on attribute release

Miscellaneous

- Created crash and burn Registry instance to facilitate testing and development of new features that impact the Registry database schema
- Addpartial overlay accepted into OpenLDAP as a contrib module.

Test and Deployment

If the Test and Deployment (TAD) Team's efficiency were measured by the number of issues worked divided by the number of person hours, their efficiency would have increased over last year by 48% (1.99 issues per person week increased to 2.95 issues per person week). However, closer analysis of issue resolutions shows a number of reported issues which were working as designed, duplicated by other testers, or miscommunications between developers and testers. To remedy this problem, the group's Information Technology intern interviewed each class of user of the Jira issue tracking system—testers, developers, reporters, and sponsors—and the testing group will use the notes from these interviews to design a better testing workflow. This redesign should provide for testing which is truly more efficient, with better problem detection and resolution, better communication between developers and technical support staff, and a realistic usability project for the group.

Testing for the eProvisioning Group. Changes in the eToken hardware, middleware, and the need to retest the middleware for each new browser release generated a lot of testing work this year. TAS 2.0 will allow user certificates to be written on higher memory tokens, with discrete

profiles for digital signatures, and TAS 2.0 was tested for each of its roles: registration and certificate authorities, inventory manager, role manager and others. eProvisioning's HTML improvements to the Leave Report signing pages were tested on each platform and browser. Web Sign-on and CAS were also tested for future use with eTokens.

Testing for the Microsoft Implementation Group. The group tested a new feature in Hokies Self Service that allows an Exchange user to specify an e-mail alias in place of an @exchange.vt.edu e-mail address, thereby masking his or her PID. We learned that we need a better way to test e-mail services, and we also learned that faculty would like to be able to filter their Exchange mail by specifying different aliases for the different courses they teach.

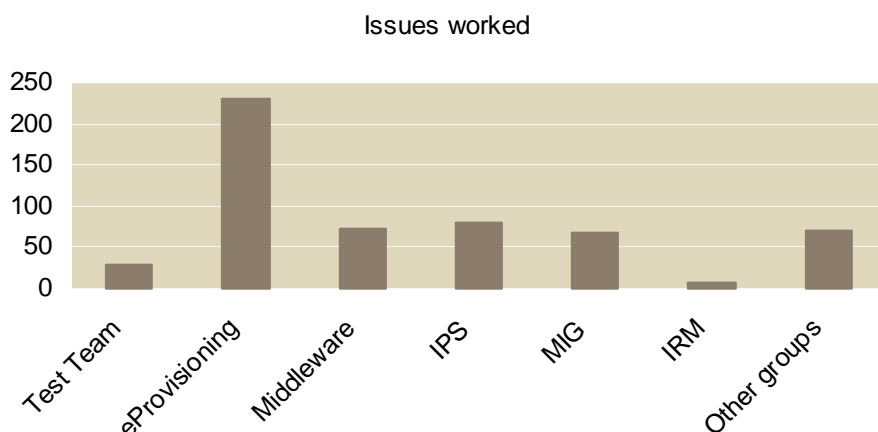
TAD tested the long-awaited MyStore2, which provides NAS space for individuals. It was a great pleasure to work with Judy Albert on this project.

Testing for the Middleware and Integration and Portal Services groups. Testing for Middleware included a new version of the PID generation tool, an update of the Directory Administration Tool (DAT), and the new group management and Guest Access Management Services. While a few issues failed to be discovered during the test phase for the March deployment, testing for the July was much more thorough, with only one minor bug that was not detected. Some of the data quality issues and usability issues discovered were beyond the scope of the testing, and will be addressed in other projects.

Other activities. An undergraduate intern continues to help with usability analysis and testing. She and another team member designed a Test and Deployment webpage [/www.seti.it.vt.edu/Test-Deployment/index.html](http://www.seti.it.vt.edu/Test-Deployment/index.html), and the team leader described the team's test methodology for other interested Information Technology groups. TAD helped test NetCerts, including providing a student's perspective on the installation instructions.

Test metrics





SETI professional development and education

Certifications: SANS GIAC Certified Forensic Analyst: Marc DeBonis, Matt Hart, Brian Long, Steve Warrick, Randall Price. Marc DeBonis and Randall Price were asked to become SANS mentors based upon their high testing scores.

Presentations

Marc DeBonis, “Email Preference Project,” DCSS October 2007; “Building Self-Service IT Applications, Services and Systems,” Virginia Chapter of Association of Collegiate Computing Services, April 2007; Microsoft Vista and Security, New Technology Council meeting held at Hollins University

Mary Dunker, “Who are you? Leveraging PKI for Digital Signatures at Virginia Tech,” Educause/Intenet2 Security Professionals Conference, April 2008

Training and conference participation

Frank Galligan, Ismael Alaoui, J.R. Fleeman, and Doug Atwater attended SANS Internet Security Training Workshop, AUD521, SEC512, SEC531, SEC601, March 2008.

Frank Galligan attended PKI Deployment Forum, April 2008, Madison, Wisconsin.

Ismael Alaoui attended RSA Conference 2008, April 2008.

Mary Dunker was on the Program Committee and chaired the Technology track for the Educause Mid Atlantic Regional Conference, January 2008

Jack Noll attended Web Standards: Making Accessible Web Sites, February 2008; Introduction to Ensemble CMS, April 2008; Using Ensemble CMS (Section 4 & 5), April 2008

Marc DeBonis, Matt Hart, Randall Price, Steve Warrick attended Subversion training.

Marc DeBonis, Matt Hart Randall Price, Steve Warrick attended Microsoft SharePoint Administration, hosted by Microsoft Implementation Group.

Cindy Woods engaged a Unix self-paced tutorial.

Cathy Winfrey, Brian Long attended training in Spring Web services.

Service in organizations and consortiums

Marc DeBonis is Virginia Tech's representative to the Microsoft Macintosh Business Council.

Mary Dunker co-chairs the Educause/Internet2 Security Task Force Effective Practices Working Group.

Mary Dunker is Virginia Tech's administrative contact for InCommon (www.incommonfederation.org/).