From the Office of the Vice President for Information Technology

Annual Report 2006-2007

VirginiaTech

Table of contents

Information Technology

The major organizational units of Information Technology are:

- Administration and Planning, led by Jeb Stewart, with responsibilities for administration, Information Technology Acquisition, planning, policy, and communications
- Research Computing, led by Terry Herdman, with responsibilities for research computing infrastructure, computational science & engineering outreach, high performance networks, terascale computing, and research computing application support
- eCorridors, led by Brenda van Gelder, with responsibilities for Information Technology outreach programs and initiatives coordination, the e-Corridors project, and Information Technology organization sponsored research development and coordination
- Enterprise Systems, led by Deborah Fulton, with responsibilities for Administrative Information Systems and General Enterprise Systems
- IT Security Office, led by Wayne Donald, with responsibilities for the Security Lab and Information Resource Management
- Learning Technologies, led by Anne Moore, with responsibilities for Computer-Integrated Classroom Support, the VT STARS program, Test Scoring Services, Assistive Technologies, Digital Imaging, Educational Technologies, Facilities Design, Classroom Support, and the Graduate Education Development Institute
- Network Infrastructure and Services, led by Judy Lilly, with responsibilities for Systems Development and Administration, Business Technologies and Services, the Blacksburg Electronic Village, Field Engineering and Service Operations, and Network and Systems Engineering
- Secure Enterprise Technology Initiatives, led by Mary Dunker, with responsibilities for Testing & Deployment, Middleware, E-Provisioning, Collaborative Technologies Unit, and the Microsoft Implementation Group

More on the organizational structure of Information Technology can be found at the website *www.it.vt.edu*.

Management Agreement

Under the Restructuring Act, the Management Agreement puts oversight of Virginia Tech's information technology under the oversight of the board of visitors. During the fiscal year, required instruments for the agreement were put into place.

These included policies and standards for

- security;
- infrastructure, architecture, and on-going operations;
- accessibility;
- project management.

The security policy complements the previous policy on information technology security (*www.policies.vt.edu/7010.pdf)* and establishes the best practices recommended in the "Code of Practice for Information Security Management" published by the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC 17799) as the basis for security, along with compliance with applicable regulations such as the Family Educational Rights and Privacy Act, Gramm-Leach-Bliley Act, and the Health Insurance Portability and Accountability Act (*www.policies.vt.edu/7200.pdf*). The accompanying standard (*www.it.vt.edu/Security%20Standards.pdf*) outlines what Information Technology will do and what each university unit must do in several areas of security.

The policy on infrastructure, architecture, and on-going operations establishes the authority to maintain standards and guidelines that for key information technology (*www.policies.vt.edu/7205.pdf*). The standards themselves are in the companion document (*www.it.vt.edu/IAO%2012Feb07.pdf)*

Policies for accessibility and project management (http://www.policies.vt.edu/7215.pdf and http://www.policies.vt.edu/7210.pdf) establish the required directions for these areas. The standards for each are managed through websites (*www.itplanning.org.vt.edu/pm/* and *www.accessvt.atc.vt.edu/*, respectively).

Open source development

"Open source is a set of principles and practices that promote access to the **production** and **design** process for various goods, products, resources and technical conclusions or advice." *Wikipedia.*

Information Technology promotes the development of open source software development collaborations, believing that the collaboration inherent in open source is likely to produce more robust software that meets a broad range of needs, that the software is adaptable over time, since it can be molded to meet emerging needs, and that problems are fixed more quickly with more interested attention to solutions.

Contributions to open source projects and development with open source code are being made actively by groups within Information Technology:

- Virginia Tech's **Scholar** project, and the associated electronic portfolio and **course evaluation system development** undertaken by Learning Technologies
- **Find_SSN,** a tool to detect Social Security numbers stored on local computers and devices, developed by the Information Technology Security Office
- SETI's Microsoft Implementation Group continued contributions and updates to desktop management and security applications (*http://opensource.w2k.vt.edu/download_stats2.php*)
- The use of Hibernate by the Information and Data Warehouse group in Enterprise Systems to enhance **Web Job** and **Web Distribution** applications
- An open source product, **Internet Messaging Program** or IMP by Horde, implemented Fall 2006 by the e-Communications team within NI&S
- **uPortal,** the free, sharable portal developed by institutions of higher-education and used by SETI's Collaborative Technology Unit for the university general portal, My VT
- **Central Authentication Service,** enhanced by CTU for an expanded client services base
- Upgrading and performance tuning of **OpenLDAP** for the Enterprise Directory by SETI's Middleware group
- The **VT User Certification Authority**, established September 20, 2006, the basis for individual digital certificates and built on OpenCA
- **JasperReports**, a Java-based, open source, reporting tool, replacing NI&S's ATLAS Oracle Reports

Tablet PCs in the classroom

Virginia Tech's College of Engineering began requiring incoming freshmen to purchase tablet PCs in the fall 2006. Combined with newly implemented DyKnow software and with the wireless network, the required tablet PCs had the potential to transform the

traditional classroom into a dynamic and engaging environment for learning.

Early trials demonstrated that using these tools in a classroom over the wireless network was unsatisfactory. Problems were especially noticeable in large lecture halls. Using wireless networks in areas with many simultaneous users had previously been discouraged. There are no industry-accepted guidelines on how to deliver content in such an environment.

Information Technology staff members in Network Infrastructure and Services and in Learning Technologies collaborated with the College of Engineering to establish the appropriate learning environment for a freshman engineering class of 300-students. The resulting specifications are a valuable resource for advancement of both a standard architecture for wireless networks, supporting synchronous and collaborative computer learning in lecture halls, and guidelines for related applications development and implementation.

The software used in this is environment is DyKnow Vision. DyKnow is a Web-based tool used to foster interaction through collaborative note taking, student response tools, content replay and more. Learning Technologies staff provided helpdesk, user account administration, and in-classroom assistance as well as Faculty Development Institute classes in using the software.

This collaboration was recognized by a 2007 Laureate Medal at the Computerworld Honors Program (*www.eng.vt.edu/news/article.php?niid=920*).

Professors Tom Walker (left) and Joe Tront (right) are key instructors in the DyKnow-wireless collaboration.

Spam

Unwanted, unsolicited e-mail doesn't just seem to be increasing, flooding e-mail systems and inboxes. Spam is on the rise. Recent estimates put spam volume at nearly 90% of all e-mail. The Federal Trade Commission issued a white paper at the end of 2007 labeling spam as "one of the most intractable" problems facing consumers. The volume of spam is exploding, and the technology for generating it is helping. Malware in the form of malicious bots is used to infect a host computer and serve as the basis for anonymous spamming. Anonymity is all the more important to spammers as the nature of these e-mail moves to phishing for identity theft-based financial crimes.

Procedures and techniques for managing spam for the organization is one component of reducing unwanted e-mail, a particularly difficult challenge in the heterogeneous environment of institutions of higher education. Among the actions taken this year by the E-Communications group are the following:

- Continuing actions to evaluate and block abusive spammers, the E-Communications group now blocks nearly 25,000 IP addresses;
- The junk mail quarantine system, Junk Mail Manager (JMM), in beta testing during this year, puts more control of spam management in each user's hands;
- Moving the greylisting product, MailHurdle, from testing to production, limits the number of e-mail received from spam-generating software.

Unit reports

eCorridors

The eCorridors unit serves as a window on the Information Technology initiatives that support Virginia Tech's mission of learning, discovery, and outreach. 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 faculty member Brenda van Gelder, and, in 2007, included two full-time staff members and 1 graduate student.

Learning

The eCorridors website (*www.ecorridors.vt.edu*) is available to the general public as the 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 impact higher education; and on network security concerns and opportunities.

eCorridors is 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.

Research

Part of Information Technology's 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. Staff members understand 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, e-commerce, 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.

Research support activities this year include the following:

- Documenting and assessing the resiliency of communications infrastructure for a large region of Virginia as part of a multi-university initiative led by the Center for Disaster Risk Management
- The development and proof-of-concept for an enterprise GIS information system and associated database management
- Analyses of broadband pricing, performance, and availability data for the state of Virginia

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. Some of the eCorridors outreach efforts in 2007 include the following:

- Legislative policies mapping and associated analyses
- Community broadband map and broadband speed test and the associated analyses
- Participating in national and regional working sessions to assess and document critical communications infrastructure resiliency and recovery
- Consultation with planning commissions and municipal organizations on broadband and wireless networks
- Participation and advocacy at all levels of government on network policy and legislation pertinent to higher education and rural community interests

eCorridors' 2007 policy agenda

- Network neutrality
- Emergency communications

- Disaster recovery/ critical infrastructure
- Identity theft and network security
- Municipal networks
- Data retention

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.

The Enterprise Systems organization is divided into two groups: Administrative Information Systems, which coordinates application software and Information Warehousing and Access, which supports the information warehouse, database management, user documentation, and Web hosting. The functional objectives of these units include the following:

- 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 continued 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 creatively utilize information 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

During this past year, initiatives of Enterprise Systems included several programs:

Research administrative system
Initiated a collaborative partnership with SungardHE to develop a comprehensive research administrative system that includes electronic proposal development, a principle investigator and grant administrator portal, effort reporting and labor redistributions, and expanded research reporting
The partnership specifically focuses on tools to promote increased research activity and improved research compliance.

Nolij imaging system
Worked with Nolij Corporation to redesign the Nolij imaging system to meet industry standards for secure document processing and management
Began project planning for enterprise deployment of the system

Portal application integration
Began work on expanding usage of My VT as an application integration platform that promotes collaborative, intuitive application interfaces
Met with various campus units to explore new directions and usage of the My VT environment

Content management system
Participated in specification and selection process for university content management system
Began project planning process for system implementation

Student data marts
Implemented the student registration and student enrollment data marts including reporting and *ad hoc* usage

April 16th response support
Supported response activities for the April 16th tragedy including reporting, website support, academic process and end-of-term changes, and memorial fund processing
Participated in implementation of 3n emergency notification system

For the coming year, Enterprise Systems' objectives and goals include the following:

- Develop and implement reorganization of Enterprise Systems organization to better address application coordination and university project initiatives
- Develop charter for portal and a process for expanding My VT as an enterprise application integration platform
  Begin enhancing the system to enable broad adoption by students, and by faculty and staff members for academic, research and administrative services
- Begin implementation of research administrative system with tools to promote research activity, support principle investigators and grant administrators, and promote research compliance
- Begin implementation of an enterprise imaging system that has the security and infrastructure needed for enterprise-wide deployment
- Develop plan for warehouse usage and expansion that promotes the warehouse as the source of university-wide analytical and reporting information
- Develop systems and processes that specifically target departmental information needs using the warehouse, portal, and other application services
- Refine and improve processes for management of Enterprise Systems' project portfolios, projects, resource prioritization, and software development
- Provide support for the university accreditation reaffirmation and work with academic administration to develop a more integrated portfolio of academic administrative software

Administrative Information Systems

Administrative 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. Administrative Information Systems consists of teams for Advancement, Human Resources, Student Systems, Enterprise Systems Support, and Finance.

The focus of Administrative 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. We did not receive a major upgrade this past year, but did convert the Oracle database that supports Banner to Oracle 10g.
- 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.
- Technology support for the university's comprehensive campaign
- Several AIS teams assisted and supported university areas following the April 16th tragedy.

Advancement Team

The Advancement Team completed 2836 service requests, an 8% increase from 2006, including 1623 production control, 688 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 cleanups, report analyses, validation table updates, and new tables and 525 desktop support requests.

Activities

- Implemented version 7.2 and 7.3 of Banner advancement software
- Tested, troubleshot and verified the Oracle 10G upgrade
- Members of the Information Technology staff helped research, identify and update over 10,000 new donor records following the April 16th tragedy, including entry of 5,010 new donor records
- Answered telephones for donations during telecast of *Meet the Press* and *Oprah* when stories about the April 16th tragedy aired
- Coded all relatives of April 16th tragedy so they would not receive solicitation materials or other mailings from Virginia Tech
- Provided 10 workstations and monitors, moved them and installed them in McBryde for Engineering staff relocated due to April 16th tragedy
- Set up workstations in the University Gateway Center for all Engineering development staff relocated due to April 16th tragedy
- Modified the online giving page to accept gifts to the Hokie Spirit Memorial fund, to display that fund name in bold orange and to accept a post request only from a VT server (due to other online giving sites accessing our business logic and posting data to our servers)
- Batch updated address, phone, e-mail addresses, and some employment history data received in final files from the Harris Alumni Directory project
- Implemented the credit card payment gateway into the online giving page that received over 17,000 gifts this fiscal year
- Created multiple reports in support of the comprehensive campaign including a report to generate the invitation lists for the National and regional campaign kick-off events, a report on regional campaign giving, a report of endowments by purpose, several regional campaign reports and a report to be used in Peer review screenings
- Added a section to the prospect profile highlighting all campaign and presidential events attended by the prospect

- Participated in Annual Giving task force
- Developed and trained all fundraisers on Phase II of Moves Management.
- Created geographic regions defined in Banner for each campaign region
- Updated addresses, telephone numbers, birthdays from Alumni Finder data file
- Update mailing addresses with data returned from US Post Office address change service for VT magazines that were not deliverable
- Created pledge creation process for all Hokie-Matic pledges
- Provided data to HEP for net-worth screening
- Created a new report for Donor Relations about advancing members of Ut Prosim and Caldwell gift societies
- Janet Linkous and Pam Croy attended the 2007 Sungard Summit Conference.
- Completed fiscal year-end archival of SmartCall databases
- Completed testing of IPSEC firewall to determine feasibility of strictly firewalling active directory domain controllers under Windows Server 2003
- Secured Internet Explorer ActiveX vulnerabilities
- Moved all servers to University Gateway center, provided technology solutions in both the new location and all old locations concurrently
- Moved and set up over 180 work stations in the move into the University Gateway Center
- Set up all printers, copiers and fax machines in the University Gateway Center
- Peter Franchi attended SANS security training
- Siegfried Hill attended SANS security training, renewed his SANS certifications, and was a member of the SANS Advisory Board.

Enterprise Systems Support Team

In the past year, Enterprise Systems Support (ESS) provided operational support to the purchasing, software sales, and software distribution functions of Information Technology Acquisitions (ITA). Prior to FY 2006, ESS was devoted to migrating ITA's core operations to platform-independent, Web-based applications. With this move completed, ESS was able to focus on enhancements, additions, and on-going support of systems that support ITA efforts. Some of the accomplishments of the past year were visible to users, such as user interface and business process changes requested by ITA. Other work, including server upgrades and documentation development, was completed as an investment in the future of ITA computer systems and applications.

Major activities in the Enterprise Systems Support Team this past year include:

- Implemented a Web-based licensing process to license 400 engineering students in a pilot LabVIEW trial
  National Instruments was interested in this project and recently came to visit to review our progress. Because of this project, National Instruments agreed to provide free perpetual maintenance upgrades to all future licenses sold to Virginia Tech students.
- Made significant changes to the software server rule set for Campus Agreement
  The Campus Agreement contract grew to include over 100 departments and 10 enrollments this year; therefore, the rule set on the software server had to grow to accommodate this complexity.
- Developed new Web tools to help manage these large rule sets that include hundreds of access rules
- Added new functionality to the student point of sale system to check a student's eligibility to purchase specific software products at the time of sale
  The new system incorporates the same rule-based system used on the network software server for student access.
- Integrated ED-ID into the student software point of sale system for better authorization of students purchasing software
- Worked on major upgrades to improve Java frameworks used for authorization and upgraded the main source code development system from Apple XCode to eclipse/WOLips
- Added to the software server list of titles
  Sixty software applications, over 300G of software, are now available on the server. Server activity has increased steadily over the last four years as noted below.

Software server connections by fiscal year

Fiscal year	Software server connections
2004	6,050
2005	9,151
2006	20,423
2007	29,031
Total	64,655

Finance Team

AIS Finance continues to provide support for Banner Finance and assist the Controller’s Office functional areas and their customers in the financial duties of the university. In addition, we are providing new functionality, new system integrations, and implementation of new systems to support those areas. The Higher Education Restructuring Act has placed demands on the

university financial systems as we assume processes from the state and implement methods for operating independently while still providing quality information to central state agencies.

The HokieMart e-procurement system continues to demand resources from the AIS Finance team as we improve and expand the integration with both the university's Banner system and the commonwealth's e-procurement system (eVA).

Improvements in e-commerce, both university to business and university to customer, have been a primary focus this year. E-procurement, e-payment, and e-billing have all been expanded and improved. Students and parents are benefiting from the ability to see bills on-line, make payments, and see immediate update of the balances. Further, if holds are in place on a student account due to outstanding balances, we are now lifting those holds immediately and automatically. This ability provides the real time interaction that students and parents are demanding while reducing in-person traffic in the central offices.

We now offer a centralized university departmental billing and payment collection system replacing many smaller systems throughout the university. This service enables consistent and accurate billing, better cash management, easier audit, and reduced workload on departments performing billing and collection.

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

- Completed eVA (state e-procurement system) interface modifications due to significant reduction of p-card use at the university and expansion of HokieMart
- Provided new and improved integration between HokieMart and Banner
- Created new PL/SQL packages to standardize chart hierarchy functions (common code shared across all Banner modules to increase programmer efficiency and accuracy)
- Made modifications to all modules necessary for implementation of the Oracle 10g database
- Implemented electronic payments to Hokie Passport (for Dining and Hokie Passport)
- Implemented a centralized Invoice Imaging system
- Implemented real time e-payment recording, current account activity and hold releases
- Installed Banner Finance 7.2 (including re-applying all local modifications)
- Installed Banner Accounts Receivable 7.3 (including re-applying all local modifications)
- Modifications made to Finance forms/programs due to restructuring
- Updated Refund Flag processing which greatly reduced processing effort in Bursar's office
- Updated multiple AR programs to use new Banner APIs

Human Resources Team

Major activities in the Human Resources team this past year include the following:

- Completed approximately 210 service requests
- Modified, tested, and installed Banner HR 7.2/HR 7.3 including reapplying modifications to Banner HR programs
  Changed Virginia Tech programs to include new columns and to use the APIs delivered in the release
- Implemented changes to the leave reporting system to allow leave reports to be signed digitally through the Web interface
  Implemented a new workflow system for IRM to route the digitally signed leave reports (and any other type document) through a series of pre-defined digital signature levels
  There are currently 438 employees participating in this pilot.
- Worked with the commonwealth's Department of Human Resource Management (DHRM) to develop the beginnings of an electronic interface of information between the university and DHRM
  Comparison program written and tested with DHRM to resolve data translations between the two systems
  The next step is the actual electronic update.
- Modified, tested, and installed the year-end tax and W2 release
  Made additional changes to the W2 and 1042 programs and reports
  Piloted the use of the electronic W2 form through employee self-service (Hokie SPA)
- Worked with the Office of Sponsored Programs to provide reports to track changes to labor distribution on export control grants to answer audit comments
- Provided information requested by Human Resources and the state used as part of the restructuring initiative
- Tested and changed programs to accommodate changes required for the migration to Oracle 10g and cost based query decisions
- Continued to improve the HRIS Web reports to improve the headings, spacing, and related layout based on user input
  Implemented ECLS security in the data warehouse to allow migration of the final users to the new Web reports
- Continued working with the Hokie Passport Office to implement a new electronic interface between HR and their system
- Automated the process used by the Controller's Office to migrate unclaimed paychecks to the unclaimed property system
- Moved PeopleAdmin data into Oracle tables in the warehouse instance to provide greater security and allow creation of reports that are available through Web job submission

- Provided information requested by the university concerning the tragedy on April 16, 2007
- Developed numerous reports to provide information to the state, the executive vice president, and the Human Resources' annual report
- Provided support for the normal yearly processing for the HR system: performance reviews, position roll, salary increases, benefit premium updates, tax updates, CVC, tax shelter limits, leave roll, and related information
- Made on-going, continual changes to the system to improve data quality, system performance, and customer satisfaction

General Team

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

- Implemented Banner General 7.4.1 upgrade
- Began work on the Budget Tuition Online Application Process
- Performed general maintenance on Oracle forms, SQL scripts, and SQR programs

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 to facilitate the performance that the functional areas require. Approximately 195 service requests for modifications/enhancements were submitted during this period.

Corrections and maintenance

- Provided on-going daily support of student/financial aid processes as required
- Participated in the testing and verification for implementation of Oracle 10g in March 2006
- Assisted in the implementation of several point releases for the financial aid module

- Continued to run processes to clear PIDMs associated with recruit records no longer needed thus reducing the size of several general tables
- Expanded the distribution of self-service data extracts from the student data warehouse

Enhancements and expansions

- Continued assistance with the implementation of a software package, Studio Abroad, to allow students to sign-up for offered programs
- Continued to work with IRM to identify and implement additional student affiliations to reflect an individual's relationship to the university
- Continued the development of processes/programs in support of the electronic loan management (ELM) implementation in financial aid
- 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
- Worked on the enhancements to DARS, primarily the implementation of DARS IA, a Web-based service for students to better access DARS information
- Developed views from Banner in support of the SAKAI project, providing course, section, and enrollment data
- Implemented Nolij Transfer in the Undergraduate Admissions office to load applications from CollegeNet and to process other tape loads
- Implemented Nolij Web imaging/workflow system in the International Office of the Graduate School; enhanced a generic image viewer to present images to the Graduate Admissions Analysis system
- Supported the implementation of wider use of Nolij Web imaging/workflow system in the Graduate School
- Enhanced the Web-based advisor comment tracking system
- Continued to enhance the Web for Student and faculty/Advisors capabilities for areas such as the National Student Clearinghouse and University Orientation program
- Continued necessary enhancements to the Undergraduate Admissions data mart
- Implemented a general student data mart, performing extensive data verification and helping to establish quality control checks
- Assisted in the implementation of prerequisite checking during course request and drop/add processing
- Enhanced the processing of Advanced Placement data from servicer
- Addressed data and process issues related to the events of April 16, 2007, including the changing of programs related to end of term processing

Team education

- As needed, continued student module and financial aid module information sessions for team staff members and functional users to help develop a better understanding of all the student processes

General Enterprise Applications

General Enterprise Applications (GEA) enables and supports data management, application administration, and the development of information delivery technologies in order to promote efficient and effective access to the Virginia Tech information resources.

Services of GEA include the following:

- Maintaining the underlying database management system and application administration for the enterprise systems, including Banner, Blackboard, SAKAI, the Data Warehouse, and the production Enterprise Directory
- Designing, and building an enterprise data warehouse to support the management information needs of research, outreach, and instruction
- Editing, publishing, and maintaining technical knowledge for the Virginia Tech information technology community through a group of Web resources including www.computing.vt.edu, *www.it.vt.edu*, *www.pki.vt.edu*, and *www.answers.vt.edu*
- Supporting Web hosting services for colleges, departments, and service units, and fileboxes for faculty, staff, and students

Although the specific units that comprise GEA require different sets of expertise and represent a diverse group of activities, their underlying focus is providing a stable, efficient, and effective information technology infrastructure for the various activities of the university.

GEA provided relevant and challenging projects for two graduate students this past year. The Knowledgebase area employed two students from English as graduate assistants. They learned skills relevant to their area of study, and gained skills and work experience that will serve them in the future.

The Knowledgebase area participated in VT, IT, and You for the second year, and informed incoming students about computing.vt.edu, and answers.vt.edu as resources to help them with their computing questions. Web statistics from computing.vt.edu and answers.vt.edu show a significant increase in user access.

The Data Base Management Systems group made several enhancements to the security of the university's enterprise data base systems, including the development and implementation of a VPN that encrypts data for direct connections to the databases.

The Web Hosting area has worked on several applications to improve monitoring, and security. They were also heavily involved in the identification of requirements for an enterprise-wide content management system.

Information Warehousing and Access created a dashboard for the College of Agriculture and Life Sciences to provide personnel and finance information to the dean and associate deans in an easy-to-use format. They are also working with the Virginia Tech Foundation to create a dashboard for their use. The Student Registration and Student Enrollment data marts were put into production, and the first group of users was trained.

Database Management Systems

The Database Management Systems (DBMS) provides the necessary controls, oversight, performance monitoring, and 24 x 7 on-call response to ensure a stable and auditable production environment for critical enterprise information technology services.

New application software

- DBMS installed new software (DARS IA) that allows student advisors to see impacts on a student's curriculum if the student is contemplating changing majors.
- DBMS also developed and implemented a VPN that encrypts data for direct connections to the databases.

Application software upgrades and enhancements

- 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.
- DBMS systems monitoring software was enhanced to include additional alerts, added application software, and hardware.
- DBMS enhanced software that allows tracking and scheduling of production updates for better security and functionality.
- DBMS worked extensively with the Nolij Imaging System and the vendor to test new releases, modifications, security, and functionality.
- The DARS application was upgraded to a new version providing additional functionality and correcting software bugs.
- SQR was upgraded to new release providing additional functionality and compliance with Oracle and the operating system.
- DBMS worked with Educational Technologies to migrate the Blackboard application to a new release supporting Oracle 10g.

- More than 24 Oracle databases were migrated to Oracle Release 10g during the year. These databases support a host of administrative system throughout the university.
- DBMS conducted extensive testing of all servers, databases, and applications for the daylight saving time change on a new date. Patches were applied for Oracle and the operating systems for compliance.
- DBMS converted database backups to use Oracle Recovery Manager providing more reliable and faster backups and recovery.
- DBMS worked extensively with the Systems Administrators to migrate all Solaris operating systems to Release 10. All servers, databases, applications had to be thoroughly tested. As a result, other software such as COBOL and SQR had to be upgraded as well.
- The Blackboard application was migrated to a Linux operating system. DBMS assisted the Educational Technologies with extensive performance testing prior to the migration.

Education/training

- Two staff members attended SANS security sessions.
- Five staff members attended Tomcat administration training.
- One staff member attended AJAX training.
- One staff member attended Oracle 10g Application Server Administration training.
- One staff member attended the South East Oracle User Conference.

Web Hosting and Filebox

The Web Hosting service provides significant support to academic and administrative areas that take advantage of these services. The group maintains a secure and stable infrastructure that supports over 1,200 websites, including *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, Web Hosting achieves efficiencies for the university and ensures a more secure environment.

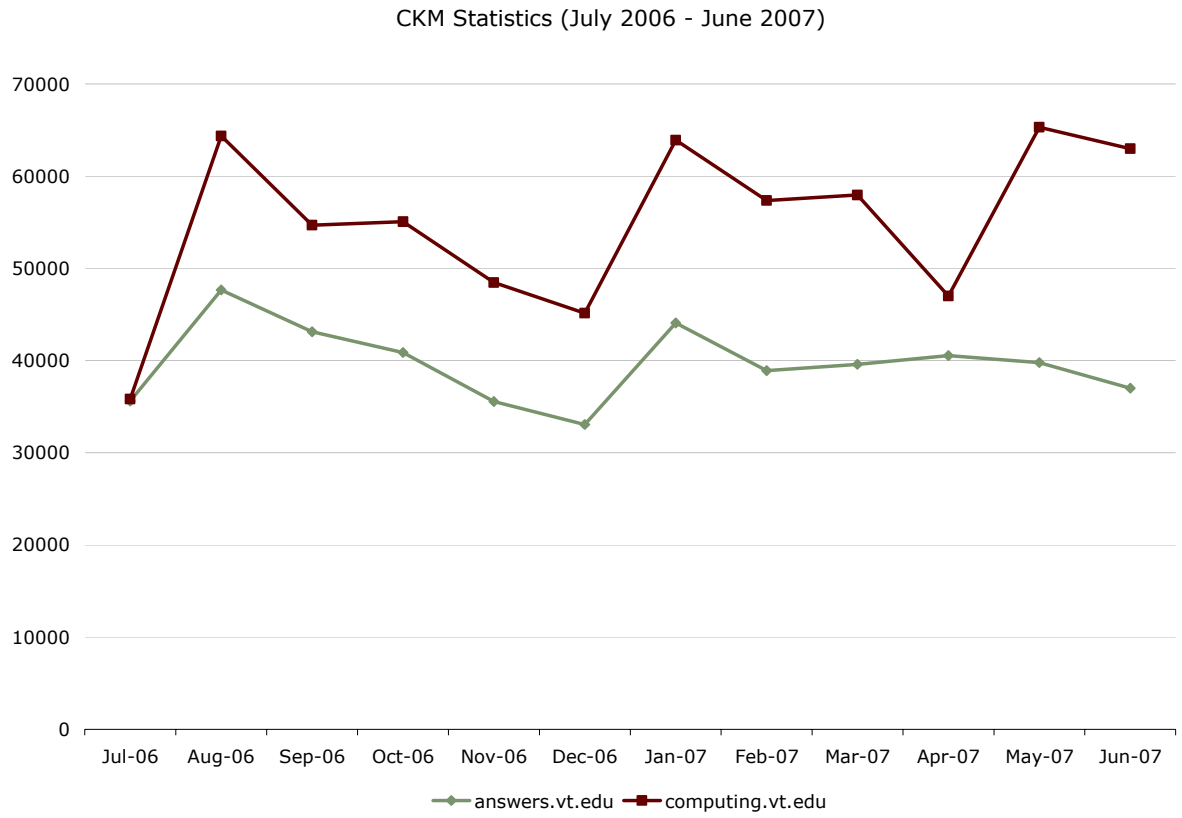
Highlights over the past year include the reconfiguration of the environment to move the university webpage to dedicated servers with load balancing which has resulted in improved performance, reliability, and stability. Significant time was also spent working on the planning for, and selection of an enterprise content management system.

Filebox provides individual websites for over 35,000 students and faculty and staff members. It is also used by the faculty for class projects. Te Filebox service is provided to current faculty members, current staff members, and students. With the introduction of a persistent PID and password for all Virginia Tech alumni and former students, it is now necessary to “clean-up” fileboxes that belong to them. The first phase of de-provisioning fileboxes was implemented.

The Knowledgebase, Computing, and the Information Technology Website

The Knowledgebase (KB) and computing websites provide information about using technology resources and services. The Knowledgebase contains specific “how-to” instructions. Each online access potentially saves a help desk call. The Knowledgebase is also used by the help desk in responding to user questions. The computing.vt.edu website provides general information about Information Technology services. Basic content for KB articles is provided by the technical area of expertise. The KB staff then edits the article to ensure end user comprehension, tests for technical correctness, and applies a style that standardizes the article for readability.

Computing.vt.edu contains over 500 pages of content that are updated upon request. Approximately 1/3 of the pages were updated during the past year. As shown on the following graph, the use of both *www.computing.vt.edu* and *www.answers.vt.edu* continues to increase.



New initiatives and projects. Participation in the VT, IT, and You project at the beginning of the school year was a success. All members of the KB staff participated. They provided new students and their parents with bookmarks containing information about computing.vt.edu and answers.vt.edu.

The Knowledgebase (KB) group established a collaborative working relationship with the 4-Help group to better identify and meet user needs for computing support.

The KB provided articles and computing pages to support several new projects, including

- VTWSUS;
- Junk Mail Manager;
- MySTOR2.

User feedback on Knowledgebase articles. The following comments received from the Virginia Tech community and the global community reflect the user satisfaction with the KB:

Students:

- “Simple and to the point. Thanks!”
- “Well planned - easy to follow - not intimidating”
- “Incredibly well written directions”
- “This was very easy to follow and complete! Thank you from a Masters student who is not so computer savvy!

Staff:

- “I am new in this field and it is really helpful. Thank you indeed!”
- “I had not set up a VPN in over a year, but it was easy using your instructions. Thanks so much!”

Alumni:

- “Great! Step by step instructions were on the ball and easy to follow! Thanks!”
- “I wish all websites had links that were this helpful. Thanks.”

The larger community:

- Independent IT tech from Montréal. “This tip guided me exactly to the solution, Thanks again.”
- Senior citizen with some computer experience.” This helped; the rep at my ISP couldn't talk on my level.”

Education/training. Julia Mays attended the Association of Collegiate Computing Services of Virginia, 2007 conference.

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.

The Data Warehouse continues to grow in terms of volume of data and range of subject areas thus providing a definitive reporting resource for the university. Dashboards are proving to be a popular technique for providing departmental and central office managers with easily obtained business information that helps in day-to-day management decisions.

IWA works together with the central administrative offices and the data users to develop the 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 *(http://www.rkimball.com/*) design methodology. The resulting enterprise data warehouse is used to report across the spectrum of university data for both day-to-day administrative functions and management decision making.

Each night, transactional data from the previous business day is extracted from the Banner transactional processing system and added to the Data Warehouse. The data is restructured in the warehouse so it is easy to understand and use. The Data Warehouse contains data current as of the previous business day, and accumulates historical data that can be used for trend analysis.

The data marts in production at the time of this report are Accounts Receivable, General Ledger and Operating Ledger, Foundation General Ledger and Operating Ledger, Proposals and Grants, Employee, Job Position, Job Funding, Payroll, Position Allocation, Undergraduate and Graduate Admissions, Undergraduate Recruiting and Student Enrollment and Student Registration and Parking Services. IWA works cooperatively with the data stewards in the various business operational areas to provide data and tool training for the users of each data mart.

Accomplishments:

- IWA was audited by University Internal Audit and received the highest rating awarded by Internal Audit.
- The Job Applications data mart using PeopleAdmin data from Personnel Services was designed and put into production. This new data mart enables HR developers to prepare reports quickly for the Provost Office.
- The Student Registration and Student Enrollment data marts were put into production. Initial training has begun for *ad hoc* users and a number of parameter-driven reports have

been created to support the data needs of our users. Subsequently, a number of enhancements were added to these data marts including improvements in data security and additional data elements.

- Modifications were made to the Finance data mart that resulted in the creation of new views for financial transaction data. These changes improved query performance and enhanced reporting capabilities in the annual financial statements.
- The HR data mart had specific data elements added pertaining to deans, directors, and department heads. This addition facilitated easier generation of reports and mailing lists for the departments.
- The Accounts Receivable data mart received a number of enhancements to improve the reporting capabilities.
- Training was provided on the data warehouse, the Hyperion Intelligence Client, query building and dashboard navigation, and data exploration to 102 staff members.
- More than 600 requests for assistance concerning data marts were received. In most cases, answers were provided immediately in response to the questions asked, which reinforced IWA's reputation for excellent customer service and responsiveness to user requests.
- The Office of Undergraduate Admissions data mart continues to be a great success. It contains nine dashboards that support the central office and departments with Admissions information. IWA works closely with the central office staff and departmental members as they develop ad hoc queries or request assistance in resolving data issues.
- The Office of Sponsored Programs data mart is also successful. The Sponsored Research dashboard provides up-to-date information on proposals, awards, and expenditures for the current and previous fiscal years. In addition, a Sponsored Research History dashboard provides users with information on proposals, awards, and expenditures for the entire data history in the data warehouse.
- The College of Agriculture and Life Sciences requested a dashboard to provide ready information to the dean and associate deans in the areas of finance and personnel information. From the initial meeting to providing a completed dashboard required less than 40 hours.
- The Web Job and Web Distribution applications were enhanced with Hibernate—a powerful, high-performance open source object/relational persistence and query service. Hibernate allows for the development of persistent classes following object-oriented techniques.
- IWA provided data mart and dashboard training to more than 100 staff members this year, improving their understanding of the data and helping them to become more efficient in getting the management information necessary for their job. Some sample comments received through the year include the following:
    - I have found [the data warehouse] very useful to be able to provide data that we have been able to use in various ways from our office. … I have found invaluable the ability to be able to change my query, run the data, manipulate the data, and change the query again if needed.
    - Many thanks for the class—it opened my eyes to a tool I think will be a tremendous benefit to us in [my department]. I've already touted it among the other administrators in the department and a couple of key staff. They're eager to watch me use it!

- Thanks so much for getting all of this to us so quickly as I am really excited about getting right to using what I learned today! And also thanks so much for being such a great instructor. The class was very well organized. I learned a lot and greatly appreciate all the work everyone has done to make this possible and available to us!
- I just wanted to drop you a quick email to tell you that I took the Student Data Mart training last week and … I have found the system outstanding – so user friendly and very much serving a lot of my needs for my responsibilities! I can only imagine how much work it took to develop this system – thank you so much for letting me use it!

Web Job Submission and Web Distribution System

The Web Job and Web Distribution applications provide easy access to information through a convenient, intuitive interface. Job scheduling and subsequent e-mail notification of report results enables users to continue to work on other tasks while reports are produced.

The SAS Interactive Application has been added to the Web Report Maintenance application. This feature allows the user to process SAS parameters from the webpage interactively. With the new feature, Interactive SAS reports can be created, distributed to the users, and processed repeatedly by the user to view multi-layers of data as needed. In addition, chaining of SAS interactive reports simulates "drill-down" functionality for the user.

The use of Web job submission and Web distribution continues to expand for jobs that run against both the warehouse and Banner. Web Distribution is the primary way of distributing reports run from Banner Job Submission.

Report Submission

Type	Start Date	Day	Total Executions	Warehouse Executions	Banner Executions	Interactive	Logins	Total Submits	Scheduled Submits	Folder Submits	Definition Submits	Saved Submits
Year	Jul 1, 06		119654	105975	13622	28307	75506	119656	16687	6381	81770	37886
Year	Jul 1, 05		97551	93882	3665	9246	55669	97473	11096	6412	68717	28755
Year	Jul 1, 04		80743	80529	214	14	43480	80750	6143	5171	60294	20455

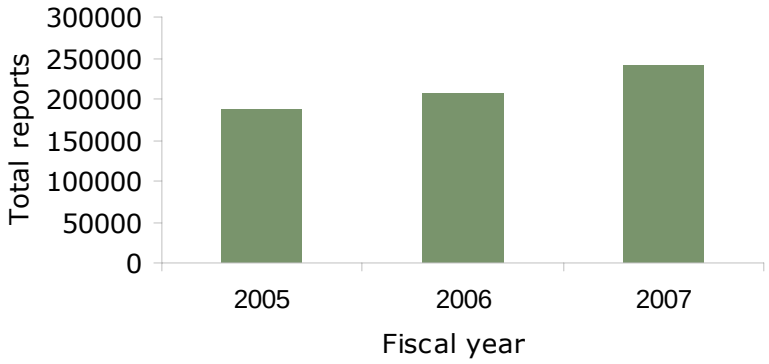
Web Job Submission

Web Distribution

Report Distribution

Type	Start Date	Reports	Sessions	Logins	Views	View Text	View Postscript	View PDF	View EXCEL	Zip	Docuprint	Labels	Local Printer	Distribute	Release
Year	Jul 1, 06	240863	380353	49789	388042	204716	35771	124168	11547	3634	4	263	809	4677	2138
Year	Jul 1, 05	206382	334146	40441	334841	187005	21417	112885	8090	3335	35	289	709	5429	2244
Year	Jul 1, 04	188553	290808	35888	291260	170680	11499	98134	6832	2459	429	348	835	5205	595

Web Distribution



Training and staff development

Vicky Shaffer

Participated in the Higher Education Data Warehousing (HEDW) Forum conference hosted by the University of Texas

She participated as a presenter—Dimensional Data Modeling. She also is serving as the Treasurer for HEDW. Vicky is involved in all aspects of planning for the 2008 conference that will be hosted by Virginia Tech.

Georgiy Kolomiyets

Attended System Forensics, Investigation and Response training provided by the System Administration, Networking and Security (SANS) Institute.

Attended Windows Vista Security training provided by the System Administration, Networking and Security (SANS) Institute

Attended Apache Tomcat training on set up, configuration, security, and deploying Java applications

Attended the Mid-Atlantic Hyperion Users Group Spring meeting

Sonj McCoy

Attended training for Hibernate, an open-source tool used in the Web Job and Web Distribution Applications.

Attended the Mid-Atlantic Hyperion Users Group Spring meeting

Alan Moeller

Participated in the Higher Education Data Warehousing (HEDW) Forum conference hosted by the University of Texas

Alan is working with Vicky Shaffer in the planning for the 2008 conference, which will be hosted by Virginia Tech.

Information Technology Acquisitions

Information Technology Acquisitions' (ITA) mission 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, and Contract Management, Licensing and Billing.

Software Distribution

Software Distribution is composed of two divisions, distributing materials to departments and to students.

Departmental Software Distribution

Departmental Software Distribution is a part of the Software Distribution Office 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 the 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 to this years departmental Microsoft Campus Agreement family include the Departments of Biological Systems Engineering, History, Mathematics, Athletics; the Virginia Maryland Regional College of Veterinary Medicine; the Executive Vice President's office; the University Libraries; and the Virginia Tech Northern Virginia Center. Additionally, we concentrated on obtaining training in new software applications. In December 2006, in cooperation with representatives from Adobe, we sponsored "Adobe Day." This was an open event and provided "hands on" training on the new version of Adobe Acrobat 8. It was such a success that we are in the process of planning another such initiative in December 2007. Other training events ITA coordinated include classes on Filemaker and LabVIEW.

In April 2007, members of ITA made a presentation at the 2007 ACCS conference in Charlottesville, Virginia, which detailed Virginia Tech's distribution and management of licensing and software applications. This demonstration documented Virginia Tech's unique ability to track and manage many different types of licensing methodologies.

This year as licensing and activation methodologies changed in an effort to combat piracy, systematic processes were developed to handle this new type technical monitoring. New releases such as Microsoft's operating system Vista Ultimate had to be managed, as we were no longer able to utilize a VLM code. Instead, each install has a unique key code that must be tracked against a particular ISR.

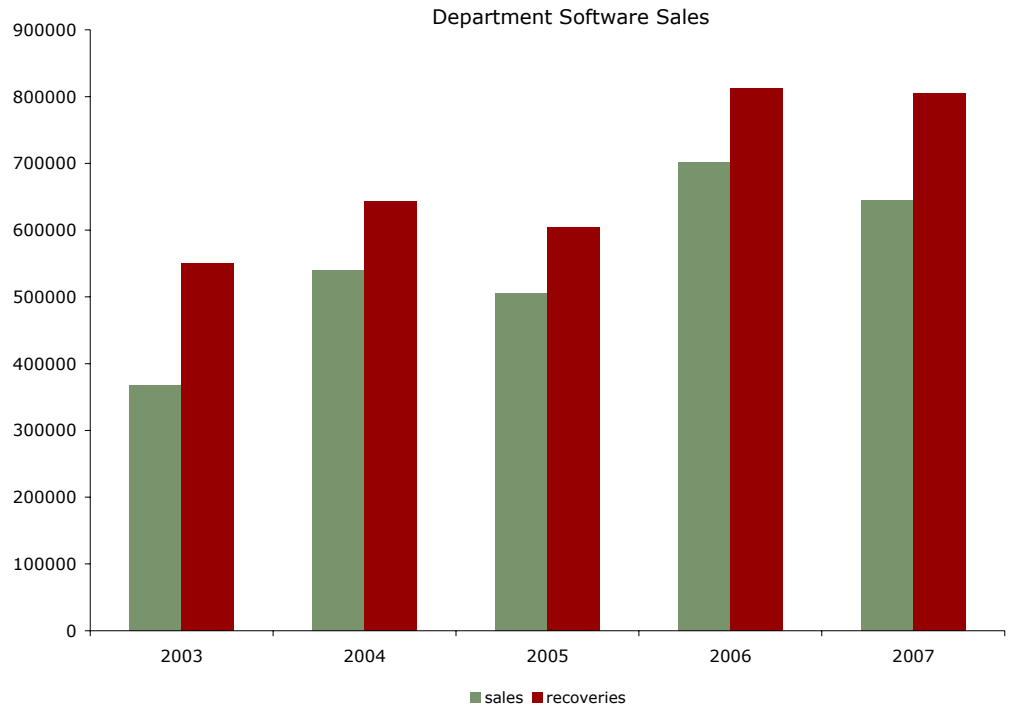
In May of 2007, we hired a new contract and licensing analyst to assist with the management of the numerous complex licensing methodologies that ITA has to administer. Over the last few months, his efforts have helped ITA become more efficient with regard to licensing requirements and compliance with contractual obligations such as Microsoft's Campus Agreement. Additionally, he has begun the search for a new contract management system to help us communicate complex licensing issues to the university as a whole.

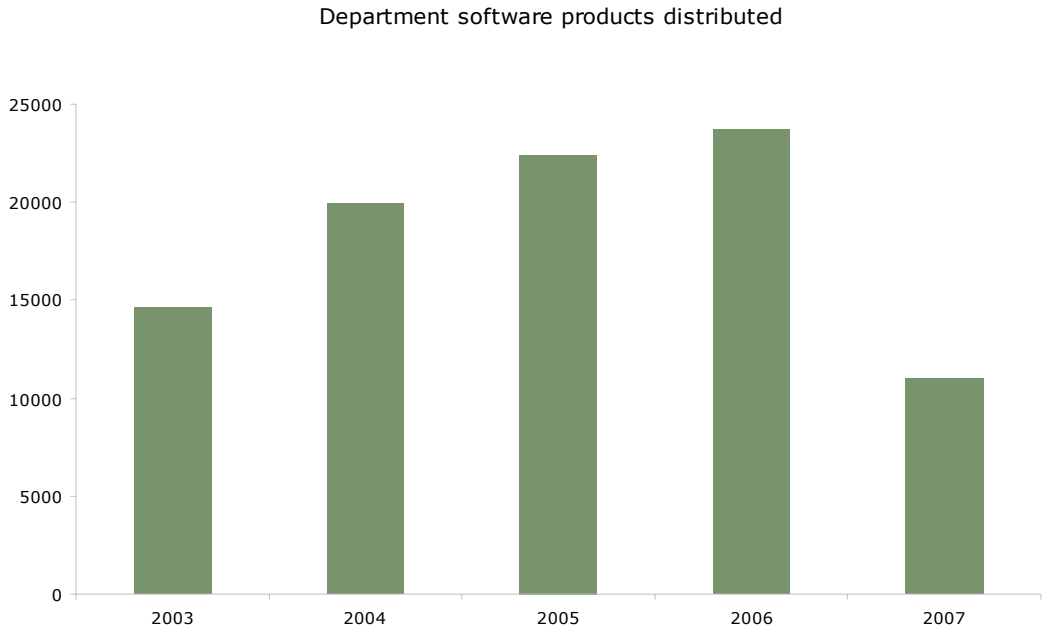
The following graphs show totals per fiscal year of ISRs processed in regard to sales, total items distributed, new products added, and distribution of software by server. Sales billings to departments vary each year based on the mix of products that are purchased by departments. FY2003 was down due to an IT security initiative to provide Microsoft Window XP and Office products at no charge to reduce the number of vulnerable systems. The sales drop in FY 2005 was due to a change in product mix and a drop in price for Adobe, Macromedia and Mathworks products. The increases in FY 2006 and FY 2007 were due to 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 due to ESRI billings to other colleges and universities in the state.

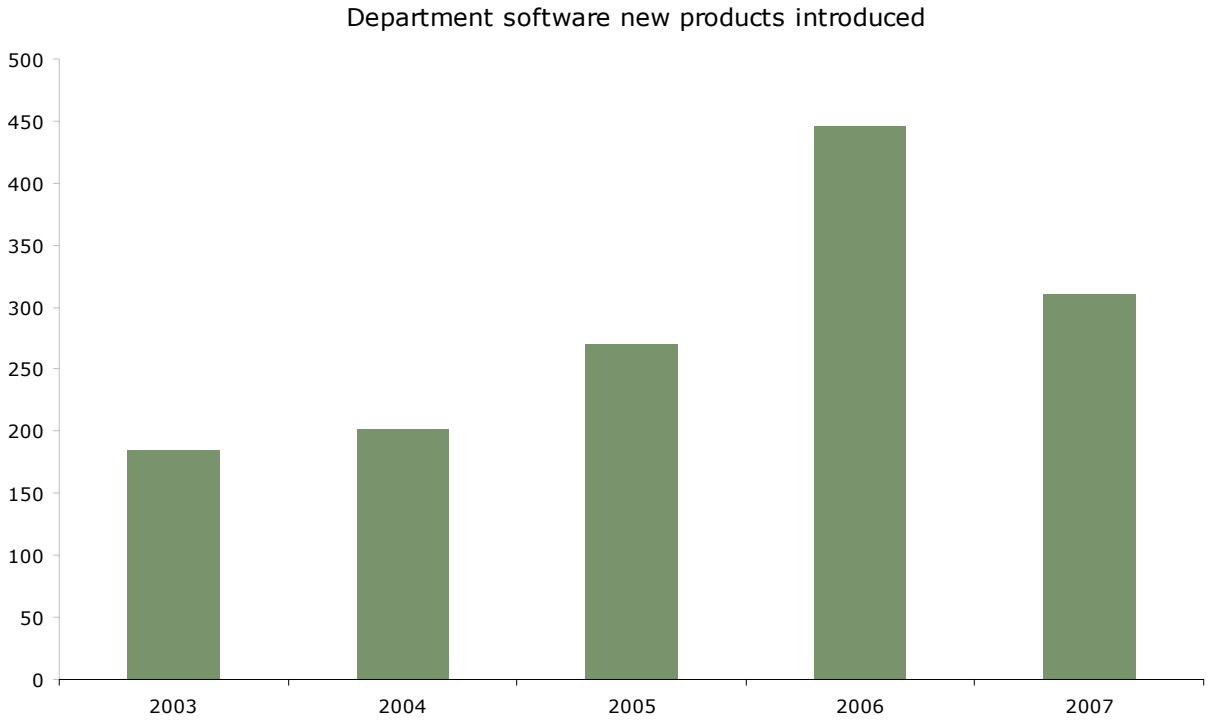
Individual products distributed include licenses, departmental licenses and additional CDs and DVDs purchased. Distribution numbers do not include numbers related to site licenses distributed through the network software installation service. The decrease seen between FY2006

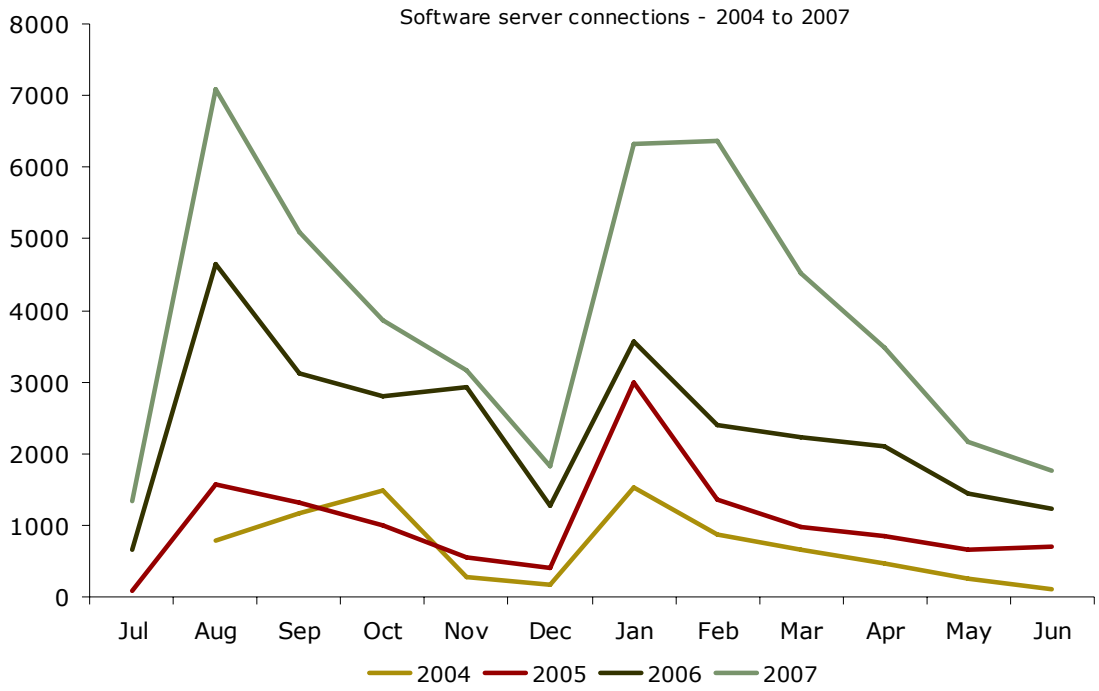
and FY2007 is due in large part to a redesign of the naming convention of many of our products in 2006 and a significant increase in the distribution of Microsoft products on our network server in 2007. The decrease in new product offering has come about as departments establish base product “staples” 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 (for example, 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.

In 2007, we have seen an explosion in the amount of software that is being distributed by download all across the university. As more and more departments are taking advantage of Microsoft’s Campus Agreement (encompassing more than 3400 FTE) to date, the effectiveness of this “just in time” distribution methodology is apparent.




Department software products distributed
25000
20000
15000
10000
5000
0
2003
2004
2005
2006
2007


Department software new products introduced
500
450
400
350
300
250
200
150
100
50
0
2003
2004
2005
2006
2007



Student Software

Student Software Distribution is a part of the Software Distribution Office and is organized as an auxiliary. Student Software Distribution was primarily organized to provide software for the Engineering Freshman Software Bundle. It now handles bundle requirements for seven academic areas within the university and Northern Virginia. Student Software also distributes software to other students, primarily Microsoft Office and Adobe releases. It only handles software that is specifically requested to support an academic program, such as the Freshman Engineering Bundle, or is only available as an add-on to a current university contract and the software is available to students at a price that is significantly lower than otherwise available.

Figures 5 and 6 below show total sales by fiscal year and total products distributed through those sales. The sales drop in FY 2005 was due primarily to the decrease in price of the engineering freshman software bundle. Since fiscal year 2002, the price of the bundle has dropped from close to $500 to $398 in fiscal year 2006. This changed was accomplished through better pricing obtained on the components of the bundle. The sales increase in FY 2006 was due primarily to 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 in FY 2003-FY 2006 primarily due to the factors noted above and an increase in the number of free upgrade trade-ins processed. The decrease in distribution shown in FY 2007 is primarily due to a significant delay between our ability to acquire Microsoft's new release of office and the last date to purchase the previous version.

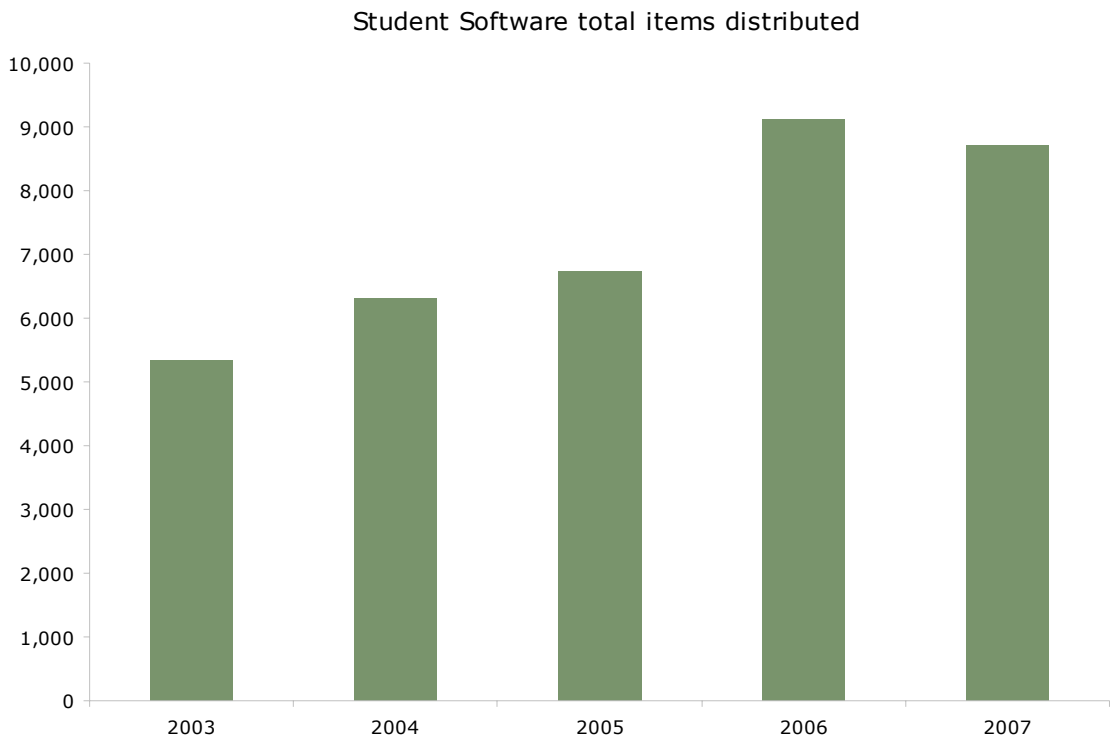
Figure 6 below, Software Server Connections, shows the explosive growth we have experienced in distributing software to students and departments via downloads or virtual mounts. We now offer 76 software titles on the network software server. We continue to invest in new hardware and software to stay ahead of this demand.

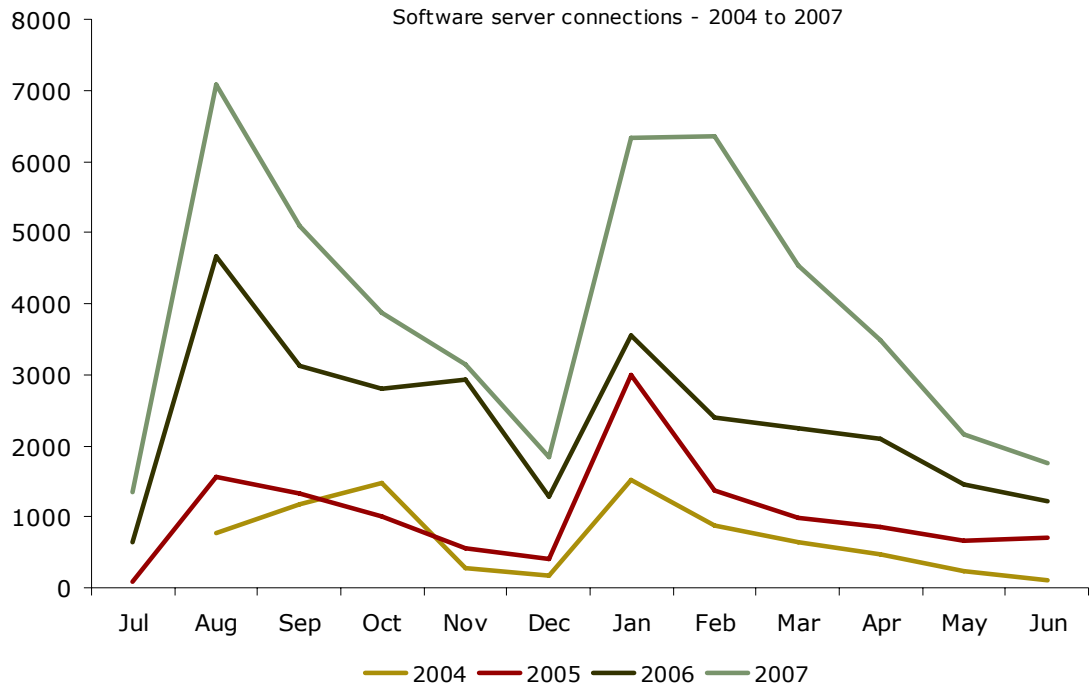
New initiatives such as National Instrument's LabVIEW allowed us to enhance the contribution that we make in support of the academic mission of the university. Together with representatives from National Instruments, we successfully designed a deployment system that can be utilized by universities throughout the country. The program began as a request from the College of Engineering at the beginning of 2007. The technical staff of ITA soon realized that if we were to meet the needs of both entities that an entirely new system utilizing FlexLM would have to be developed. In the spring of 2007, a pilot of the deployment system was launched with 400 engineering students. The success of the pilot led to only minor modifications to the system and a full deployment was released this past fall.

The year 2007 brought about several new product releases along with new licensing methodologies. This year Microsoft's Vista Ultimate and Parallels required individual key codes that had to be tracked. Just recently, in partnership with ELI, ITA began offering Auralog Tell-Me-More licenses and training opportunities to the university's foreign language departments.

The fall 2007 student Virginia Tech Information Technology initiative was record setting for the department. This year we set an hourly record (158 sales), a daily record (989 sales), and a five day total record (3051 sales) while wait time never exceeded 16 minutes. To date, we have sales totaling over 7500 units. This year vendor participation was up with the inclusion of National Instruments, Apple, Microsoft, Fujitsu, and Adobe.

As on the departmental side, ITA served as a valuable resource to departments that were in need of product negotiation with vendors. Products such as PDF Annotator 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.


Student Software total items distributed
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2003
2004
2005
2006
2007


Software server connections - 2004 to 2007
8000
7000
6000
5000
4000
3000
2000
1000
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
2004
2005
2006
2007

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 holds the VASCUPP contracts for ESRI software (GIS software) which now includes all middle and high schools in the commonwealth, BlackBoard and Angel (Learning Management Systems). They handle billing for both Student Software and Departmental Software. This section also manages most of the technical aspects related to software distribution with regards to

- developing new distribution CD's (e.g., reducing the SAS distribution from 23 CDs that are sent from SAS to one DVD for distribution to departments and students);
- creating and managing license codes (e.g., creating the yearly Matlab key that terminates on a date certain that helps us manage our licenses);
- managing license servers for LabVIEW and Diffpack;
- acting as a liaison to departments regarding access to software and services specified in contracts (i.e. Microsoft Software Assurance and MSDNAA);
- managing software and license deployment.

Computer Purchasing

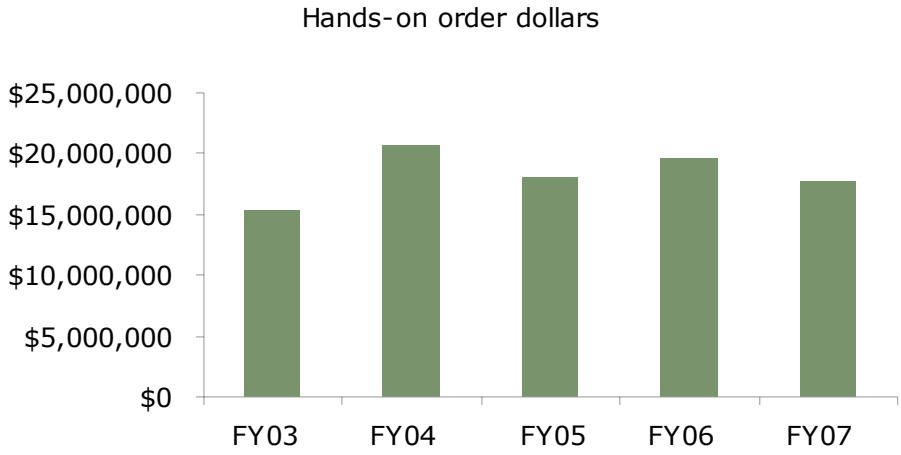
The Computer Purchasing office manages the fulfillment of campus-wide requirements for information technology, including computer equipment, software, systems, networks, maintenance, service, and software end-user license agreements. The office establishes new contracts with providers and utilizes existing internal and external contracts to achieve the most effective and efficient procurement process, meet end-user requirements, and assures compliance with university and state policies and procedures and legal requirements.

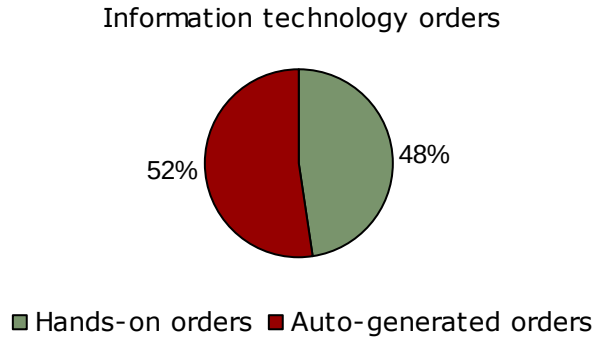
Fiscal year 2007 was a transition year toward full implementation of the HokieMart e-procurement system as the university's single point of entry for procurement. HokieMart provides a unified ordering and reporting system in conjunction with Banner. HokieMart impacts the entire university's procurement processes, from initial requisition input to approval routing, purchase order creation, and centralized invoicing and payment. During this transition year paper requisitions, speed purchase orders, blanket orders, and purchase card orders were gradually phased out while use of HokieMart increased. Five contract vendors are now accessible as HokieMart punchout vendors, allowing departments a method to direct order contract items to those vendors.

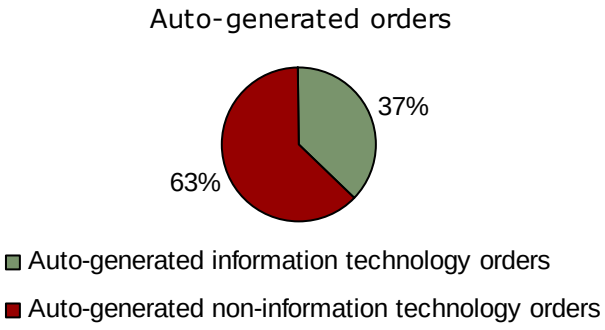
Order dollars and volume reported in prior years were based on hands-on purchase orders, and did not include orders not processed through Computer Purchasing or Purchasing, such as Speed Purchase Orders and purchase card orders. As departments are transitioning to HokieMart, those orders not previously reported are being processed as HokieMart auto-generated orders. This new auto-generated order category includes what was previously ordered with speed purchase orders, blanket orders, and purchase cards, as well as orders departments place directly to punchout vendors.

To provide a clearer picture of purchasing activity, the auto-generated order category is now included in this report. Key measures are presented below using two main categories, order dollars, and order volume. Within those two main categories are the subcategories of hands-on information technology orders, which are placed by the Computer Purchasing office, and auto-generated information technology and non- information technology orders, which are issued by the HokieMart tool.

As compared with prior years, the minor change for fiscal year 2007 reflects a relatively stable level of hands-on information technology order dollars. The small reduction from prior years is attributed to use of the HokieMart Punchout process, which provides auto-generated orders. Though HokieMart auto-generated orders include five information technology punchout vendors with online catalogs and ordering, the Computer Purchasing office processes three times the dollar amount for these punchout vendors ($6.9M vs. $2.1M). The nearly even split between hands-on and auto-generated information technology order dollars demonstrates the continuing value provided by the Computer Purchasing office with complementary support from HokieMart. A comparison of auto-generated information technology and non- information technology order dollars shows IT encompasses 37% of all auto-generated order dollars.

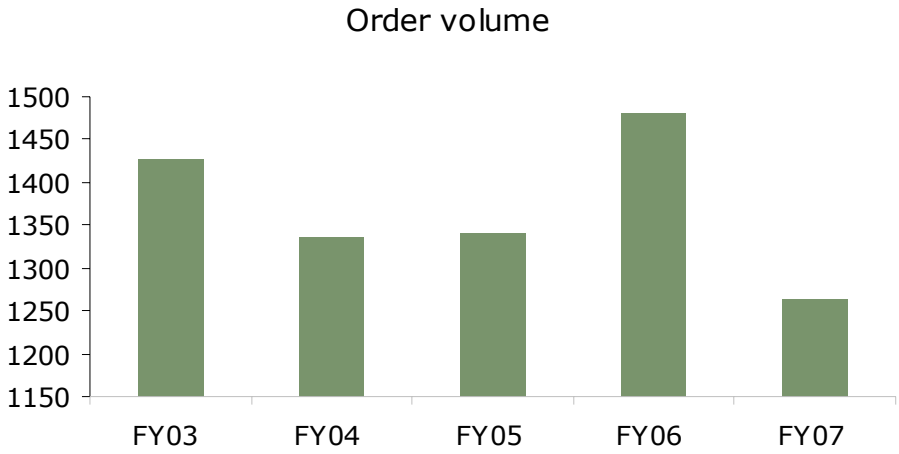


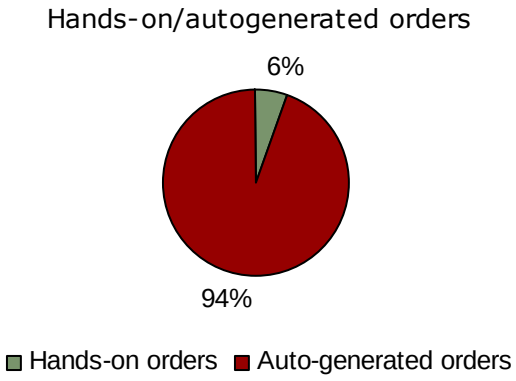


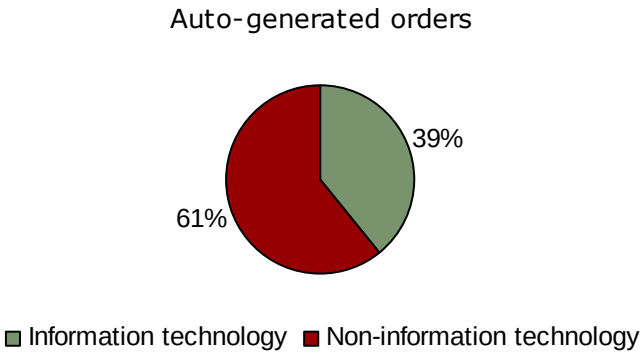


An analysis of information order volume combined with the above hands-on order dollars indicates that the focus of the Computer Purchasing office is the more complex, higher dollar

orders, while the HokieMart tool provides a complementary function by auto-generating a large volume of smaller dollar purchase orders. The auto-generated orders predominately replace the use of Speed Purchase Orders, blanket orders, and purchase card orders, not the hands-on orders. In addition, the HokieMart punchout function further expands the volume of auto-generated orders. This impact of HokieMart to order volume appears to be similar for both IT and non-IT orders. A comparison of auto-generated information technology and non- information technology order volume shows information technology encompasses 39% of all auto-generated order volume.







The Computer Purchasing office continues to provide effective and efficient procurement processes and compliance with university and state policies and procedures and legal requirements. HokieMart provides a complementary tool to support Computer Purchasing in fulfilling their mission. The Computer Purchasing office issues and coordinates contracts and license agreements and orders the more complex, higher dollar procurements, while HokieMart fulfills a large volume of smaller dollar orders, which in previous years were predominantly filled through Speed Purchase Orders, blanket orders, and purchase card orders. Computer Purchasing continues to provide critical value-added procurement processes to meet university information technology requirements.

Information Technology Security Office

The Information Technology Security Office has three operating entities—the IT Security Office, the IT Security Lab, and Information Resource Management. This report shows each mission statement with goals and objectives, and the accomplishments for each within their major areas of responsibility.

IT Security Office

The 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 IT Security Lab and the Information Resource Management office.

The goals and objectives of the office are to:

1. work with university management to ensure educational and promotional programs are made available to the entire university community, by
    - designing, developing, and implement training materials and classes (in-person and online) for the general user community;
    - incorporating various awareness programs into daily user activities;
    - assisting in providing technical training with the IT Security Lab;
2. ensure all departments under the Vice President for Information Technology annually complete a risk assessment, an appropriate continuity of operation plan (COOP) and a combined disaster recovery plan as deemed necessary, including scheduling appropriate times for testing and reviewing during the year;
3. provide necessary tools and directions to enable university offices and departments to complete individual information technology risk assessments.
4. maintain a central website that can be used as an informational tool and provide university users with access to security-based tools for use at the departmental and individual levels;

5. work with other university security personnel to evaluate current policy and procedures, and recommend updates and define areas needing new policy and/or procedures;
6. coordinate and manage the university's Computer Incident Response Team, and coordinate and maintain the Virginia Higher Education CIRT mailing list (VA-CIRT);
7. function as the Root Certificate Authority for Virginia Tech in the area of digital signatures;
8. work with Virginia Tech departments on- and off-campus to increase their security awareness, and ensure that developed and purchased software meets minimum security goals;
9. provide a technology security review service to all departments on campus to ensure that sensitive data is secure and that machines within a department are secure from outside sources, including working closely with Internal Audit and the Controller's Office to identify critical areas that need security reviews;
10. 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;
11. provide leadership and direction for Information Resource Management and the IT Security Lab, secure appropriate funds, and assist these units in planning efforts and obtaining their goals.

Major accomplishments and ongoing activities

Accomplishments for the year are organized topically:

Education and awareness

- Continued to provide security presentations when invited to groups and departments In 2006-2007, invitations included visits to specific academic classes that are utilizing and/or studying technology (amounting to over 3,500 students).
- Participated in all Faculty Development Institute sessions during the spring and summer, and also participated in certain selected groups during the past months
- Provided technology security awareness to orientation sessions, including
    - assisted orientation leaders in developing appropriate presentation for the new student orientation held during the summer (incoming freshman class)
    - presented security session at several student orientations; for example, foreign students (twice), new graduate teaching assistants, graduate student orientation fair, the College of Engineering freshman orientation
    - worked with other areas to present to new faculty members during their orientation
    - participated as part of classified employee orientation on a weekly basis

- Maintained an improved security website to provide users with easy access to security tools and references for the latest security news
- Assisted in hosting professional security-related programs on campus for both technical and non-technical personnel; for example, hosted a week-long sans security class
- Used publications, both locally and on the national level, to promote security issues within higher education
- Participated in programs where visitors were hosted by other university departments by sharing our technology security programs
- Utilized student interns in the it security office to reach out to the student population using technologies commonly used by those users, and developing other methods to reach students (posters, tent cards, etc.)

State and federal interactions

- Continued active participation in Virginia Alliance for Secure Computing and Networking (VA SCAN; *http://www.vascan.org/*)
- Assisted in planning the VA SCAN annual conference and participated on a panel to discuss security initiatives at higher education institutions
  Virginia Tech will host the VA SCAN conference in 2008.
- Worked with the SANS Institute on educational opportunities for high education, and with the Center for Internet Security on tools and possible training programs, including assisting with video broadcasting for 1- and 2-day sessions
- Remained active in EDUCAUSE, particularly with the various security initiatives
- Worked with state agencies through VA SCAN to provide security presentations at various agency locations around the commonwealth
- Attended a major security conference for higher education in Denver, Colorado, and participated in committee work to improve offerings to institutions

Continuity of operations plan/Business impact analysis/risk assessment

- Oversaw the process for Information Technology to develop coops and update their business impact analysis/risk assessment (BIA/RA)
- Worked with Internal Audit to ensure departments on campus have updated assessments every 3 years
- Made minor modifications to the risk analysis forms and updated to the security website
- Directed planning for next risk analysis period (2007-2008) by discussing how the process might be improved using a secure website, including changing the process to include more on the BIA

Disaster recovery plan

- Kept the Information Technology disaster recovery plan updated to reflect changes in personnel and equipment.
- Worked with the Virginia Tech Environmental, Health and Safety Services to ensure our plan is in compliance with federal and state guidelines

- Worked with other information technology offices to ensure each recovery plan interacts in the proper manner
- Met with Network Infrastructure & Services (NI&S) staff members to ensure that plans reflect organizational changes

Security review program

- Provided resources and direction for the security review program that has been implemented university-wide and secured necessary funding for it
- Worked closely with the controller's office and internal audit to identify the critical areas for review
- Worked with staff members to define ways to identify areas within the university that might be a "high" risk

Enterprise Directory (ED) initiative

- Provided leadership for the ED Advisory Group
- Attended meetings to plan for implementation schedules and future efforts by the team
- Ensured that IRM has the necessary resources to assume production responsibilities

Information Resource Management

- Worked closely with IRM in the past year to ensure they have necessary resources to respond to audit comments, and have appropriate backup personnel
- Assisted the IRM director in looking at processes that can be automated to provide a more efficient and auditable environment
- Worked with the IRM director to become more involved in areas that impact access to systems such as Enterprise Systems, various directories, and data stewards

Virginia Alliance for Secure Computing and Networking

VA SCAN exists to strengthen information technology security programs within the Commonwealth of Virginia.

- Continue to be an active member representing Virginia Tech and participate month in either a conference call or on-site meeting
- Provided awareness session to the Virginia Community College System at their annual meeting and to some individual colleges during the course of the year
- Assisted other VA SCAN members in updating and designing a new website to provide more assistance to higher education institutions in Virginia (*http://www.vascan.org*)
- Assisted in planning for VA SCAN 2007 to be hosted by Virginia Commonwealth University in October 2007
- Agreed to host VA SCAN 2008 in Blacksburg

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 projects 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 IT Security Lab include the following goals in technical education:

- Develop and provide computer security guidelines for Virginia Tech system and network administrators
- Develop and provide technology-based acceptable use training for general users (faculty, staff, and students) with the cooperation of the IT Security Office
- Develop and conduct system administration, computer and network security training classes (in-house and online) for system and network administrators within and outside of the university
  This training includes offerings for professional organizations, conferences, state and federal government agencies.
- Coordinate computer and network security training classes and material with distance learning initiatives at the academic and continuing education levels
- Develop marketing strategies to "sell" computer and network security to the general user community
- Assist in developing and delivering awareness training that can range from basic lessons to more complex technical information

An important area is that of technology security reviews with these goals and objectives:

- Work with Virginia Tech departments to conduct security reviews to ensure sensitive data and other resources are secure, and that departments are taking the necessary precautions to ensure an appropriate operating environment

- Directed by the Executive Vice President to conduct technology security reviews on a periodic basis
- Use scanning tools and work with the Controller's Office and Internal Audit to identify the most critical and vulnerable areas at the university, and respond as appropriate to requests received directly from departments and/or other areas
- The purpose is to review systems/applications within an department to identify potential disclosure or integrity problems with hardware, applications, and critical data; to help departments recognize their vulnerabilities and offer alternatives; and to prepare a security review report for distribution to appropriate individuals.
- The reviews help prevent data disclosures and possible manipulations that might embarrass the university, department, or individuals.

The lab coordinates the Computer Incident Response Team (CIRT) and undertakes additional security initiatives:

- Coordinate and manage all security initiatives in coordination with the IT Security Office
- Define guidelines and procedures for the six phases of Computer Incident Response—preparation, detection, containment, eradication, recovery, and follow-up
- Coordinate responses to system and network attacks
- Coordinate with external CIRTS
- Maintain and manage VA-CIRT

The IT Security Lab collaborates with acadmic departments to enhance and extend teaching and learning:

- Assist the Electrical and Computer Engineering (ECE) Department to develop a system administrator intern program
- Assist the ECE Department in teaching the graduate-level Computer & Network Security Fundamentals course
- Provide online materials for computer and network security distance learning classes
- Provide guest speakers for undergraduate and graduate level classes offered by university colleges on computer and network security topics

The lab also functions to test and certify information technology elements:

- Serve in partnership with the Center for Internet Security (CIS)
  The laboratory is the testing site for certification of compliance of vendor security software with CIS benchmarks.
- Develop methodology for testing security of network capable devices such as printers, data acquisition devices, modems, environment control systems, and medical equipment, and create security guidelines for these devices
- Develop methodology for testing security of Unix, Linux, Windows 2000, Windows XP and Macintosh systems
- Develop and implement forensic kits for Unix and Windows systems

- Develop and update computer and network minimum security benchmarks for Unix, Windows, Apple and network devices
- Work on security initiatives with the SANS Institute, FBI, Center for Internet Security, NSA, Federal and State agencies

Professional development and outreach by the lab personnel includes the following:

- Provide speakers to local, state, regional, national and international conferences on computer security issues
- Host regional and national security conferences and seminars for peer organizations

Major accomplishments and ongoing activities

Academic support

- Lab provides full classroom support for ECE 4560—Computer and Network Security Fundamentals
    - 275 students have taken the class since 1999
    - Graduate and senior level ECE/CS students
        - Class taught at the Northern Virginia Graduate Center and main campus via television
        - Class taught statewide via College of Engineering CGEP
    - Hands-on exercises
        - Learning how to use attack/defense tools
        - Analyzing attacks in real-time
        - Team based

Teaching hospital

- The lab is being configured to allow students to observe, "treat" and immunize systems in a real world setting.
- The lab is using Virtualization Software (VMWARE) to create virtual network for use in information technology audit class.
- The lab is using VMWARE to create virtual systems that can connect to the real Internet. This setup allows students to observe and defend against live attacks without compromising real systems.
    - Designed to allow cybersecurity experiments to be run in a controlled environment
    - Student "Pipeline"
        - Graduate research assistant position

- Graduate student intern position
- Designed, built and maintaining ITSO vulnerability scanning www site (*www.ids.vt.edu*)
- Designed, built and maintaining vulnerability scan engines that are the core of the *www.ids.vt.edu* site
- Designed, built, and maintaining SQL database of vulnerabilities discovered by the scanners

Technology security reviews

- Acquired additional position to assist in security reviews
- Purchased Rapid7 software to be used in security reviews
- Staff members attended session on project management to better schedule and manage security reviews
- Worked with Controller's Office and Internal Audit to identify areas requiring reviews
- Completed security reviews on several areas and worked with departments to correct any shortcomings

Research support

- Facilities available for Masters and PhD research in cybersecurity
- Completed Ph.D. degrees that used the lab:
  - "Taxonomy of Computer Attacks," 1999, ECE
  - "Battery Based Intrusion Detection," 2005, ECE
    - Patent pending—G. Jacoby, R. Marchany
  - "Thwarting Network Stealth Worms Through Biological Epidemiology and Natural Immune Systems," 2006, ECE
  - "Wireless Sensor Networks," 2006, ECE
  - "Visualization Tool for Determining Network Attacks," 2006, ECE
  - "Taxonomy of Vulnerabilities," 2006, CS
- Completed Masters degrees that used the lab:
  - "Using Plant Epidemiological Methods to Track Computer Network Worms," 2004, CS
  - "pTCP: A Client Puzzle Protocol for Defending Against Resource-Exhaustion Denial-of-Service Attacks," 2005, ECE
  - "E-Commerce Security," 2003, MIT/Business
- Current research:
  - "Network Based Visualization," 2007, ECE
- Lab provides work space and systems for graduate student research
- Student "pipeline" has been established with ECE and CS
- Lab director serves as a member of graduate student's committee
- Research papers have been submitted for publication
- The current research by graduate students also is a "pipeline" for undergraduate students.

NSA Center for Academic Excellence in Cybersecurity Research

- Virginia Tech named an NSA CAE in Fall of 2004
- This designation allows Virginia Tech to apply for cybersecurity research grants
    - Multidisciplinary curriculum: ECE, CS, Bus, MIT
- IT Security Lab will be the Teaching Hospital for the CAE
    - *http://research.cs.vt.edu/infosec*

Lab director projects

- Training
    - Coordinated 2006 SANS-EDU program at Virginia Tech
        - 245 attendees from US, Canada, New Zealand
    - Coordinated 2007 SANS-EDU 1 day course on Windows Vista Security that used Interactive Video Conferencing (IVC) to allow 15 institutions to connect to our site for the class
      252 students from 15 institutions attended the class
- Presentations
    - Guest lectures: IS Audit class; College of Business Information Technology class; Ecommerce class; College of Engineering Freshman orientation; VT Outreach; FDI classes; 4HELP, Get Connected; AF ROTC orientation, Schiffert Health Center staff orientation, graduate student orientation, international graduate student orientation
    - Conference talks:
        - Institute of Internal Auditors, New York, NY
        - NCTC, Roanoke, VA
        - College and University Auditors of VA (CUAV), Richmond, VA
        - Security Awareness Day, ECU, Greenville, NC
        - ISACA Richmond Chapter, Richmond, VA
        - Council of Independent Colleges of VA, Charlottesville, VA
        - VA Society of CPA's, Richmond, VA
        - VA SCAN Conference, GMU, Fairfax, VA
        - SANS-EDU, Ohio State, Columbus, OH
        - SANS-EDU, VCU Richmond, VA
        - EDUCAUSE Security Conference, Denver, CO
        - Information Assurance Workshop, USMA, West Point, NY
        - SANS Institute (week course), VA Beach, VA, Washington, DC,
    - Local presentations:
        - FDI, lunch seminars
        - Administrative Staff Professional Network
        - DCSS
        - VT Institutional Research
        - VT Graduate School: International students, GTAs, and general graduate students

        - Get Connected
        - Commission on Classified Student Affairs
        - Users groups

Other lab projects:

- Vulnerability scanning
    - Checknet style scan engines
    - Fast scan tools
    - SSN, CCN scan tools
    - IPS installation and management
        - Collection of metrics
    - *www.ids.vt.edu*
    - *http://security.vt.edu*
    - Security metrics project

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:

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

7. inform the university community of security procedures through open communication.

Major accomplishments and ongoing activities

The IRM Office is recognized as the production office responsible for electronic user identities at Virginia Tech, overseeing all aspects of the production environment. IRM carries out its goals, and is involved in defining access and enforcing rules for Virginia Tech resources.

Public key infrastructure

- The IT Security Office and associated entities including IRM have been involved in the production environment for the university's certificate authority (CA) service that provides digital certificates to sign documents securely, to secure transactions, and to 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 RA Administrators and CA Administrators for the Class 1 Server CA and the Middleware CA. IRM also serves as the role manager for the VT User CA.
- IRM developed and maintains a workflow process to support digital signing of leave reports.

Enterprise Directory project

- IRM sponsored the Enterprise Directory (ED) project and continues to define requirements for implementations. IRM also provided database programming support for the project.
- The IRM director leads a weekly meeting of an ED technical group and also a weekly meeting of an ED policy group.
- IRM has created 27 production services that use ED-ID for authentication and authorization.
- IRM has created 97 ED groups for use in authorization.

Virginia College of Osteopathic Medicine

- IRM developed an interactive process to allow the Virginia College of Osteopathic Medicine (VCOM) to update identity information on their faculty, staff and students. This deliverable has saved VCOM considerable time and frustration.

Consultation

- One of the important responsibilities for IRM is to provide consultation to university groups within Information Technology and beyond on user access issues. IRM has done this during the past with Banner and other administrative applications, as well as with those defined above.
- Consulting activity has increased over the past year as other groups recognize the importance of security and granting/denying access to data.

Daily support and production work

- Worked closely with application areas to define requirements for any applications dealing with identity and access
- Maintain and provide access capability for Virginia Tech systems
    - PIDs (approximately 148,000 PIDs)
    - UNIX
    - Banner/Oracle access (approximately 4000 production accounts)
    - Virginia Information Technologies Agencies (VITA) access
    - Distance learning access
    - Active Directory (Hokies domain)
    - Other special needs
- Responded to Remedy trouble tickets for any "access" issues
  There have been over 5500 trouble tickets since mid-August 2006.
- Created two replacement solutions for departmental PIDs that would provide greater security and accountability
  VT PACE accounts were developed as a departmental shared email solution and sponsored PIDs are being used to provide credentials to individuals who have a temporary need for VT credentials but who do not have a core affiliation with VT.
- Cleanup and conversion of traditional departmental PIDs is underway. Approximately 1100 accounts have been deleted and an additional 50 have been converted to a more secure solution.
- Developed a new PID generation application that performs identity verification in a more secure manner
  The architecture used also enables the application to be more stable and scalable than the previous iteration of pidgen.
- Led focus groups and developed functional and technical requirements for ED group tools and the Guest Account Management Service
- Currently maintain and enforce most of the access policies/procedures

Professional efforts:

- Selected IRM staff members attended the following professional meetings: EDUCAUSE 2006, Banner Summit 2006, Collaborate 2006 (Oracle), JA-SIG 2006, Educause Identity Management Camp, MABUG 2007
- IRM director leads the Enterprise Directory Policy and Technical Issues meeting each week and the Enterprise Directory Project Planning meeting each week.

- IRM director is a member of both the Educause and Sungard SCT Identity Management groups.
- IRM director is a member of the ED Advisory Board, ED Liaison Group, and the Data Security Committee of the Security Task Force.

Learning Technologies

Learning Technologies is a comprehensive, learner-centered organization dedicated to supporting the tripartite mission of the university: teaching and learning, research and discovery, and outreach and engagement. The mission of Learning Technologies is to provide a teaching and learning infrastructure that meets modern needs for integrating technology across content areas. We seek to create and support robust environments for teaching, learning, and discovery for faculty members and 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 to accomplish these aims in several ways:

- 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 network-assisted teaching, research, and outreach.

Building on its exemplary track record as demonstrated by last year's EDUCAUSE award, Learning Technologies continues to have a significant impact on the instructional mission of the university. Major activities include

- the Faculty Development Institute, designed to have a long-term effect on acceptance of instructional technology as a critical, enabling component of the university's mission
- open source software development, participating in national initiatives for collaborative learning, portfolios, and online course evaluations
- the Graduate Development Institute, collaborating with the Graduate School to increase graduate students' opportunities for professional development

Supporting groups within Learning Technologies include the following:

- The New Media Center, providing technology support to faculty members and students
- Assistive Technologies, providing technical expertise, leadership, and coordination for disability accommodations
- Digital Imaging, proving high quality scanning services for library and faculty projects
- The Summer Academy for Rising Students, offering programs to high school students from economically depressed regions of the commonwealth to help them reach their potential for success in higher education
- Areas providing consulting on the integration of technology in new and renovated facilities on campus, continuing support for computer labs, and opscan processing

Learning Technologies Development Initiative

Faculty Development Institute

The Faculty Development Institute (FDI) provides the teaching, pedagogy, knowledge, skills, and tools needed by faculty members 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 the opportunity to provide the most efficient and effective learning environment for our students.

During the spring and summer of 2007, 557 faculty members participated in short courses and workshops in the second year of the fourth cycle (2006-09) bringing the total of all participants to more than 5400 since 1993.

In 2006-2007, our overall aim was to strengthen the FDI program's relevance and value to the faculty by providing a wider range of content, all with an underlying technology connection, that appeals to an increasingly diverse range of faculty interests, including topics that are consistent with the university's renewed emphasis on research. This increase in programming was facilitated by several innovative arrangements with content providers. First, additional partnerships were forged with other university departments and teaching faculty members from across campus. Second, arrangements were made with software vendors to provide training on specialized software newly available from Software Distribution. Third, new FDI short courses were developed internally to create awareness and readiness for several important new educational technologies being introduced to the faculty, such as TabletPCs, Scholar (Virginia Tech's version of Sakai, an open source collaborative environment), and electronic portfolios.

Between Fall 2005 and Fall 2006, the number of attendees grew from 1,759 to 2,115. Summer enrollment also increased, from 348 in the summer of 2006 to 417 in the summer of 2007. These increases indicate that there continues to be a clear demand across campus for our training and development offerings and suggests that adopting sound principles of learning as part of our curricular objectives resonates with the university community.

The FDI staff meets regularly with faculty members from all colleges. These meetings provide direction for the offerings we provide. 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. These evaluations have also shown that FDI is currently on-target with faculty needs (evidenced by evaluation scores and faculty comments). By staying current and continuing to learn from faculty members regarding their needs, FDI continues 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
Summer 2006	3-day Tracks	21	348
Fall 2006	Short Courses	126	2115
Spring 2007	Short Courses	159	2335
Spring 2007	Spring Tracks	9	135
Summer 2007	3-day Tracks	23	417

Overview of FDI track offerings

Track topic	Spring, Summer	Participants
Track A New Faculty Computing	Summer	61
Track B An Introduction to Blackboard	Both	35
Track C Using the Web for Instruction: Blackboard and Other Tools	Both	49
Track D New Strategies and Tools for Teaching with Technology	Both	80
Track E Creating Media Content for Instruction	Both	24
Track F Developing and Delivering Online Instruction at a Distance	Both	30
Track G Northern Virginia Track: Using the Web for Instruction	Summer	18
Track H Faculty Inquiry Group: Teaching and Learning with Technology	Spring	12
Track J Fostering Student Engagement, Learning, and Development	Summer	24
Track K Statistics: Statistical Data Exploration, ANOVA, and Regression using JMP	Summer	24
Track L Advanced Statistics: Design and Analysis of Experiments using JMP	Summer	23
Track M Using LabVIEW	Summer	12
Track O Life Cycle of a Sponsored Project: Research Administration	Spring	12
Track P Creating Database-driven Web Sites with PHP & MySQL	Summer	14
Track Q Parallel Programming	Summer	10
Track R Deep Media for Research and Education	Both	14
Track S Using GIS in Research and Teaching	Summer	22
Track T Using Tablet PCs in the Classroom: Teaching in a Mobile Environment	Summer	38
Track U - Independent Study / Project Development	Spring	37
Track V - Refresher Track	Summer	13
Total Number of Participants		552*

* Note that the number of participants exceeds the number of faculty members receiving computers (see chart below) by 62. These participants either attended two summer tracks, asked to attend training even though they were not due for computer refreshment, or were graduate students for which faculty members requested a seat.

The table that follows summarizes the distribution of computers that took place during the spring and summer of 2007:

Summary of FDI computer distribution

	Apple	Dell	Fujitsu	Totals	Percents
Desktops	50	78	0	128	26%
Laptops	126	121	6	253	52%
Tablets	0	0	109	109	22%
Totals	176	199	115	490	
Percents	36%	41%	23%		

Online Course Systems

Online Course Systems (OCS) supports enterprise-level academic services such as Blackboard and Scholar learning management systems used by virtually all students in residence and in distance learning settings, as well as electronic portfolios, Course Evaluation, Courseware, Element K, and DyKnow Vision. Serving as Learning Technologies' public face for online services, OCS provides

- learning systems user support: support desk, help pages, Web support, application documentation;
- learning systems training: user training (FDI), handout materials, tutorials, resource development;
- product evaluation and quality assurance: usability and functionality testing, quality analysis and documentation, product design, and new services;
- coordination of faculty collaboration and participation.

In June 2007, the application development group became a part of OCS as a first step towards placing a formal emphasis on end user experience (UX) during the software development process. All full-time development staff now report directly to the OCS manager. The addition of a formal emphasis on user experience within OCS will ensure that all groups are working towards the same goal—the overall satisfaction of our end users with the products we provide. UX recognizes that a user's perception of a software product is not only affected by the tools within the software, but with all interactions that the user has related to the product. This includes software quality, usability, helpdesk support, documentation, and training sessions, all of which we currently provide. An emphasis on user experience is expected to have the following positive results within OCS:

- End users will have direct input into the user requirements process of development.
- End users' responses to products will be collected throughout the development process resulting in tools better matching the needs of Virginia Tech faculty, staff, and students.

Obtaining user requirements early ensures that major changes in scope or direction can be made prior to the start of development.

- Quality assurance will be considered an integral part of the development cycle and will be present throughout all iterations of the development to ensure that software bugs do not hinder the overall user experience.
- Formative usability will be an official part of the development process, including user requirements gathering, prototype development, usability testing; usability will no longer be considered a luxury if time permits.

The staff will have more time to develop documentation and training plans since the needs of the users will be known in advance.

Blackboard. The Blackboard learning system has evolved into an enterprise level system that is mission critical for instructors, researchers, and students. OCS works closely with the vendor's technical support to address technical and performance issues. This year Blackboard was upgraded to provide Windows Vista compatibility. OCS managed and supported two versions of Blackboard simultaneously, and assisted with load testing and performance certification. This major upgrade to Blackboard 7.1 involved relocation and conversion of 20,000 courses and was accomplished within the scheduled downtime of only twelve hours.

The statistics below show usage of Blackboard over the past 18 months.

Blackboard statistics—Active classes, instructors & students

	Spring 2006	Fall 2006	Spring 2007
Course sections	2313	2652	2664
Faculty & GTAs	1671	1678	1890
Students	24,593	27,442	28,501

Open Source Portfolio. Two versions of electronic portfolios are used at Virginia Tech, ePortfolio 1.5 and OSP 2.2 (in pilot). ePortfolio 1.5 is actively used by targeted audiences to document learning and share professional and personal materials to advance career opportunities. OSP 2.2 contains much of the functionality of ePortfolio 1.5, but also includes features that can assist with student assessment, departmental self-studies, and accreditation processes. OCS tested numerous potential release candidates of OSP, created the scripts used as a baseline for the national OSP testing community, and participated in planning for the OSP 2.4 release to ensure that Virginia Tech's needs were represented. As piloting concludes for OSP 2.x at Virginia Tech, ePortfolio and OSP will be combined, with version 1.5 phased out.

ePortfolio 1.5 active shares, instructors, and students

	Spring 2006	Fall 2006	Spring 2007*
Shared Portfolios	1694	2588	2022
Instructors	82	42	47
Students	1176	2098	498

The statistics below illustrate pilot activities for OSP 2.2.

OSP 2.2 Pilot statistics**

	Fall 2006	Spring 2007*
Instructors	21	7
Students	129	20
Reviewers	N/A	N/A
Presentations created	57	22
Matrices published	9	3

** Assumes newly created OSP sites in Fall 2006 and Spring 2007

*Usage declined since Spring 07 projects were optional.

DyKnow Vision. DyKnow is a Web-based tool that is used to foster interaction through collaborative note taking, student response tools, content replay and more. It is especially popular for integrating tablet PCs into instruction. OCS staff provided helpdesk, user account administration, and in-classroom assistance for DyKnow Vision to support the Tablet PC initiative in the College of Engineering in collaboration with NIS, assuring it functioned under the intense wireless demands required for use by 250 students. This collaboration and technical achievement was recognized by a Laureate designation in the Education and Academia category presented at the Computerworld 19th Annual Laureates Gala Awards Evening in Washington, D.C., on June 4.

OCS Helpdesk. OCS currently tracks user questions via an internally developed database, which is not integrated with other helpdesk operations on campus. Problems, therefore, cannot be tracked across systems to look for correlations that may reveal the true nature of an issue.

In an effort to streamline and improve services, OCS staff is testing a Remedy queue, with the intention of switching to the enterprise-level helpdesk application in September 2007.

OCS Helpdesk General Statistics — Questions Answered by Submitter Type

	Spring 2006	Fall 2006	Spring 2007
Questions answered	2664	2102	2201
Submitted by:			
Instructors	524	543	688
Undergrads	102	134	115
Grads	61	29	63
GTAs	103	109	109
Other	178	69	99

OCS training. The OCS staff played an active instruction and supporting role in FDI, reaching hundreds of faculty members who use the systems supported by OCS. The staff 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 7, OCS revised its curricular approach in FDI to provide more variety and depth, while also more narrowly targeting specific themes and functionality. A renewed emphasis on pedagogy is now infused into the new curriculum, which will be launched in August 2007.

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, a technical writer undergraduate intern was hired to update the OCS website and update and create new handouts.

New Media Center. The New Media Center 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 2006 through June 2007.

2006-2007 Lab Summary

	Faculty	Staff	Graduate	Undergraduate	Public	Total
3D	0	0	2	3	0	5
Audio	58	27	20	288	8	401
Authoring	4	102	3	14	2	125
Blackboard	7	3	5	3	1	19
CD/DVD Burn	11	9	16	38	6	80
Desktop Publishing	30	20	104	283	6	443
ElementK	1	0	1	4	0	6
Equipment Loan	70	81	95	304	15	565
ETD	1	0	5	2	0	8
Flatbed Scanning	95	29	244	530	12	910
Graphics	57	38	179	908	23	1205
PowerPoint	10	0	4	46	1	61
QTVR	0	0	1	2	0	3
Slide Scanning	31	11	51	74	11	178
Video	128	106	204	1365	50	1853
Web Development	21	13	80	201	8	323
Total	524	439	1014	4065	143	6185

New Media Center staff manages and schedules three classrooms used by FDI, New Horizons (staff training), faculty, and other groups.

Faculty Development Classroom Usage Summary

Classroom	Number of university class sessions	Total number of events (incl. FDI)	Total number of users
1120 Torgersen	78	230	2549
3060 Torgersen	209	368	7002
3080 Torgersen	104	276	4837

Projects

Projects are undertaken by Learning Technologies 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

Learning Technologies has become involved in open source projects in order to enlarge the scope of applications and services available to faculty members and students, and to ensure that the products available meet diverse user needs.

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 is working directly with universities including Cambridge University, the University of Texas at Austin, the University of Maryland, the University of Michigan, and others to enable use of the system at Virginia Tech and develop needed tools.

ePortfolio development. The Open source Portfolio (OSP) was upgraded to version 2.2 for the 2006–2007 school year, featuring a fully integrated Scholar and OSP environment for the first time.

The Spellings Commission Report on Higher Education, released by the US Secretary of Education, underscored a need for a more rigorous assessment of student outcomes. In response, OSP 2.2 has been positioned as a tool to assist in the assessment/accreditation process by providing tools to capture student work over time electronically. At Virginia Tech, pilot projects are being launched and customized templates and forms are being developed to collect student work for program outcomes reviews, skills, competencies assessment and more.

Course evaluation system development. The Application Development group collaborated with Columbia University to modify and extend a course evaluation system in 2004. The system developed out of that effort is currently being piloted at Virginia Tech, integrated with the paper evaluation system so that all results from either system end up in a secure database. Student responses are anonymous. 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 last year to include several entire departments, with over 10,000 students responding in Spring 2007.

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 70%, which is comparable to the response for the paper-based system.

The application development group also contributed to the development of the Sakai Course Evaluation tool, an open-source Sakai-compatible version of the evaluation system. It provides more flexibility and allows colleges, departments, and instructors to manage their own body of questions and collect targeted information from their students while preserving a consistent set of questions used throughout the institution. The tool was developed with assistance from University of Michigan, University of Maryland, and Cambridge and will be piloted by three universities this fall. Members of the team also assisted in documenting the tool, and OCS provided quality assurance for the project.

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 FDI system has been extended to include features that allow faculty members to self-register for workshops, choose computers, and view events. Additionally, administrators within given departments can perform these assignments for faculty members who choose not to self-register. Administrators can also be assigned an observatory role, allowing them to see what choices are made by faculty members in their department without altering those choices. The system has been improved to allow a larger number of courses and events to be managed by the same number of staff and other efficiency improvements are planned for the coming year.

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. After a review of helpdesk suggestions, it was determined that an electronic notebook tool had the most potential to impact teaching and learning across disciplines. SENRG 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. A pilot test is planned for spring 2008.

A faculty stakeholders group was formed to guide the development of the tool and OCS staff conducted several interviews to elicit requirements and obtain feedback on user interface mockups.

Software Skills Gateway development. The Software Skills Gateway (*https://gateway.edtech.vt.edu/*) provides a way for end-users to seamlessly link to ElementK software tutorials using a VT PID and password without having to know a custom username and password. Tools were added this year to provide administrative functions such as search, report, sort, and enable/disable accounts.

Training and tool support for project development across Virginia Tech. 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*).
- Built interest for and located a trainer to provide training on AJAX, a Web development technique
  Several Learning Technologies staff members and numerous staff members from campus groups attended the training, which was well received. AJAX was integrated into some existing Learning Technologies applications and will be used in those under development. This effort is a prototype for the type of activity that will eventually be part of the Professional Development Institute, if funded.
- The Virginia Tech Java Users Group, initially formed by the Learning Technologies Systems Integration and Application Development managers, met several times during this reporting period. The group consists of Java developers and application support personnel from many information technology areas on campus who meet to discuss issues related to Java, including presentations on Java technologies and programming techniques designed to improve skills across the enterprise.

External project development. Application Development and Systems Integration work with groups involved in the Sakai community and open source projects on programming or Web hosting projects as time allows. Highlights from the reporting period are:

- The Systems Integration group hosted and maintained the Sakai collab server (*https://collab.sakaiproject.org/portal*) at Virginia Tech. The server hosts the Sakai project mailing lists and collaborative tools and is used by roughly 2000 people from all over the world. Hosting of this project was transferred to the University of the Highlands and Islands in Scotland in June 2007.
- The application development group provided training to staff from the University of Maryland and the University of Michigan. The training took place on campus at Virginia Tech, and focused on development within the Sakai framework, including best practices for development.
- The Application Development group contributed to a series of tutorials to assist programmers in creating new tools and extending the Sakai framework

WhizQuiz migration to Blackboard. WhizQuiz, an out-dated student testing system, was discontinued in Fall 2006. OCS staff manually re-created 49 WhizQuiz assessments in Blackboard and provided training in order to provide a seamless migration from WhizQuiz for the remaining users.

Systems Integration projects

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

Application upgrades. The Systems Integration team played a key role in designing and deploying upgrades to two enterprise applications in the report period. In August of 2006, Scholar was updated to use Sakai 2.2 for a large-scale pilot, and in May 2007, the Blackboard system was upgraded to version 7.1 with minimal downtime.

Standardization and automation. In order to provide the highest level of service for all Learning Technologies applications, the Systems Integration team has embarked on a mission to fully standardize and automate application configuration across all of our systems. Standards and automation will mean fewer configuration errors, less time spent troubleshooting problems, and more rapid configuration changes as our environment continues to evolve.

Server virtualization. As more services are provided to more users each year, one challenge for systems administrators is how to continue to provide a high level of support for existing services while planning for future growth and retaining the flexibility to add new services and

applications rapidly. Server virtualization promises the ability to consolidate many small physical servers into fewer, more powerful machines, providing flexibility in assigning resources to applications based on their immediate needs. It also reduces configuration effort and minimizes the number of physical servers required, along with associated expenses for power, networking, cooling, and physical space. The Systems Integration team began a server virtualization pilot program in June 2007 to assess how we can harness these benefits in our environment.

New Media Center projects

- Podcast Test Server
  The New Media Center created, maintained, supported, and customized a test instance of Weblog, an alternative solution to iTunesU, serving about twelve faculty members in the test phase.
- Faculty Production Support
  In cooperation with FDI, the NMC assists numerous faculty and departments with the development and creation of various media projects directly supporting instruction. Support ranges from general assistance and consultation to the actual creation of digital objects. This year NMC handled six projects.
- Faculty Course Media Development Support
  The NMC also supports instruction by working 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 provided direct support for two FDI tracks, acting as facilitators, instructors, and consultants. The Center also maintains and schedules a cart of TabletPCs.

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

- Upward Bound
  Provided instruction and assistance to nearly a dozen 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.

- Apple Certification Classes
  Hosted two certification-level classes taught by Apple technicians which were open to the university as well as the public
- Media Arts Series
  Coordinated a New Media Arts series open to the university community, featuring film screenings or other media presentations and discussions to showcase the work of multimedia artists active at the local, national, and international level
- McCormick Farm Project
  Worked with Digital Imaging to produce a video detailing the history of mechanical reaping for the McCormick Farm Museum
- The Multimedia Music Dictionary
  Provided technical support for media object development, primarily video and audio illustrations and some assistance with Flash animations
- Student Media Organization Support
  Served as host for group functions and offered special equipment loans to media-oriented student organizations such as VT MUG (Mac User's Group) and AMP (the Association of Movie Producers)

Department projects. The New Media Center utilizes resources and staff to explore emerging technologies as well as inventive applications of existing technologies. Highlights from this past year include the following:

- Second Life
  Exploration of the virtual world of Second Life, acquiring access through close ties to the NMC National Consortium
- Departmental wiki
  Migration of policies, procedures, planning, budgeting, and development documents into the Confluence wiki, providing wider access to the information and better staff collaboration
- New Media Center website
  Began migration to the enterprise CMS, positioning the Center to be an early-adopter with the expertise to provide support to other units on campus when they migrate their own Web presence
- Dual-boot classroom
  Updated 1120 Torgersen Hall to Intel-based iMacs and tested different virtualization and dual-boot techniques to select the best method to balance ease of use, performance, and maintenance

Scholar

Virginia Tech's Scholar project comes out of two international open source communities, Sakai and Open Source Portfolio (OSP), which have recently merged. A collaborative effort with institutions around the world, Scholar provides an alternative to Blackboard's online instruction capabilities along with additional toolsets that are unique to this system. Faculty members from a variety of disciplines are currently exploring Scholar to evaluate efficacy for their own disciplines and applications, and there is increasing interest in administrative and ePortfolio applications of the system. Twelve committees and university administrative areas, as well as many individual departments have expressed interest or are using Scholar to manage administrative work.

The Scholar Fellows Program, begun in Spring 2006, includes 23 faculty members who contribute to the product's development, local customization, and take an advocacy role with their colleagues and students.

Usage statistics for the year 2006-2007:

2259 VT users and 105 guests have logged into Scholar.
21 course sites for Fall and 24 courses for the spring term were created/modified.
120 project sites for Fall and 101 project sites for the spring term were created/modified.
316 users were enrolled as an instructor/maintainer in at least one current site for the fall semester and 290 for the spring semester.
1363 users were enrolled as a student/member in at least one current site for the fall semester and 544 for the spring semester.
The average session length for all users was just under 51 minutes for the fall term and 67 for the spring term.

For more information about Learning Technologies Development Initiatives, contact John Moore, Director, *jmoore1@vt.edu*, 540/231-8991.

Graduate Education Development Institute

During the 2006-2007 academic year, the Graduate Education Development Institute (GEDI; *www.gedi.vt.edu*) added a full-time assistant director who works closely with GEDI fellows to improve both the scope and delivery of emerging technologies within the course. He also works directly with graduate students in the GEDI course, "Pedagogical Practices in Contemporary Contexts" (GRAD 5114), which enrolled more than 90 students in 2006-2007. In addition, nine students pursued further study, working with the Director of the program in two- and three-credit Independent Study courses on technology-enriched teaching strategies. The enrollment in GEDI continues to increase even though most of the graduate students take the course in addition to a full semester of graduate coursework in their discipline.

In Spring 2007, a pilot GEDI workshop in computation science was developed and offered. The workshop provided graduate students with a 21-hour curriculum in computational science with an emphasis on real-world simulations, an introduction to visualization, and parallel computing. Twenty-two students from a range of disciplines in the sciences and engineering attended a 3-hour session for seven weeks. There was general enthusiasm about the course, and the vast majority of participants found the curriculum helpful to their current and/or future research plans and indicated that they would recommend the workshop to other graduate students.

Assessment data. Assessment data for the GEDI pedagogy course continues to suggest that the program is fulfilling a need in helping graduate students explore technology-enriched pedagogy, and the course plays a vital role in their professional development as current teachers and future faculty members.

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

Response	Fall 06-1 entry (33)	Fall 06-2 exit (40)	Spring 07 exit (13)
Extensively	16 (55%)	23 (58%)	8 (62%)
Moderately	10 (34%)	15 (38%)	4 (31%)
Minimally	3 (10%)	2 (5%)	1 (8%)
Not at all	0	0	0
No answer	0	0	0

Question: My own best evaluation of my teaching skills at this point in time would be:

Response	Fall 06-1 entry	Fall 06-1 exit	Fall 06-2 entry	Fall 06-2 exit	Spring 07 entry	Spring 07 exit
	(n=33)	(n=29)	(n=37)	(n=40)	(n= 29)	(n=13)
1 = Very unsure of my skills	2 (6%)	0	0	0	2 (7%)	0
2 = Unsure of my skills	8 (24%)	2 (7%)	11 (30%)	8 (20%)	8 (28%)	1 (8%)
3 = Average skills	17 (52%)	14 (48%)	19 (51%)	18 (45%)	14 (48%)	7 (54%)
4 = Above average skills	5 (15%)	13 (45%)	6 (16%)	13 (33%)	3 (10%)	5 (38%)
5 = Superior skills	1 (3%)	0	0	1 (3%)	2 (7%)	0
No answer	-	-	-	-	-	-

Contact information: Shelli Fowler, *shfowler@vt.edu*, 540/231-2176

Classroom Technology Integration

A university-wide classroom improvement project is currently underway as part of the first phase of the classroom master plan. During the summer of 2007, eight centrally scheduled classrooms will receive extensive renovations, which will complete the first phase of the master plan. These renovations include 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 AV Services.

Several other classrooms received presentation technology upgrades over the past year including Room 111 in Femoyer Hall, Room 316 in Patton Hall, and Room 212 in Cheatham Hall. The 325 Burruss Hall conference room was also upgraded.

Consulting services were provided to the Art Museum of Western Virginia to assist that institution in the design of instructional technology systems in the new facility under construction. A collaborative effort with the College of Veterinary Medicine resulted in the installation of three teaching stations in that college.

In addition to major renovations, an ongoing computing technology refresh program continued this year, systematically to replace existing technology supporting presentations in the classroom. A concerted effort is made to ensure that high capacity auditoriums are kept up to date. As an example, all of the classrooms in Torgersen Hall, and two major auditoriums (100 McBryde, and Colonial Hall in Squires) received new computer systems.

Over the past several years, more than 145 classrooms have been upgraded with presentation technology systems designed to assist faculty members and students in teaching and learning. This represents 85% of all centrally scheduled classrooms on campus. These facilities provide the faculty and students the capability for displaying 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 in the university.

Contact Information: Bruce Rakes, *Bruce.Rakes@vt.edu*, 540/231-5470

Computer-Integrated Classroom Support

The mission of the Computer-Integrated Classroom Support unit (CICS) is to provide the highest quality and most reliable computer-integrated classroom environment to enable faculty members to transform teaching and learning at the university. CICS provides support for all computer-integrated classrooms on campus, including approximately 1000 computing stations throughout the campus.

CICS services include the following:

- Provide software/hardware installation, maintenance and troubleshooting for computer-integrated classrooms (CICs) and labs
- Train faculty and staff members on the use of computer teaching stations and A/V equipment in CICS
- Provide consultation and support as requested to other departments
- Provide laptops for check-out by students or faculty or staff members from the TechConnect Lab (Torgersen 3250)
- TimeClock System Administration and Training
- Support the President's Conference Room in Burruss 325

Manage and maintain computer-integrated classrooms:

Computer-Integrated classroom	Macintosh	Windows
AIS Classroom		19
Ambler-Johnston 4102		45
Architecture Annex 1		25
*Art & Design Learning Center 112	16	
Chemistry/Physics 305		25
*Derring 2069		22
Graduate Life Center		18
*Henderson 23A	30	
Math Emporium	520	
Price 301A	15	
Randolph 114E		36
Saunders 101		25
Shanks 160	30	
Shanks 180		25
Shanks 360	25	
Torgersen 1010		33
Torgersen 1080		35
Torgersen 3250	18	18
Ware 103		5
Total	654	330

*Closed in FY06-07

PACE/PDM collaborative course support. CICS also plays an essential support and development role for Dr. Jan Helge Bøhn (Mechanical Engineering), who has created several collaborative Product Data Management courses involving other PACE Institutions in the United States and five foreign countries along with General Motors. CICS administers the Teamcenter Engineering application and database servers, Teamcenter Community Web and database servers, and consults with other institutions on installation and setup of their clients to interface with our systems.

Pay-for-Print service. The following table shows printing activity in the past year:

Printer	Jobs	Pages	Sheets	Amount Charged
Ambler-Johnston 4102	890	3212	3198	$321
Architecture Annex 1	1155	4418	3862	$386
Architecture Annex 111	0	0	0	$0
Burruss 122 HP8150	0	0	0	$0
Burruss 122 HP8550	0	0	0	$0
Cheatham 217	120	611	611	$61
Cheatham 220	785	2552	2552	$255
Chem-Phys 306	2155	7281	7220	$722
Donaldson-Brown 40	2514	13467	10141	$1033
Durham 152	91	166	166	$16
Durham 187	49	139	139	$13
Litton-Reaves 1370	2487	7237	7237	$723
Math Emporium #1	24153	99087	97291	$9729
Math Emporium #2	2455	10871	10482	$1048
McBryde 116	333	805	795	$79
Pamplin 2010	4073	13461	13461	$1390
Patton 316 HP4000	1903	4506	4225	$422
Patton 316 HP5100	1019	1095	1095	$219
Patton 319	2202	6101	5798	$579
Randolph 114E	1441	5515	5515	$551
Randolph 114E Color	43	84	84	$23
Saunders 101	16	42	35	$3
Shanks 160	2	11	11	$1
Shanks 180	105	238	238	$23
Shanks 360	0	0	0	$0
Torgersen 1010	1409	4077	4066	$406
Torgersen 1080	1256	4405	4311	$435
Torgersen 1140	676	2147	1978	$228
Torgersen 3250	4758	18061	17398	$1877
VetMed Library 101T	687	2853	2853	$285
	56,777	212,442	204,762	$20,839
% Change from FY05-06	-12%	-4%	-6%	-16%

Tablet PC Initiative. CICS provides support for a project conducted in partnership with Microsoft, which is studying the impact of specialized, collaborative software and tablet computers on learning.

Contact information: Rob Dickert, *rdickert@vt.edu*, 540/231-4810

Digital Imaging

The mission of the Digital Imaging Center is to support 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 that require a high degree of image scanning precision and network accessibility. Projects are considered based on the merits of proposals submitted by faculty members and graduate students interested in converting collections of original materials to digital formats suitable for research or instruction, following established imaging standards for creating digital archives.

To date, and through the end of the fiscal year represented in this report, Digital Imaging scanned 496,673 individual items associated with 69 distinct projects. A representation of this effort includes:

E–reserve	16,621 Journal pages	1,272 documents
Reserve annex	4,719 Journal pages	328 documents
Theses/dissertations	312,704 Manuscript pages	1,660 documents
Collections	93,613 Assorted images	pictures
	46,382 Page images	Manuscripts, books

We also produced over 40,000 surrogate images for the Center for Civil War Studies as part of a project to prepare Civil War newspapers for online delivery. This project represents the first in a series of pilot projects intended to expand support for creating a digital image repository at Virginia Tech. Other participants working together on this project include Data Warehousing, Database Management, and the University Libraries.

Work on the Civil War project helped us develop expertise, which can be offered to other agencies across the Commonwealth interested in similar repository projects. Digital Imaging is involved with a statewide committee looking at grant-funded opportunities to enhance the work developed through the Virginia Heritage Project. A grant application submitted by the Virtual Library of Virginia (VIVA) representing the college, university, and institutional libraries within

the Commonwealth of Virginia, acknowledges Digital Imaging's leadership in quality control and metadata standards for archiving the digital master files.

Using Pound Hill's Metagrove software, we developed custom XMP-based panels that work in Adobe CreativeSuite products for the purpose of adding technical metadata in each of the scans we make. This metadata enhances the process of describing digital objects and increases their subsequent usefulness as resources in digital libraries and future data repositories.

2006-2007 summary. During the past fiscal year a total of 10 separate collections were completed. These collections represent 7,648 individual images represented by slides, negative films, photography, and printed pages. A description of those collections is provided below.

Completed projects: 2006-2007

Library Archives	32	illustrations	Cadet uniforms
Architecture	213	negatives	Ferrari Collection
McCormick Farm	47	photographs	Reaper images
University Libraries	4	photographs	Appalachian Studies
University Libraries	390	pages	Dance cards
Foreign Language	252	book pages	French novel
Art & Art History	709	35mm slides	ART: 3004
Horticulture	139	35mm slides	HORT: 4664
PPWS	1,174	35mm slides	Plant diseases
Education School	4,688	book pages	Industrial arts

Two completed projects were directly related to the preparation of class materials used for instruction. Many of these images were also made available to the students in those classes as supplemental course materials.

Art & Art History	709	35mm slides	ART 3004
Horticulture	139	35mm slides	HORT 4664

Additional course material was created through support provided to the Electronic Reserve hosted by the University Library.

E-reserve	1,307	Journal pages	94 Documents
Reserve annex	494	Journal pages	30 Documents

The 1,801 pages scanned represent 124 new individual supplemental readings made available to students online through links established in Blackboard and on the University Library electronic reserve website.

In addition to the completed projects mentioned above, Digital Imaging continues to provide scanning support for numerous projects originating from the University Library's Special Collections and Digital Library and Archives.

Selected specific projects

Electronic Thesis & Dissertations

Current requirements for submission of electronic thesis and dissertations make access to these types of research materials a valuable resource to both on campus and off campus researchers. Dissertations housed in the University Library that were submitted prior to this requirement are also available to researchers in printed form and as a result require the user to visit the library or submit a request for use of that material. By converting selected dissertations to digital format, the library can provide remote access to these materials and enhance the magnitude of online research material available to both on campus and off campus research. These materials will be selected by discipline with the assistance and recommendation of faculty members in those areas.

Project Status: 312,704 Manuscript pages scanned 1,660 Completed documents

University Archives

Creating a digital archive for the historical images and documents related to the university benefits the preservation effort for these materials as well as increasing the accessibility to the documents and photos. This project includes over 100,000 items currently housed in the Athletic Department alone that are not protected from environmental damage due to heat and humidity. It also represents over 9,000 photographs (slides) that were previously housed in the University Relations Department along with the Bugle Collection (Virginia Tech Yearbooks). Providing accessibility to the images and documents recorded throughout the existence of Virginia Tech is considered a primary resource for research on the history of the university. Upon completion, the University Archives will be available electronically with an option for requesting printed copies of selected items. This archive should provide the capability to reproduce each item matching the condition of the original in terms of both size and coloration.

Project Status: 65,251 images have been scanned

Microscopic Pathology

This collection representing approximately 1000 2x2 slides of gross and microscopic pathology images from the College of Veterinary Medicine is intended to support student learning and research in the Center for Comparative Oncology. Specific courses benefiting this effort include Veterinary Pathology I, Veterinary Oncology I & II, and Veterinary Physiology II.

Project Status: 586 images have been scanned

McCormick Farm Project. In February of last year, we were contacted by David Fiske to provide assistance with redesigning the McCormick Farm Museum. This historic site includes machinery, photographs, models, and tools related to the Cyrus McCormick family as well as the farm buildings and home where Cyrus McCormick grew up. The McCormick Farm is the place

where the McCormick reaper, considered to be one of the five great inventions of the industrial age, was invented.

A new presentation was developed using the existing images located at the museum along with additional images acquired from the Wisconsin Historical Society. These historic images were combined with period music, an existing narration, and site photography to create a DVD that will be used in the visitor's museum and other applications for Web viewing and group presentations. The DVD was mastered in the New Media Center and duplicate copies were then made available to the McCormick Farm Museum staff.

Summary: 47 large format photographs. Scanned as archival masters
15 inkjet prints. Mounted for display in the museum.
Museum DVD. Designed and produced for presentation.

2006-2007 technology improvements

Equipment enhancements during the 2006-2007 fiscal year increased the quality and consistency of our scanning services, supported growth in our capabilities, and provided for software and processes that improve the value of our digital products.

- Standardized scanning workstations with widescreen Eizo professional-quality, high-resolution monitors that support hardware calibration and offer a variety of color controls and viewing options. These monitors will aid in achieving uniformity and superior results across different computer platforms and scanning devices.
- Modernized DVD recording and copying equipment to boost the speed and widen the scope of this essential tool. DVDs continue to provide a stable medium for long-term storage and convenient delivery of the growing collections of archival scans we are producing.
- Acquired a unique 3D scanning system, the Kaidan Meridian C-60 Object Rig, for performing 3D and VR scans of large objects up to 5 feet in diameter.
- Added a large format flatbed device that will scan material up to 18" x 24" at 400 dpi, and a digital scanning back for medium format cameras capable of a native resolution of 8000 x 10600 pixels (384 mega pixels).

Contact information: Gary M. Worley, Director, Digital Imaging, 540/231-9277, *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. Last year the number of jobs declined due to changes in final exam and course evaluation policies for spring semester, but usage under normal circumstances continues to be about the same. Statistics for the 2006-2007 academic year show the following:

Number of different clients served: 800
Jobs processed: 5,300
Exams: 4,400
Final exams: 700
Course evaluations: 500
Research data capture jobs: 500
Total sheets processed: 700,000

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 archive data, which will be available in a new online course evaluation system.

The department also completed a major effort to renovate Test Scoring webpages to enhance and update information as well as adopt the look and feel of the new central Virginia Tech system. The webpages not only provide extensive information on office procedures and services but also offer help to understand the technicalities of the output provided, background information on test design, and even alternatives to opscans, which take advantage of new technologies.

Contact information: Barbara Robinson, *robin@vt.edu*, 540/231-3950

Assistive Technologies

Assistive Technologies ensures that all students, faculty members, employees, and the general public with disabilities have the appropriate technology needed to access programs and services of the university. The unit provides technical expertise, leadership, and coordination of assistive technologies (AT) for disability accommodations, as well as for research, instruction, and public outreach activities. The Assistive Technologies department consists of the AT Lab and Special Services, which embrace a wide range of working relationships inside and outside the university community.

Assistive Technologies Lab. The Assistive Technologies Lab (AT Lab), located in Torgersen Hall, is a multidisciplinary research lab, training, outreach, and teaching facility that creates or improves assistive technologies for persons with disabilities and works to advance emerging technologies useful to all individuals. Research, instruction, and outreach opportunities for the AT Lab involve:

- Collaborating and promoting AT projects within the university and research community
- Participating in college and university consortiums on AT services and public outreach events
- Working with other state agencies or universities in obtaining grants or sponsored funding from government, industry, and the private sector for AT related research
- Working with disability service agencies on sponsored programs, one-time projects, and outreach

The AT Lab provides classroom instruction, technology demonstrations, and participates in public outreach forums regionally and statewide to raise awareness about disability issues, publicize AT research opportunities and results, and demonstrate the benefits of assistive technologies for all individuals.

Special Services–AT Services (ATS) in Newman Library. University AT Services (ATS) include local and university-wide licensing of specialized computer software, accessible computer hardware, and Special Services for the disabled that include maintaining a wide range of adaptive equipment needed for post-secondary education. Special Services, in Newman Library, provides individualized training on the software, hardware, or equipment when requested by customers as a disability accommodation.

The Special Services facility also serves the regional on-campus transition program (OCTP), 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.

ATS in Computer Labs. Assistive Technologies helps coordinate computer workstations and AT software support in approximately 25 locations across campus. An initiative to provide ubiquitous networked AT support for all university computers continues.

AT consulting services. Consulting services are available to any university entity providing support for disability accommodations or wanting to utilize assistive technologies. Formal instruction on issues for persons with or without disabilities is available upon request.

Assistive Technologies Lab

Research activities and sponsored programs

- Worked collaboratively with the College of Education and University ADA Services on ***Creating High Expectations*** (CHE), a Virginia Board for People with Disabilities and VATS funded project
  A website with CHE modules was created for students, families, and educators including transition information on careers, leadership skills, and assistive technologies.
- Working with the Brain Injury Services of SWVA, Radford University, and a not-for-profit 501(C) foundation to develop a research proposal to help people with acquired brain injuries in rural settings to live happily and productively within their community and home environment
  The model being prototyped, if successful, would emulate services currently available in long-term ABI treatment centers that are rarely located in rural communities and home environments.
- Working with individuals in Electrical and Computer Engineering, Computer Science, and Industrial and Systems Engineering, to support students' research and production of "custom designed" devices and software that will directly aid individuals with a disability.

Outreach activities. Assistive Technologies participates in many events designed to inform students with disabilities, their parents, and educators on the realities of attending college, help them learn about disability service agencies and try a variety of assistive technologies. Events this year included:

- College Bound "Preparing students with disabilities for a collegiate experience," a two and 1/2 day conference attended by 35 students, 30 parents, 10 educators, and 7 Department of Rehabilitation Services counselors
- Real World Day, an outreach project of Virginia Tech, Radford University, New River Community College, and the Virginia Assistive Technology System

Estimated attendance: 175 students, and 100 parents, college students, and other consumers, and 53 educators

- New World Day at UVA-Wise, similar to Real World Day, is a program that gives high school students with disabilities in far Southwest Virginia the opportunity to learn what programs and services are available to ensure their successful transition from high school into college or employment.
- Taking the Next Step, targeted at middle schools, and attended by 75 students, 20 educators, and one parent
- High School/High Tech, a national initiative of the President's Committee on Employment of People with Disabilities, serving Montgomery County
  Estimated attendance: 18 students in two workshops
  Assistive Technologies also employed two students for the summer to provide them with work experiences in a technology field.
- Youth Leadership Forum (YLF-VA) seeks to empower young people with disabilities to develop their leadership skills during a four-day conference on a university campus
  Estimated attendance: 35 students in one panel discussion and five AT workshops
- C-Tech2 "Computers and Technology at Virginia Tech," a College of Engineering program to help young women prepare for careers in engineering, math, or science
  There were 28 participants this year.
- AgrAbility Virginia helps individuals with disabilities overcome barriers in agriculture
  AT provides technical assistance at monthly meeting and annual events.

University lectures and presentations. Assistive Technologies participates in a wide range of university presentations and classroom lectures, to raise accessibility design issues and disability awareness for computer science, education, and other university disciplines. Fourteen sessions were offered this year.

Special Services

E-text provisioning and alternative media formats

- As a member of a statewide consortium working to create alternative media formats from printed materials for people who are blind or have print disabilities, worked with the consortium to load a preliminary model of an e-text library (at GMU) and host the first annual Scanning Forum (at UVA) which brought together e-text vendors, librarians, and AT specialists
- Investigated infrastructure issues of inter-library loans based on California's Alternative Media Exchange (AMX) database model
- Worked on scanning and Braille embossing techniques that could simultaneously print and Braille pictures from electronic books with graphic images
  The printed image could be used by a sighted person to understand the graphic image being displayed in the alternative Braille format.

- Added a pilot bulk scanning service for students seeking textbooks in an alternative format

Student referrals for disability accommodations and training

- Increased student AT trainings and decreased the number of students who delay the process of coming to Special Services for assistance by obtaining notification and introduction of AT staff to new students being referred by Services for Students with Disabilities

University faculty and staff referrals. There was a 50% increase in the number of referrals from University ADA Services, perhaps due to the increase in the average age of faculty members and university employees.

Accessibility Standards Committee

- Chaired the university Accessibility Standards Committee (ASC)
- Helped support university licensed software, training materials, and open-source software being used for accessible Web design
  AT licensed software (AccVerify and AccMonitor) can be used to verify and monitor websites for compliance with university accessibility standards, and AT worked with major university Web initiatives such as University Relations website redesign, procurement of a Web content management system, and train-the-trainer initiatives for accessible Web design.

Contact information: Bill Holbach *holbach@vt.edu* 540/231-3461

Summer Training Academy for Rising Students

Summer 2007 marked the completion of the third summer residency of the Summer Training Academy for Rising Students (VT STARS) funded by the US Department of Education (DOE) for 2005-2007. This phase includes a major shift of the program to a year-round focus.

Continued partnerships with several university partners, Fralin Biotechnology Institute (Fralin), the College of Science (Diversity Committee) and the Materials Science Department (MSE) resulted in excellent content development and student engagement.

Several new departments joined the program's instructional activities, with research faculty members agreeing to mentor students during the 2007-08 school year. Other plans for the year-round activities include individual science fair project development and transportation to Blacksburg for periodic laboratory activity.

Program assessment and participant transcript review is underway, including website development to document and disseminate the findings of the last three years. Coordinating with the university's government affairs officer, with ongoing solicitation of federal and regional funding, the program is envisioned to evolve into a regional model for a pipeline approach to minority under-representation in science and technology sectors of the emerging knowledge economy.

VT STARS was redesigned and re-positioned as an immersive academic enrichment program with an inquiry-based summer residency and after-school component targeted to 'high school students in the academic middle' in Public School Divisions within the Southside region. The repositioning of the program included an expansion of the participating school divisions to broaden the program's regional impact, in conjunction with relationship building at the Institute for Advanced Learning and Research (IALR).

In collaboration with CAEE, Undergraduate Admissions and the Provost's Office, a series of workshops and information sessions were held at IALR in spring 2006 and 2007 to promote the program and recruit participants.

In summer 2007, thirty-three new students comprised the third cohort of the DOE funded second phase of VT STARS. Additionally, twenty-three of the thirty-three eligible students returned for a second summer residency of seven days. The graduate student e-mentoring component was once again broadened, with six doctoral students directly involved in the summer's instructional activities. Additionally, nine undergraduates were involved in various aspects of the program, including an evening study hall, and recreational events.

The instructional activities for summer 2007 utilized a constructivist approach with the theme of *Energy Resources, Scarcity and Our Changing World* in a 'quest' format, allowing full integration of the instructional topics and informal hands-on activities within a learner-centered project focus. It also provided a concrete organizational emphasis for the summer's mandatory evening study hall, which was also improved by the direct involvement of several graduate, and undergraduate students who were assigned specific support roles as project resources.

The instructional activities for math were embedded in *seminars on sustainability and systems engineerin*g, which were conducted in a large class lecture format to simulate a college class. The design was highly interactive and engaged the students in critical thinking, and problem solving.

Discussions for institutionalization continue with the Provost's office as part of the effort to link VT STARS to the university's increased focus on diversity, pipeline programs, and innovative ways to contribute to economic development in targeted southwestern regions.

Studywiz software provides a flexible and robust standards-based network infrastructure to support VT STARS' e-Mentoring and year-round focus. Studywiz will enable reuse of previous instructional content and support online collaboration among participants, facilitating creation of after-school science and technology clubs at participating high schools. Studywiz also has support for parental involvement and creation of learning resources by teachers. Streaming media of selected content is also planned as part of the shift to a year-round focus.

Contact information**:** Ed McPherson, *ejay@vt.edu,* 540/231-8029

Learning Technologies professional activities

Courses taught

EDP 6006, Learning, Teaching and The Role of Higher Education in a Democratic Society, Spring 2007, 14 graduate students (Moore, A.H.)
GRAD 5114, Pedagogical Practices in Contemporary Contexts, Fall 2006, two sections; enrollment = 70 (Fowler, S.B.)
GRAD 5974, Integrating Technology into Teaching (Independent Study), Fall 2006, for the FP graduate certificate (2 and 3 credits); enrollment = 5, (Fowler, S.B.)
GRAD 5114, Pedagogical Practices in Contemporary Contexts, Spring 2007, one section; enrollment = 29 (Fowler, S.B.)
GRAD 5974, Integrating Technology into Teaching (Independent Study), Spring 2007, for the FP graduate certificate (2 and 3 credits); enrollment = 4, (Fowler, S.B.)
GRAD 5114, Pedagogical Practices in Contemporary Contexts (Pacifici, J., assisting Fowler, S.B.)
ENGL 1105, English Composition, Spring 2007 (Pacifici, J.)

Awards

Moore, J.F. Won a *Computerworld* award based on extensive work with Glenda Scales, and Tom Walker in the College of Engineering, and Steven Lee and others in NIS regarding pilot project in Spring 2007 using DyKnow software in large (250+) engineering classes. Wireless

collaboration in this large classroom setting was considered an industry first and won a *Computerworld* award.

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

Watson, C.E. Selected as "Outstanding Graduate Student of the Year" in IDT Program (2007).

Publications

Fowler, S.B. and Diaz, V. "Professional Development and Support for New Audiences," in ACTL authored "Top Ten Teaching and Learning Issues for 2007," *Educause Quarterly* (in press).

Fowler, S.B., and Carter-Tod, S. "Integrating technology into Language Arts Curricula," book chapter in *Developing Competency: A Standards-based Approach to Technology Integration*, under review with Wadsworth press.

Fowler, S.B. "Dual-Career Couple Hiring," contribution to chapter in *Faculty Career Paths: Multiple Routes to Success and Satisfaction*, eds., Bataille, G.M. & Brown, B.E., 2006, Greenwood Publishing.

Moore, A.H. "The New Economy, Technology, and Learning Outcomes Assessment." *EDUCAUSE Quarterly*, 32(3): 6-8, 2007.

Moore, A.H. "Virginia Tech's Math Emporium." In Sally Johnstone and WCET Associates, Advancing Campus Efficiencies: A Companion for Campus Leaders in the Digital Era." Anker Publishing Company, Inc., 2007.

Moore, A.H. "The Math Emporium: A Case Study." In Diana Oblinger (ed.) Spaces That Enable Learning. EDUCAUSE E-book. September 2006. With Barbara Robinson.

Moore, A.H. "Torgersen Hall: A Case Study." In Diana Oblinger (ed.) Spaces That Enable Learning. EDUCAUSE E-book. September 2006. With J. Thomas Head.

Moore, A.H., Fowler, S.B., and C. Edward Watson "Active Learning and Technology: Development Designed to Change Faculty, Students, and Institutions" *Educause Review* (under review-publication expected October 2007).

Plymale, W. "Do We Need Discreet Computing in Instruction?" EDUCAUSE Review 42(3): 84-85, 2007, Educause Publishing.

Watson, C.E. "ePortfolio in higher education: Student assessment and beyond". In S.C. Henry (Ed.), *Proceedings of the Thirty-Sixth Annual Conference of the International Society for Exploring Teaching and Learning*, 287-289, 2006.

Watson, C.E. *Self-efficacy, the Innovation-Decision Process, and Faculty in Higher Education: Implications for Faculty Development*. Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University, 2007, Blacksburg, VA.

Worley, G.M. ETD 2007 Conference Proceedings: Paper published as part of the accepted papers for the conference.

Zaldivar, M. "The Game's Afoot: Images of Infinite Games" in Samuel Delany's *Trouble on Triton*." *Reconstruction*. 6.1 Winter 2006. Available online at http://reconstruction.eserver.org/061/zaldivar.shtml.

Presentations

Fowler, S.B. Invited speaker, *AdvanceVT* conference, "Contemporary Pedagogy & Marketing your Teaching Philosophy, July 2006.

Fowler, S.B. Invited speaker, Seminars on Academic Computing (SAC) Aspen Colorado, "Strategic Investments in Teaching and Learning," co-presented with Jeshua Pacifici, August 2006.

Fowler, S.B. Invited keynote, Diversity Conference, University of North Texas, "Higher Education Employment Issues and the LGBT Community," co-presented with Karen DePauw, November 2006.

Fowler, S.B. Invited keynote, NetworkVA Conference (Ford Foundation-funded project for building LGBTQ coalitions on Virginia's university and college campuses), University of Virginia, "From Homophobia to Dual-Career Policies: Making Change Through Activism and Coalitions," co-presented with Karen DePauw, March 2007.

Gausepohl, K. Sakai QA Roundtable Discussion, 5th Sakai Conference with OSP, June 2006, Vancouver.

Head, J.T. and Plymale, W. "TeamSpot Collaborative Learning Study Room in Newman Library" Semi-annual DCSS Meeting, March 2007, Blacksburg, VA.

Head, J.T. Presentation on the open source online student evaluation system was accepted for the EDUCAUSE Annual Conference, October 2007, Seattle, WA.

Humphries, W. "Evaluation Tool Demonstration." 6th International Sakai Conference, December 2006, Atlanta, GA

Humphries, W. "RSF Programming Techniques in Sakai - Lessons from the Evaluation Project." 7th International Sakai Conference, June 2007, Amsterdam, The Netherlands.

Humphries, W. "Evaluation Tool Demonstration." 7th International Sakai Conference, June 2007, Amsterdam, The Netherlands.

Moore, A.H. "New Instructional Roles"; "Using Assessment to Achieve Other Goals." March 2007. The National Center for Academic Transformation's Redesign Alliance Conference. Orlando, FL. Moderator with Burck Smith, Karen Mills, Scott Karakas; Peter Ewell, Candace Thille, Randy Smith.

Moore, A.H. "Parallel Universes and the New Economy: Challenges to Learning." November 2006. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America International Annual Meeting. Indianapolis, IN.

Moore, J.F. Invited keynote presentation: "Systemic approach to faculty development and learning technology," to Pittsburgh Regional Blackboard conference, March 2007, Duquesne University.

Pacifici, J and Gausepohl, K. "Shaking the Vending Machine: Management and Pedagogical Implications of OSS", 5th Sakai Conference with OSP, June 2006, Vancouver.

Pacifici, J., "Strategic Investment in Teaching and Learning," Educause Director's Conference, August 2006, Snowmass, CO.

Pacifici, J. and Gausepohl, K. "Haute Software: Juggling Open Source and Vendor Software", Educause National Conference, October 2006, Dallas, TX.

Pacifici, J., "Considerations and Concerns When Moving From Commercial to Sakai," Sakai Winter Conference, December 2006, Atlanta, GA.
Pacifici, J., "Practical Pedagogy," Sakai Summer Conference, June 2007, Amsterdam, NE.
Pacifici, J., "A Strategy for Moving from Commercial to an Open Source Environment," Sakai Summer Conference, June 2007, Amsterdam, NE.
Plymale, W. and Head, J.T. "TeamSpot Collaborative Learning Study Room in Newman Library" Semi-annual DCSS Meeting, March 2007, Blacksburg, VA
Watson, C.E. "Preparing faculty to use OSP: Facilitating ePortfolio pedagogy development". Sixth Sakai Conference with OSP, December 2006, Atlanta, GA.
Watson, C.E. "ePortfolio in higher education: Student assessment and beyond", Annual conference of the International Society for Exploring Teaching and Learning, October 2006, Palm Springs, CA.
Worley, G.M. "Dissertations Unbound: A Case Study for Revitalizing Access", Annual ETD Conference, June 2007, Uppsala, Sweden
Worley, G.M. "Archival Scanning and Technical Metadata," Virtual Library of Virginia (VIVA), January 2007, Richmond, VA
Zeckoski, A. "Programmers Cafe: Data persistence using Hibernate", 5th Sakai Conference with OSP, June 2006, Vancouver.
Zeckoski, A. "Discussion: Sakai Requirements", 5th Sakai Conference with OSP, June 2006, Vancouver.
Zeckoski, A. "Panel: UI Panel: Toward a Delightful Sakai User Experience", 5th Sakai Conference with OSP, June 2006, Vancouver.
Zeckoski, A. "Programmers' Cafe Workshop" 6th International Sakai Conference, December 2006, Atlanta, GA.
Zeckoski, A. "Reasonable Sakai Widgets," 6th International Sakai Conference, December 2006, Atlanta, GA.
Zeckoski, A. "SAKAI: A Capabilities Engineering Perspective" 6th International Sakai Conference, Dec. 2006, Atlanta, GA.
Zeckoski, A. "Comparing Presentation Technologies," 6th International Sakai Conference, December 2006 Atlanta, GA.

Outreach activities

Brackett, H.J. Annual Planning and Consortium Member for College Bound and Real World Day, ongoing
Brackett, H.J. Advisory Member for Creating High Expectations, ongoing
Head, J.T. Participated as an active member of the Learning Technology Consortium that meets semiannually with nine participating universities for planning and discussion of critical instructional technology issues in higher education.
Holbach, W.H. Annual Planning and Consortium Member for College Bound and Real World Day
Holbach, W.H. Advisory Member for Creating High Expectations, ongoing
Holbach, W.H. Strategic Planning and Fundraising, Montgomery County - High School High Tech program, ongoing

Moore, A.H. Advisory Committee for the Coalition for the Revitalization of Southside Virginia, 2006-

Moore, A.H. Outreach Advisory Council, Institute for Advanced Learning and Research, 2006-

Moore, A.H. Development Team–Leadership Development Through the Arts, Urban Affairs and Planning, Theatre Arts, UVA's Cooper Center for Public Administration, Proposal for Private Funding Pending, 2003–

Moore, A.H. Strategic Planning and Fundraising–VTStars Program, ongoing.

Moore, J.F. Meet regarding learning technology with Dr. Mohamed Youssef (V.P. for Information Technology) and Dr. Yasser Hanafy (Dean of College of Computing and VT-MENA resident director, representatives of Arab Academy of Science and Technology.

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

Watson, C.E. Delivered talk to the Rotary Club on emerging instructional technologies.

Phillips, S. Member, Content Management System Selection Committee

Phillips, S. Member, Content Management System Work Group

Phillips, S. Member, Accessible Web Development Committee

Watson, C.E. Provided presentations and consulting for other institutions considering the adoption of open source learning tools, including RU, UCF, JMU, and the Ohio Learning Network.

Worley, G.M. Design assistance for repurposing materials used in the Cyrus McCormick Museum, including creative design and production consultation for a digital display presentation that will be used as a guide for visitors and as part of the McCormick Farm website.

Zaldivar, M. Consultant. *Optimized Learning, Inc.* 2-day Sakai Training Workshop. March 2007.

University service

Brackett, H.J. Member, Accessibility Standards Committee

Fowler, S.B. Pedagogy consultant, "Earth Sustainability—Living in the 21st century," a Curriculum for a Liberal Education (CLE) Learning Community project, currently in its second pilot, weekly meetings, Summer /Fall 2006–Spring 2007.

Fowler, S.B. Invited committee member and pedagogy consultant, College of Engineering Tablet PC Initiative Working Group, Fall 2006–Spring 2008.

Fowler, S.B. 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.B. Guest lecture, "Contemporary Technology and Learning Communities for 21st-century Learners," Earth Sustainability course, September 2006.

Fowler, S.B. Guest lecture, for Dr. Tonya Smith-Jackson's ISE graduate seminar, "Net Gen Learners: Trends and Issues," November 2006.

Fowler, S.B. Invited panelist, Faculty Leadership Development Academy at Virginia Tech, "Leading Diversity Efforts with Faculty, Staff, & Students," November 2006.

Fowler, S.B. Guest lecture, for Citizen Scholar Engagement seminar, "Diversity and Technology in the 21st century," January 2007.
Fowler, S.B. Invited dialogue facilitator, VT Diversity Summit, January 2007.
Fowler, S.B. Invited panelist, English Graduate Student Organization (EGSO), "Diversity in our Discipline," February 2007.
Fowler, S.B. Invited lecture, *AdvanceVT* luncheon seminar, "Post 9/11 and 4/16 Pedagogical Issues: Addressing Student Concerns," April 2007.
Fowler, S.B. Mentoring Committee Member for two junior faculty members, Dr. Sheila Carter-Tod and Dr. Gena Chandler, Department of English.
Fowler, S.B. Academic advisor for Sean Kelly, MA student in English, Fall 2006–Spring 2008.
Fowler, S.B. Dissertation committees (in EDP, STS, MFT, and T&L); EDP and STS dissertation defenses, and one preliminary exam and defense in T&L, 2006-2007.
Fowler, S.B. Ongoing advising (open door policy) for GEDI students who are teaching or about to teach here at VT.
Fowler, S.B. Supervisor for the creation of an electronic Pedagogical Field Guide (ePFG) for technology-enriched learner-centered instruction at VT. The initial version is being tailored specifically for the Earth Sustainability CLE course.
Head, J.T. Served as a member of the University Committee on the Evaluation of Teaching.
Head, J.T. Served as the Learning Technologies coordinator for Continuity of Operations Planning (COOP).
Head, J.T. Dissertation committee work in Teaching and Learning in the School of Education, 2006-2007.
Head, J.T. Worked in collaboration with the University Libraries to establish a study room in Newman Library that provides a state-of-the-art collaborative learning space that uses TeamSpot software and a large interactive display.
Holbach, W.H. Member, Americans with Disability Act (ADA) Executive Committee
Holbach, W.H. Member, Information Technology, Security Task Force
Holbach, W.H. Member, VT.edu redesign, Advisory Committee
Holbach, W.H. Chairman, Accessibility Standards Committee
Moore, J.F. Member, University Employee Development, Leadership and Training Committee.
Moore, A.H. Dissertation Committee: Adrienne LaBranche (EDP Ph.D. candidate)
Moore, A.H. Human Resources Employee Advisory Committee, June 2007-
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-
Moore, A.H. University Strategic Planning for the Arts Initiatives, Roanoke Art Museum and University Performing Arts Complex, 2006-
Moore, A.H. Advisory Committee, Institute for Governance and Accountabilities, 2005-
Moore, A.H. University Director, Center for Innovation in Learning; Coordinates annual XCaliber Award; Provides grants for e-learning development when funds are available. 1998-
Moore, J.F. Member, SCHEV Learning Technology Advisory Committee.
Moore, J.F. Member, University Classroom Master Planning Committee.
Moore, J.F. Member, University Computing Requirement Committee.
Moore, J.F. Member, Center for Innovations in Learning XCalibur Award committee.
Moore, J.F. Member of search committee for CEUT Assessment positions.

Moore, J.F. Member of TLG/SFF internal grants committee, CEUT.
Watson, C.E. Active member of the "VT Alerts" Deployment Committee and the CMS Committee.
Watson, C.E. Delivered presentations for students in BSE, Human Development, and EDCI.
Watson, C.E. Delivered talk as part of COE's Student Technology Showcase.
Watson, C.E. Participated as a panelist in a CEUT workshop on ePortfolio.
Watson, C.E. Provided campus tours to tenure-track faculty candidates.
Worley, G.M. Art Museum of Western Virginia Advisory Group.
Participated in meetings related to the creation of a creative arts center and performing arts building on the Virginia Tech campus. The creative arts center would work closely with the Art Museum to create instructional materials for public school systems throughout the region.

Professional service

Moore, A.H. University of Alabama, Tuscaloosa, College of Arts and Sciences Technology Review, Committee, March 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–
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- : Executive Director Search Committee, May–September 2006.
Moore, A.H. Commons Solutions Group, 2005-
Moore, A.H. Sorensen Institute for Political Leadership, Regional Advisory Board, 2005–
Moore, A.H. EDUCAUSE Center for Applied Research, Institutional Representative to ECAR, 2003-
Moore, A.H. Blue Ridge Public Television, Higher Education Council. 2002–
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. Consultations about planning and implementing faculty development programs, ePortfolios, and online course evaluation software with academic and IT staff at Carlow University, Duquesne University, George Mason University, MIT, University of Central Florida, University of Delaware, University of Maryland, University of Michigan, and University of Minnesota.
Moore, J.F. Participant, Educause national conference, Dallas.
Moore, J.F. Member, Educause Advisory Committee on Teaching and Learning.
Moore, J.F. Participant and discussion leader, Seminar on Academic Computing, Snowmass.

Moore, J.F. Participant, Educause Learning Initiative focus group on academic assessment, Boulder.
Moore, J.F. Participant, Sakai winter conference, Atlanta.
Moore, J.F. Participant, Coalition on Networked Information conference, Washington.
Moore, J.F. Participant, Learning Technology Consortium meeting, University of Notre Dame.
Watson, C.E. Serve on the Review Board of the International Journal of Teaching and Learning in Higher Education (IJTLHE).

Recognition

Moore, J.F. Department was recognized as a major collaborator in the Sakai project, by the Mellon Foundation. Mellon Technology Collaboration grant
Fowler, S.B. Selected IT participant for two-day workshop, "Moving Forward Together," an Effectiveness Institute leadership program, Virginia Tech.
Watson, C.E. Ph.D. in Instructional Design and Technology completed in May 2007.

Active grants

Head, J.T. Received a Parents Fund Grant that provided resources for establishing a collaborative study room in Newman Library.
Moore, A.H. U.S. Department of Education. Grant Consultant/University Coordinator. VTSTARS Second Phase programming. (Ed McPherson, Principal Investigator)
Moore, J.F. Andrew Mellon Foundation, SENRG

Network Infrastructure and Services

Network Infrastructure and Services provides and manages the university's information technology infrastructure and services by

- identifying and incorporating solutions through the dynamic implementation and management of emerging technologies;
- promoting sound fiscal management;
- endeavoring to advance the capabilities of our existing information technology infrastructure and services;
- broadly disseminating information regarding new technological developments;
- providing network, system, and services management, maintenance, and support with emphasis on a high level of security, availability, and reliability;
- supporting the teaching and learning, research, and outreach missions of the university, while embracing our role as a corporate citizen within the local, state, regional, and international communities;
- remaining sufficiently flexible to pursue aggressive development and expansion of new services.

Technological innovation and improvements support and enhance Virginia Tech's position in an increasingly global and competitive digital environment. NI&S strives to anticipate the technological needs of the university community and provide the leadership to create innovative and cost-effective solutions. NI&S identifies leading-edge technological advances and makes them available as Virginia Tech pursues national recognition as a top research university. NI&S also contributes to the university's outreach efforts, endeavoring to influence the development of the information economy to improve the quality of life for the university community and the citizens of the commonwealth.

The technology infrastructure units are aligned under the Associate Vice President, Network Infrastructure and Services, Ms. Judy L. Lilly. Goals include the identification and adoption of solutions that meet current needs, anticipate future demands, and provide the best combination of price, performance, stability, availability, and reliability. Emphasis is placed on promoting secure, integrated information technology strategies to advance the university's excellence and to maximize its competitive advantage in the digital economy.

Communications Network Services, the telecommunications auxiliary, is one part of the comprehensive NI&S organization. NI&S includes Systems Support and Information Technology Support, which support the university's centralized information technology services. Video/Broadcast Services (VBS) produces broadcast-quality instructional video and advanced multimedia instructional materials. Printing and Mail Services provide efficient and timely distribution and dissemination of information. An internal systems development

team creates management tools allowing the integration of all NI&S information needs, quick adaptation to new requirements in a changing environment, improved internal controls, and the use of better planning methods to maximize efficiency.

The Network Infrastructure and Services organization provides leadership for the Blacksburg Electronic Village and NetworkVirginia to help improve the quality of life for citizens throughout the commonwealth. Taking advantage of an optical and wireless infrastructure providing ubiquitous, high-performance network access and direct connections to national and international research networks, NI&S also participates in and supports the deployment of regional, national, and worldwide high-performance computing and communication networks.

Rapid changes in technology, mobility, flexibility, and the nature of broadband infrastructure are changing the way the university community works. The expectations of and demand for the benefits of that technology continue to grow. Virginia Tech relies on NI&S to understand and forecast user needs and to identify leading-edge technological advances and make them available to the university community. Access to next-generation network technologies, protocols, services, and applications is critical, as the university pursues top-tier research status; strives to create a modern, technology-enriched, advanced learning environment; and fulfills its outreach mission to improve the quality of life for the commonwealth’s citizens.

Today, 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. The telecommunications infrastructure reaches almost every corner of campus. Plans are now being made to implement a new infrastructure architecture including upgrades for the equipment/telephone rooms, telecommunications cables (fiber and copper), network equipment, the telephone system, and unified communications systems. The new system, employing advanced network switching and processing technologies, will be based on a diverse, survivable, optical core and ubiquitous wireless and wired access. It will provide a pervasive, leading-edge, technology infrastructure to support the vision and mission of the university.

Virginia Tech's campus-wide network and the entire NI&S organization are a reflection of the commitment and dedication to thoughtful planning and management practices in a dynamic technological field, which is evolving at an ever-increasing pace. The university community relies heavily on near-instantaneous and continuous access to information from anywhere, at any time, over a wide range of media. As a leader in higher education network development, Virginia Tech makes use of gigabit Ethernet, wireless local area network access, wired and wireless voice communications, video and related services, broadcast-quality teleconferencing, and a cable television system for teaching, learning, research, administration, and community service. New, readily available, Internet-based applications like IP videoconferencing and high-definition video provide greatly improved reliability and performance for Internet access and distance learning programs. Support services, enhanced network security, and help desk functions are integral to daily operations.

NI&S collaborates with Research Computing, Learning Technologies, Enterprise Systems, and the Information Technology Security Office to provide network management, support, and centralized services emphasizing security and reliability to the entire university community.

NI&S sustains and enhances the university's reputation in advanced network initiatives and learning environments through increasing involvement in research activities. The organization has expanded its partnerships and collaboration with faculty members to advance the university's reputation as a highly rated research university and to integrate technology in teaching, research, and outreach programs.

NI&S seeks to attract, develop, and retain quality employees to enhance the organization's effectiveness and contributions to the university. The highly skilled and talented NI&S workforce is committed to achieving excellence. NI&S staff members take advantage of all opportunities to work together to improve the organization's flexibility and agility in the delivery of services and the deployment of new technologies.

Network Infrastructure & Services staffing by unit

Unit	2005	2006	2007
Communications Network Services	110	113	114.5
Systems Support Services—Help Desk / 4 HELP	21	21	16
Systems Support Services—Server Administration	12	11	12
Systems Support Services—E-Communications Clients	8	8	9
Video/Broadcast Services	14	14.5	14.5
University Printing and Digital Imaging	26	26	26
University Mail Services	19	18	18
Total Staffing (faculty and classified)	**210**	**212.5**	**210**

Virginia Tech is adapting to new financial and administrative responsibilities and opportunities as the Restructured Higher Education Financial and Administrative Operations Act of 2005 is implemented. NI&S has always emphasized financial integrity and stability in all operations and administers a balanced budget to ensure financial resources are available to continuously invest in new technologies. Business processes and systems are constantly improved to maximize organizational effectiveness. Maintaining and enhancing an advanced communications infrastructure and remaining at the forefront of technology services require an up-to-date and evolving funding model. Planning and resources must be linked. Organizational units within Network Infrastructure and Services are supported from a combination of auxiliary, education and general (E&G), and cost center funds. NI&S makes use of all funding mechanisms to provide access to cutting-edge technology and services. As an auxiliary, Communications Network Services (CNS) is permitted to assume some debt for capital expenditures related to infrastructure development. However, the majority of NI&S funding comes from revenues associated with the resale of services from auxiliary operations. The auxiliary portion of NI&S is required to recover all operational costs as well as all costs necessary to maintain and continually upgrade the network. NI&S participates in funded sponsored projects and research.

The department's main offices are located in Research Building XIV at the Virginia Tech Corporate Research Center. Our address is 1770 Forecast Drive (0506), Blacksburg, Va. 24061. The departmental website is *www.cns.vt.edu/* and Judy L. Lilly, the Associate Vice President, Network Infrastructure and Services, may be reached at (540) 231-2599.

Strategic Initiatives Group

Drawing on expertise from across Information Technology, the university, and colleagues at other Virginia universities, this Network Infrastructure and Services group pursues multiple strategic program areas. The charge to this group is to enhance the competitiveness of Virginia Tech and the commonwealth's citizens through early access to advanced broadband technology. In addition, this area provides direct support to Information Technology's executive administration for special assignments typically involving overall strategy and communication related to strategy.

The Mid-Atlantic Terascale Partnership (MATP) is a consortium of research entities in Virginia, Maryland, and the District of Columbia. MATP provides aggregated access for member institutions to the National LambdaRail and to multiple other high-performance national and global networks. MATP also provides a forum for collaboration in high- performance networking and computing for regional universities. On behalf of MATP, NI&S operates the NOVA Aggregation Facility in McLean, Virginia, to provide physical aggregation services for research and education (R&E) networks as well as low-cost, high-capacity access to internet and other commercial services. In addition to fulfilling the requirement for high-performance, research network connectivity, this facility saved Virginia universities a significant amount in commodity Internet service costs. This facility is among the premier R&E network aggregation points nationwide. A representative from the NI&S Strategic Initiative Group serves as program director for MATP as well as the mid-Atlantic administrative representative for National LambdaRail.

NetworkVirginia provides broadband network access for over 2,000 sites statewide reaching an estimated 1.4 million Virginians. Participating sites include higher education, K-20 education, municipalities, health care, museums, libraries, government, small local Internet service providers, and other commercial entities. The program has focused on promoting equitable access to broadband services particularly in rural communities. NI&S provides program administration, contract administration, and oversight for NetworkVirginia. In addition, the Virginia Tech Operations Center is a subcontractor to Verizon and Sprint providing order processing, network management, and trouble reporting and resolution services. The Blacksburg Electronic Village serves as a subcontractor to Sprint providing multiple internet-support services to NetworkVirginia subscribers statewide.

The Strategic Initiatives Group provides a substantial outreach component by supporting infrastructure development initiatives including the Mid-Atlantic Broadband Cooperative (MBC)

and the LENOWISCO tobacco commission-funded fiber-optic projects. The group integrates with the activities of the eCorridors and Blacksburg Electronic Villages programs. During the past year, a series of agreements between Virginia Tech, the Virginia Tech Foundation, and MBC resulted in execution of a 20-year, indefeasible right to use (IRU) lease agreement for four strands of fiber throughout MBC's network. Virginia Tech will leverage this IRU for research and connectivity to support the future needs of the university and the Southside region of Virginia. The value of the IRU agreement to Virginia Tech exceeds $2.5 million.

Network Engineering and Operations

Network Engineering and Operations includes Research and Development, Network Engineering, Systems Support, Information Technology Support, Network Security, and Project Management.

Research and Development

Members of the Research and Development (R&D) group contribute to the innovative implementation of networking technologies throughout the university and beyond at local, regional, and national levels. R&D leads the strategic development of the university’s communications services and infrastructure and provides technical leadership to the university community.

Network Infrastructure and Services encourages employee involvement in research and outreach efforts. The advice of the R&D engineers is continually sought in matters of advanced network services, system security and design, database systems and applications design and development, and scientific and quantitative analysis methods. The wide-ranging educational backgrounds and real-world experiences of the group bring diversity to problem solving and a broad insight not found in more specialized areas. NI&S seeks to attract and retain the best engineering staff members, and to promote creativity, interaction, and team building within the R&D group. The varied team experience provides a foundation to develop solutions that are not only technically

successful but also efficient in terms of total cost-of-ownership through effective implementation and maintenance processes.

The R&D group provides the planning and design support for the implementation of almost all new or upgraded network services for Virginia Tech, including those addressing the current demand for converged technologies and those anticipating future requirements. Wide-ranging projects undertaken by the group will enable future enhancements in areas such as distributed computing, wireless networking, regional and national networking infrastructure, increased redundancy and reliability, pervasive computing, and network security.

Providing leadership in open source development will position NI&S to contribute to the university, the surrounding community, and others in the higher education environment as well as enhance the university's national visibility. Other software and systems development activities include Web-based Remedy forms, a Confluence wiki for sharing information, activities related to Central Authentication Service single sign-on, Oracle upgrades and improvements, and deployment of additional Linux servers to support new application requirements.

Research and Development also has the primary planning responsibilities for the planned infrastructure upgrade project that will eventually provide increased connection speeds for most university users as a result of re-engineering, the upgrade of the majority of network equipment, and the rebuilding of approximately half the in-building wiring. Appropriate physical facilities and an up-to-date cable plant will enable new technologies to develop and allow quicker adaptation of current and emerging technologies.

The department's strategic plan defines network security as "the sum of the security measures taken with individual network components and is accomplished by maintaining appropriate code and patches on network switches and devices, by providing network integrity, and by proactively monitoring for and isolating potential violators." The forward-looking work of the R&D engineering staff has helped Virginia Tech earn a reputation of having a robust, highly functional, and adaptable network and computing infrastructure, creating a secure environment providing privacy for network users as well as integrity and availability of computational and network infrastructure resources. Those resources will be critical to the support of university researchers as their environment becomes increasingly competitive. NI&S will continue to support maturing technologies as well as provide campus research groups with robust, secure, high-performance networks that have convenient and flexible access to national and international high-speed networks.

Network Engineering

The university's core network must serve the challenging needs of university researchers as well as a myriad of administrative and learning applications. Advanced grid-based computation, network-based collaboration environments, and other research efforts in key areas such as biotechnology, computer science, engineering, and mathematics depend on a secure and reliable network as well as one able to take advantage of the latest technologies. A key part of the NI&S mission is to advance the capabilities of and provide daily support for our existing information technology infrastructure and services while simultaneously planning for increased capabilities to empower Virginia Tech's faculty, staff, and students as newly evolving technologies become available.

Supporting the Virginia Tech network is a Network Engineering team of highly skilled and resourceful information technology specialists who design, implement, and manage a reliable, scalable, adaptable, and secure telecommunications infrastructure. The group has extensive experience and strong credentials in statistics, mathematics, computer science, network engineering, software development, and systems analysis. Their responsibilities include network architecture and engineering, network operations and maintenance, security assessment and implementation, and network performance measurement and analysis. The team conducts network protocols research and pilot testing of new products and technologies in cooperation with hardware and software vendors. Software development is another major activity with continuous work on applications to support fault management and problem reporting, configuration management, authentication and authorization services, and performance measurement and analysis. Software tools with open, consistent, and extensible interfaces are used.

NI&S television and satellite uplink engineers provide support for operations associated with distance learning, cable TV service, and special events, as well as the maintenance and improvement of facilities. They provide daily satellite uplink service for the Virginia Satellite Educational Network throughout the public school year. They also support satellite uplink services to commercial television networks for media events involving University Relations, the Athletic Department, and the Graduate School. In addition, the team provides rapid response to reported television service outages including coordination with our service providers and the constant repair and enhancement of facilities to maintain a high level of service availability.

Switch Engineering

Switch Engineering (SE) is tasked with the planning, design, implementation, operation, and optimization of the systems and equipment utilized to provide telephone and voice messaging services to the university community, on campus and at other Virginia Tech locations throughout the state. Even as the university's technology systems develop, grow, and adapt to changing requirements, the main goal of the SE group remains the achievement of the expected "five nines" of reliability (99.999 percent) in the delivery of telephony services. SE will manage the end-of-life and decommissioning of legacy voice technologies in a way that will be as transparent as possible to the university community.

In cooperation with the Virginia Tech Police and other campus departments, CNS provides oversight for the installation of emergency phones throughout campus as well as cost estimate information for future installations. The "blue light phones" provide a more secure environment for students, faculty and staff members, and campus visitors. E911 calls placed from these phones are delivered to the Virginia Tech Police with specific location information allowing the police to respond quickly even to remote campus locations.

In accordance with well-defined procedures, the SE group provides full cooperation and technical assistance to the Virginia Tech Police and other law enforcement agencies in the investigation of annoying and harassing calls received at or originating from campus telephone numbers. These investigations are also coordinated, as necessary, with regional and long distance telecommunications service providers.

Telecommunications Facilities Management

The Telecommunications Facilities Group ensures all facilities (including HVAC systems, normal and backup power systems, fire alarm systems, environmental monitoring systems, and security systems) in NI&S equipment and telecommunications rooms throughout campus are robust, secure, and highly reliable. The group performs minor maintenance for these systems, schedules vendor maintenance if needed, and installs, troubleshoots, and repairs telecommunications cabling, hardware, and equipment as required. Regular inspections of all switch and equipment rooms are completed to ensure there are no physical problems, such as water leaks, lighting failures, or broken equipment. The group performs facilities planning for

capital projects and building renovations while working closely with the project coordinator, project contractor, project designer, network engineering, and quality assurance personnel for the duration of the projects. This area also functions as the primary contact point for any facilities-related failures occurring after normal business hours.

Systems Support

Systems Support provides reliable and secure, mission-critical, electronic communications, central computing resources, and stewardship of university information assets in support of the university's mission of teaching and learning, research, and outreach. Group goals include the provision of a secure, 24 x 7, high-availability, computing resource environment with standards-based, centrally managed, hardware and software configurations. Systems Support strives to provide a stable and reliable computing environment by performing in-depth service monitoring, trend analysis, and predictive capacity planning and through the use of standard systems configurations and access controls.

The Systems Support department administers a wide variety of centrally provided, computing infrastructure services including campus e-mail services as well as central storage and backup facilities and services. Systems Support is responsible for the server hardware and operating system software on which the university's enterprise applications (such as Banner, Web Hosting/Filebox, Information Technology Acquisitions, Information Warehousing and Access, Middleware, Portal, and eProvisioning), instructional applications (including Blackboard, Sakai, and ePortfolio), and research applications operate. Using best practices for systems administration, the department supports the university community by providing a robust technical computing infrastructure with secure, reliable, centralized services. Systems Support is also responsible for production-level computing services in the high-performance computing arena including 24 x 7 support for System X hardware and operating systems. The goal is to leverage System X and other high-performance components for use by all campus researchers and departments.

E-Communications Services and Windows Administration Services Team

The E-Communications Services and Windows Administration Services (ECS-WAS) Team provides primary operating systems (OS), hardware, and application support for all centralized messaging systems (e-mail, Listserv, mobile messaging, USENET news), and OS and hardware administration support for all non-UNIX-based centralized services (CITRIX, Enterprise Systems and Central Services Domains, Microsoft Exchange). Other miscellaneous responsibilities of this group include the maintenance of the Virginia Tech UNIX/Linux mirror

site, responding to Internet abuse complaints (through *abuse@vt.edu*), and participation in the Computer Incident Response Team. The group also supports Listserv, a distributed, subscription-based, email communications tool that allows Virginia Tech students, faculty and staff members to post information on specific topics (such as class work or assigned projects) to a wide audience with a single message.
Listserv usage remained steady over the previous fiscal year, delivering an average of 300,000 messages to 1,500 active mailing lists per day in the fall and spring semesters. It proved a highly efficient vehicle for distribution of information during the tragic events of 4/16/07, averaging over 500,000 messages per day for that week. One day, over 750,000 messages were processed.

Storage Management Team

The Storage Management Team (SMT) is primarily engaged in providing centralized, state-of-the-art, self-managed storage environments and backup facilities for university affiliates. Such services mitigate the risk of information loss caused by catastrophic hardware failure of storage media. SMT services include the administration of the IBM storage area network (SAN) for large, database-intensive applications, as well as the network-attached storage (NAS) devices that provide file-level storage for desktop and laptop users or department-level file sharing. Eighty percent of all storage is used for academic and research purposes. Backup services are provided for desktop users as well as enterprise and departmental-level servers.
SMT engineers research new developments in managed network storage infrastructure to meet growing storage demands as well as network backup service to provide for faster and more reliable restoration of data.

UNIX Administration Services

The UNIX Administration Services (UAS) team provides hardware and operating system support for UNIX/Linux-based services offered to the university community. These services include administrative application services (such as Banner and the Data Warehouse), instructional application services (such as Blackboard), and research applications services (such as those running on System X, Silicon Graphics Inc., and Sun-based hosts). By utilizing consistent standards across all platforms and concentrating on the hardware and operating systems, a relatively small staff can accommodate a large and growing set of servers. Currently, the team manages over 150 non-research systems, providing systems administration support to 11 separate groups within Information Technology. They also support over 1,000 research systems including Apple MAC OS X-based System X, Sun Microsystems' Solaris-based systems, and Silicon Graphics Incorporated IRIX and Linux-based systems.
Load balancing management is employed throughout for improved reliability and performance. Internet protocol security (IPSec) policies provide end-to-end encryption for Banner database links to better secure the service and the data transmitted between users' workstations and database servers. Additional servers and a migration of databases into the storage area network

(SAN) have enhanced reliability and performance for Blackboard and Sakai services. New and more powerful hardware now supports the data warehouse.

Information Technology Support

Information Technology Support (IT Support) is comprised of two units: the Virginia Tech Operations Center (VTOC) and University Computing Support (UCS). IT Support provides a 24x7, centralized, single point-of-contact for computing and telecommunications services support to all Virginia Tech affiliates. IT Support provides

- support and consultation on computer desktops and laptops;
- support for use of central computing, telecommunications, and multimedia services;
- development of software tools and utilities, such as the VTnet CD, to facilitate support of end users;
- reclamation of surplus computers to insure compliance with requirements set forth by Virginia Tech standards and guidelines;
- advocacy for the university community by presenting computing-related concerns and suggestions for ways to make computing offerings more user friendly.

Virginia Tech Operations Center

The Virginia Tech Operations Center (VTOC) provides support for the services provided by Information Technology. The center, located in the Corporate Research Center, serves the campus as well as other Virginia Tech locations around the commonwealth. It merges traditional call center and computing help desk functions with network operations, video operations, and systems support in an integrated operations center. The VTOC provides support 24 hours a day, seven days a week for telecommunications, Information Technology services, constituents' computing platforms, cable television, uplink operations, Video/Broadcast Services, and NetworkVirginia problem reporting. Tape backup services including loading/unloading of tapes, off-site rotation, location documentation, tape inventory monitoring, and data restores are available as well.

The VTOC supports the unique needs of the university computing and network environment by receiving initial trouble calls or Web-submitted inquiries from faculty, staff, alumni, retirees, parents, and students. Problem tickets are opened to track the diagnosis, escalation (if required), and resolution of each reported problem. The VTOC provides proactive monitoring of faults and service degradation for Information Technology services, network hardware, and network connectivity components.

University Computing Support

University Computing Support (UCS) provides end user technical support for many of the information technology services offered to students, faculty and staff members, and other Virginia Tech affiliates. Supported services include, but are not limited to the following:

- VT Mail
- Exchange mail including mobile messaging
- Ethernet, wireless, and modem network connections
- Blackboard
- Hokie SPA and Banner
- Network-attached storage
- Backup services

UCS provides assistance with general computing issues including these topics:

- Computer security
- Virus and spyware removal
- Microsoft Office products
- General Windows and Macintosh computer issues
- Computer requirement questions

Network Registry Services

The Network Registry group provides support related to IP and IPv6 address management and registration and plays an important role in providing and managing the university's information technology services to ensure their security, reliability, and availability. Network Registry services include the following:

- IP Address Assignment.
  Every host in the Internet has an IP address. This unit manages and tracks all addresses assigned to Virginia Tech.
- IP Domain Name Service (DNS)
  DNS provides a mapping between the host names and the IP addresses of the hosts. Almost every network transaction begins with a DNS lookup.

- Dynamic Host Configuration Protocol (DHCP) Service
  Hosts registered to use DHCP obtain their network configuration information from the DHCP servers. This process allows registered hosts to be moved from one network to another without requiring the system administrator to reconfigure them. It simplifies the task of renumbering networks.
- Design and Development
  The Network Registry unit develops new systems and tools to enable efficient and effective management of address management and registration services.

These services are used by every host attached to Virginia Tech's network and every host outside the network that interacts with hosts on the network. The supporting tools are part of the mechanism Virginia Tech uses to operate a reasonably open network while still being able to hold individuals accountable for their network activity.

Staff in this unit provides consulting and engineering assistance in the areas of networking, security, and system administration in support of special applications used by other groups within the university.

Project Management

Many NI&S projects to advance campus communications services and infrastructure are lengthy and complex, involving significant investment of financial and personnel resources. Managing projects on such scale presents special challenges. The Project Management Team exists to meet these challenges.

Project management involves the application of sophisticated tools and techniques to increase organizational efficiency and help ensure a project will be completed successfully. The Project Management group uses software tools to maximize resources, prioritize tasks, and ensure every project team member can successfully execute their individual tasks. The Project Management Team employs project plans to assist in keeping projects on schedule and within budget.

For consistency, NI&S project plans are developed using a standard template, and each plan plots the necessary tasks for the duration of the project. Plans are distributed in portable document format and hypertext markup language format so team members can track progress. Complex projects may require tiered project plans.

Periodic project status meetings are held to review the project timeline and deliverables and allow team members to communicate completed tasks, outstanding issues, and other details pertinent to the project. Monitoring and tracking progress helps the Project Management Team anticipate, identify, and resolve problems that could impede successful completion of the project.

When each project is completed, the project team works together to prepare a closing report. The closing report provides final project status information and highlights lessons learned so future projects can benefit from the experience of past projects.

Technology outreach: Blacksburg Electronic Village

The Blacksburg Electronic Village (BEV) strives to increase the availability and encourage the use of information technology to enhance social capital and broaden economic opportunity in Virginia communities.

Since its inception in 1993, BEV has performed an important outreach effort by encouraging the community to come together by using technology. Through outreach and education, BEV works to increase the community's capacity to adapt to rapid changes in society and to use technology to solve increasingly complex challenges.

BEV (*www.bev.net*) remains one of the longest running and best-known community networks in the world. Its early focus on building a data infrastructure has expanded as the private sector has increased its ability to meet demand for Internet service. Nevertheless, BEV remains central to ongoing community information technology efforts and continues to serve as the prototype community network infrastructure model through which Virginia Tech Information Technology and its partners work with communities. In addition, BEV remains the Web-hosting service provider of choice for many local civic and social organizations, including the Town of Blacksburg.

Video/Broadcast Services

Video/Broadcast Services (VBS) produces broadcast-quality instructional video and advanced multimedia instructional materials. The group operates and maintains network-based systems to deliver live and prerecorded class materials both on-campus and to distance-learning students.

Through the development, production, and distribution of synchronous and asynchronous instructional content, VBS supports the university's missions of teaching and learning, research, and outreach.

VBS has provided the university and the commonwealth with avenues for distance learning for more than 20 years. About a decade ago, Virginia Tech expanded distance-learning opportunities as a response to the higher costs involved with 'brick and mortar' campuses. That effort led to the interactive asynchronous transfer mode network, managed by Virginia Tech, which now reaches all corners of the state and has delivered coursework for thousands of Virginians.

Interactive videoconferencing is one means by which the university maintains its commitment to distance education. VBS maintains and operates electronic classrooms throughout the state for the interactive videoconferencing (IVC) network, providing full-service connectivity, real-time management and monitoring, instructor training, technical assistance, and diagnostic support. VBS coordinates the scheduling of interactive videoconference and video bridging services to the university's distance-learning classroom facilities, as well as to non-Virginia Tech facilities, including other universities and the community college system. VBS offers live and on-demand streaming media servers to support classes, projects, and special events. Problem resolution for the network is available through the Virginia Tech Operations Center.

Business Administration and Operations

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

Systems Development and Administration

The Systems Development and Administration (SDA) team is responsible for developing, implementing, and maintaining much of the organization's administrative telecommunications management systems and the computer infrastructure supporting those systems. The group

handles the development and operational support for Blacksburg Electronic Village initiatives, systems, and services. Work by SDA to develop and maintain secure and reliable Information Technology application solutions supports the vision and mission of NI&S and provides a strategic advantage to the department.

ATLAS, developed and maintained by the Systems Development unit, is the organization's principal telecommunications management system. It 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 is the Web-based customer portal for ATLAS providing electronic bill delivery, account information, and service provisioning and management.

The Systems Administration unit supports more than 75 servers and over 250 desktop systems. The team provides server and middleware support for Oracle database systems, network management systems, printing management systems, BEV systems, voice call detail polling systems, general file and application servers, and Web systems.

Network Administration

The Network Administration Group—including Call Detail Record (CDR) Operations and Security—coordinates with industry representatives and others within CNS. The group has developed and continues to maintain critical business relationships with key providers of telecommunications goods and services and works closely with the Switch Engineering and the Business Operations groups within CNS. Network Administration consults with peer institutions throughout the country on issues related to telecommunications administration. Within CNS, Network Administration develops, refines, and maintains many of the department's methods and operational procedures. The group proposes improvements to business practices to ensure the department is operating in accordance with university rules and to increase the department's ability to respond to the university's needs in a timely and effective manner.

The Network Administration group oversees telecommunications administration and the successful operation of switched and dedicated facilities. This work includes an emphasis on CDR management and security, the integration of new technologies into existing systems, effective fiscal operations, technical and administrative support for network design, and network adjustments in order to maintain maximum service levels for the university at the lowest possible cost. In addition, Network Administration staff work with internal groups and our vendors to ensure a timely resolution of reported service and vendor billing issues in order to minimize the impact to the university community.

The CDR Operations and Security staff acts as a primary resource to protect the university from fraudulent use of its telecommunications network by proactively monitoring for misuse and

providing requested information to Internal Audit and legal authorities as appropriate. The staff provides high-level technical and administrative support in systems operation, design, maintenance, and financial management of the university telecommunications system as well as in the research, evaluation, and development of detailed and accurate communications design cost estimates.

Network Administration personnel work regularly with vendors providing communications products and services to the university. Regular meetings are conducted with Verizon, Sprint, Virginia Information Technology Agency, and other vendors to maintain open lines of communication and to ensure the rapid and efficient resolution of any contractual issues, service problems, and billing disputes.

As indicated above, Network Administration cooperates, collaborates, and supports other groups across NI&S. Together with Network Administration, these groups work to enhance the ability of NI&S to make timely, accurate, and cost-effective decisions in support of daily operations, the evaluation of new service offerings, special initiatives, and long-term planning. In addition, Network Administration frequently organizes departmental participation in teleconferences on issues of interest or concern, participates in meetings about special projects, and proposes system enhancements to increase efficiency and support the deployment of new services.

Field Engineering

Field Engineering (FE) designs, installs, documents, and maintains state-of-the-art telecommunications distribution systems. FE supports a full range of telecommunications services responsive to the specific and complex needs of the university community. Working closely with leading industry vendors to develop new products required to meet the university's demanding and diverse requirements, FE deploys the most reliable, adaptable, and secure systems available. The installed systems are designed to be flexible enough to meet the university's evolving technological needs over a ten-to fifteen-year period and include campus-wide wireless networking and ongoing infrastructure upgrades.

The Field Engineering team strives to maintain positive relationships with and fully support the university community. FE works closely with project architects and engineers, as well as with the university's Capital Design and Construction teams during project development, to ensure communications cable pathways and spaces meet industry and Virginia Tech standards. As technologies migrate towards Voice over Internet Protocol (VoIP), the designs for new facilities include the required environmental controls, physical security, and backup power systems. FE coordinates its activities with Physical Plant to minimize disruption of university operations and plans its work schedules to avoid disturbing classes in session.

The Field Engineering group, with assistance from Network Infrastructure and Services' Research and Development team, works closely with manufacturers of station cable, connectivity products, equipment racks, and horizontal cable distribution systems. The goal is to pursue and apply reasonably priced, leading-edge technology in support of the latest advances in high-speed telecommunications applications. These efforts include rigorous testing, thorough evaluation of products, and refinement of installation practices resulting in maximum utilization of the installed systems.

Field Engineering is involved with capital projects from the earliest planning stages through project completion and focuses its processes on the university community's satisfaction with telecommunications services. The group identifies, refines, and documents operational procedures to provide a smoother, timelier, workflow process and to increase employee efficiency, safety, and professionalism. Inside Plant design work is incorporated in each of the building design phases and reflects input from the future building tenants as well as project planners, architects, and engineers. Outside Plant infrastructure is designed and sized to provide adequate capacity to serve the facility being built and provide for the university's master plan expectations for future construction in the area. FE project designers continually strive to improve the data-carrying capacity and capabilities of the telecommunications infrastructure.

Thorough planning efforts and quality workmanship ensure the communications infrastructure in university buildings provides the highest network performance and the longest and most reliable service life possible.

CNS maintains a warehouse facility of 26,400 square feet. Material stock levels are maintained for routine telephone and network installations and repair work, outside plant infrastructure, and inside plant new construction. A separate, dedicated space at the warehouse is used to store departmental records.

Safety

As NI&S has grown, it has become more efficient to handle the majority of important safety issues in-house. While our strong partnerships with Facilities and Environmental, Health and Safety Services remain, environmental, safety, and health questions are now answered more quickly and efficiently by the NI&S safety coordinator.

Managers and staff members receive information regarding health issues and Occupational Safety and Health Administration compliance directly from the safety coordinator. Training is customized to specific NI&S workgroups and environmental investigations are completed more rapidly. Personal protective equipment is now internally coordinated, and the safety coordinator conducts periodic reviews of construction sites to raise NI&S employee awareness, increase compliance, and proactively prevent injuries and worker's compensation claims. The result is a

safer, more supportive, and more efficient work environment for employees at NI&S and throughout the university.

Business Operations

Business Operations encompasses three major areas: Ordering and Provisioning, Business Services, and Public Relations. These areas support the day-to-day operational activities and facilitate the business and administrative needs of Communications Network Services, University Printing Services, Mail Services, Video/Broadcast Services, the Blacksburg Electronic Village, Systems Support, University Computing Support, and the Virginia Tech Operations Center.

Business Operations facilitates transactions between various NI&S departments and their clients, including students, university faculty and staff members, vendors, the Commonwealth of Virginia, and other NI&S partners and constituents. One of the group's major objectives is to respond to all customer inquiries in a professional and timely manner in an endeavor to improve processes, refine business practices, and provide enhanced services. Staff members strive to balance information gathering with decision making to support the timely implementation of service offerings in order to meet identified needs. Business Operations is charged with ensuring these functions are carried out in accordance with university policies and procedures and industry best practices.

Ordering and Provisioning

Ordering and Provisioning (O&P) processes departmental telecommunications orders and helps ensure timely provisioning of services and equipment, including phones, cellular phones and service, and integrated voice and data equipment and services. The O&P group serves as the primary point of contact between CNS and the university community and is in an excellent position to evaluate customers' telecommunications needs. The team assists in strategic telecommunications planning efforts for new buildings, as well as tactical planning for routine voice, data, and video requests.

With a fundamental goal of ensuring customer satisfaction, O&P provides extensive support for all major telecommunications projects. O&P plans and coordinates the development and submission of letters of estimate, meets with departments, receives and processes interdepartmental communications requests, initiates work orders, and follows up with customers after the completion of the work. One critical aspect of the O&P involvement in provisioning telecommunications services is facilitating the management and preparation of service requests.

This assistance includes an inventory of current active services, advice on the design and reconfiguration of services, and coordination of work when services are moved or installed. O&P arranges meetings with other NI&S groups, particularly with engineering and technical staff, upon customer request.

Business Services

Business Services includes Accounts Payable/Telecommunications (or Telco) Vendor Billing, Accounts Receivable, and the Student Telecommunications office. Business Services supports the day-to-day operational activities and facilitates the business and administrative needs of NI&S units.

Accounts Payable/Telecommunications Vendor Billing (AP/TVB) personnel provide essential, administrative support services for CNS, Video/Broadcast Services, University Printing Services, Mail Services, the Virginia Tech Operations Center, University Computing Support, Systems Support, and the Blacksburg Electronic Village. Their work includes support for purchasing, accounts payable, and travel requests and reimbursements.

The AP/TVB staff works extensively with the key vendors providing the university's communications products and services. The goal is to ensure the best possible service for the department and all university customers and to ensure the most rapid and efficient resolution possible of contractual disputes, service issues, and billing problems. The Telco Vendor Billing area is responsible for the management of more than 60accounts and approximately $1.9 million dollars annually.

Accounts Receivable provides timely and accurate billing and accounts receivable functions for CNS, the Blacksburg Electronic Village, Video/Broadcast Services, Mail Services, University Printing Services, the Virginia Tech Operations Center, Systems Support, and University Computing Support. Monthly billing for various telecommunications services is provided to university academic departments and administrative areas, on- and off-campus students, as well as outside agency customers of the university-owned telecommunications system.

Student Telecommunications, a branch office located on campus in the Student Services Building, is the primary point of contact between students and NI&S for telecommunications service and billing.

Public Relations

The Public Relations group within Network Infrastructure and Services ensures the smooth flow of information between users of the university's telecommunications services and NI&S. Public Relations personnel in the Reception, Web and Documentation, and University Switchboard groups provide information and assistance to students, parents, faculty, employees, vendors, and

visitors. Public Relations is directly involved in developing, piloting, and implementing university network services by disseminating accurate and timely information about NI&S activities and services and by soliciting feedback for other NI&S support units. Internal and university-wide information campaigns leverage a wide array of information media to ensure "news gets to those who need it." All inquiries and requests are addressed quickly and accurately.

University Printing Services

University Printing Services provides a means to produce and deliver tangible documents to support the university's missions of teaching and learning, research, and outreach. Services include a full-service print facility, digital copying/printing centers, management of the contract allowing university departments to lease copiers/printers, pre-sort standard (bulk) mailing, and copyright clearance according to federal copyright laws.

Printing Services offers high-quality products and services to meet the varied needs and ever-increasing demands of the university community. Digital workflow efficiencies are now being fully realized, particularly in the area of full-color printing for which there is a significant and constantly increasing demand within the university.

Printing Services uses leading-edge technology infrastructure to enable faculty, students, and staff, regardless of their physical location, to submit jobs with customizable options through the Printing Services website at *www.printing.vt.edu***.** The group continually investigates new technology options to provide enhanced services and attempts to implement funding methods to provide for necessary equipment upgrades. In addition, Printing Services is constantly working to improve business processes and controls to reduce costs while maintaining outstanding service levels.

Printing Plant

Producing a high-quality product in a timely manner in support of the university's mission is the main goal of the Printing Plant. The university's print requirements mirror national trends: runs have shortened and the demand for color is constantly increasing. A new initiative is underway to make Print Plant staff the "go to" people for quality color work as we implement a strategy to move to quality color, digital presses, and smaller presses.

The installation of new pre-press hardware to aid in color reproduction, as well as advanced training for staff on computer-to-plate technology, has kept Printing Services on the cutting edge in this area. New software has added continuity to workflow and aids in color calibration and reproduction. In addition, new finishing equipment and software provide a higher degree of quality and greater efficiencies. The well-trained and dedicated work force uses quick set-up and versatile finishing equipment to complete required deliveries rapidly.

Copier Management Program

The Copier Management Program (CMP) is extremely popular, and University Printing Services constantly reviews the process to ensure continuous improvement. The CMP has three main objectives: management of agreements with the copier vendor; serving as liaison between the copier vendor and university departments; and providing cost savings to the university. Vendors are obligated and motivated to deliver service in an appropriate and timely manner providing an excellent level of service to customers.

The CMP has placed over 400 copiers and increased revenues significantly. At the same time, no existing customer has opted out of the program.

Hardware provided by the program allows a department to copy, print, fax, scan-to-fax, and scan-to-e-mail—eliminating the need for additional devices and reducing the cost per copy. A combination color copier/printer/scanner, now available through the CMP, allows departments to laser-print full color at a reasonable cost.

Online tools allow departments to submit requests for service calls and supplies directly from the Printing Services website, allowing off-campus Extension offices and research facilities to take advantage of the program.

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 not only as a result of increased speed, but also with complete finishing, which has eliminated the need to transport an unfinished product to another location for finishing. Receiving Web-submitted files and having a student-dedicated print and copier area have improved the ability of the Digital Print Centers to serve the needs of the university community and to reduce operating costs.

Centralized Mail

Centralized Mail handles approximately two million pieces of outgoing mail per year in addition to all mail sent internally to deans, directors, and department heads. As the steward of the university's Pre-sort Standard Postal Permit #28, Centralized Mail handles labeling and presort bar coding to achieve the lowest possible cost and keeps accurate records of all usage.

Mail Services

Mail Services provides timely, efficient, and cost-effective mail services to the faculty and staff, and to students. It provides a critical infrastructure support service through convenient delivery to and pickup from the United States Postal Service. Customer feedback is sought in order to analyze needs and provide better and more efficient service.

Mail Services is composed of two functional entities—one processing mail for university departments (University Mail Services or UMS), and one processing mail for students living in on-campus residence halls (Residential Mail Services or RMS).

UMS delivers mail and picks up mail and packages on a regular schedule 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.

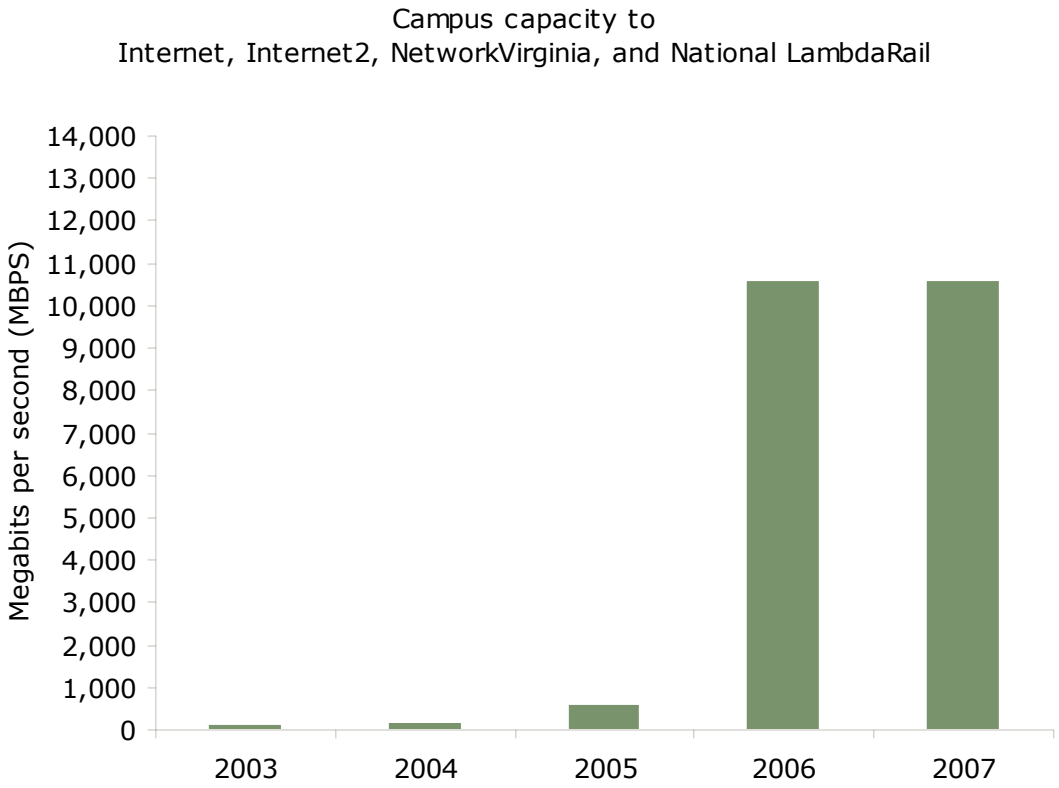
RMS is responsible for delivering mail and distributing notices for packages to approximately 8,900 students living on campus. Residential Mail serves students using five staffed mailrooms on campus and proudly provides high-quality assistance with a personal touch. Residential Mail employees strive to ensure students receive important mail, even if incorrectly addressed, and to provide information on ways to limit unwanted or junk mail. Residential Mail has implemented procedures emphasizing the protection of students' privacy. For example, the name and address on every piece of incoming mail is cross- referenced with the name of the student(s) living at that address. If there is not a match, every effort is made to find the correct address for the student. If no campus address is found, the mail is returned to the sender. Packages are not given to a student unless the student has a form of photo identification to prove they are the student to whom the package is addressed.

Mail Services works with vendors such as DHL, UPS, and the United States Postal Service. The rate at which mail is processed, even at increased volumes, has been improved by using automated systems. Network connectivity has allowed more efficient use of Mail Services resources including the establishment of an online departmental billing process that leverages the capabilities of NI&S's ATLAS enterprise management system. The online billing system has automated transactions between university departments and UMS, saving paper and printing costs, as well as increasing transaction accuracy. Mail Services constantly researches technological advances in mail-handling equipment and mail-related software to insure the most cost-efficient mail and parcel services are provided to the university.

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

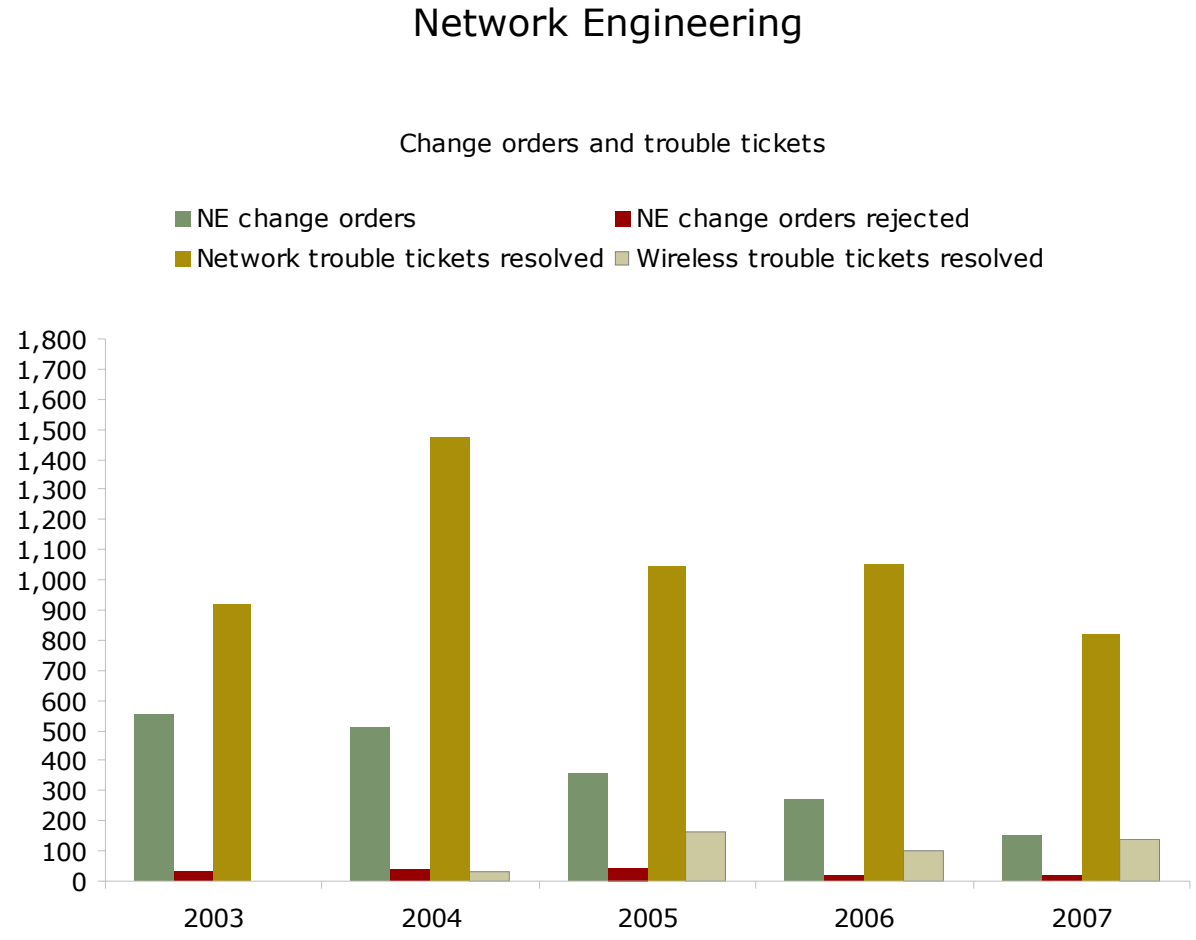
Performance and Productivity Metrics

Strategic Initiatives



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 over the last several years concurrent with increased utility of the Internet and the demand for related services. During the last five years, high-performance connectivity for computational research, coupled with increased requirements for visualization and collaborative tools, has 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 3-5 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 (NE) change orders are the number of orders submitted to make changes to existing network configurations or to introduce new equipment and configurations into the network.

NE change orders rejected represents the number of 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 by the committee; 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 in the submitted time period due to other changes taking place or conflicts with the critical dates calendar, and so on.

Network trouble tickets resolved is the number of opened network trouble tickets in the Remedy trouble ticketing system that were successfully resolved by whatever means necessary to repair the failure.

Wireless trouble tickets resolved is the number of opened wireless trouble tickets in the Remedy trouble ticketing system that were successfully resolved by whatever means necessary to repair the failure.

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 resolved has also decreased as a result of the attention given to network management tools. These tools have allowed 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. (See above)

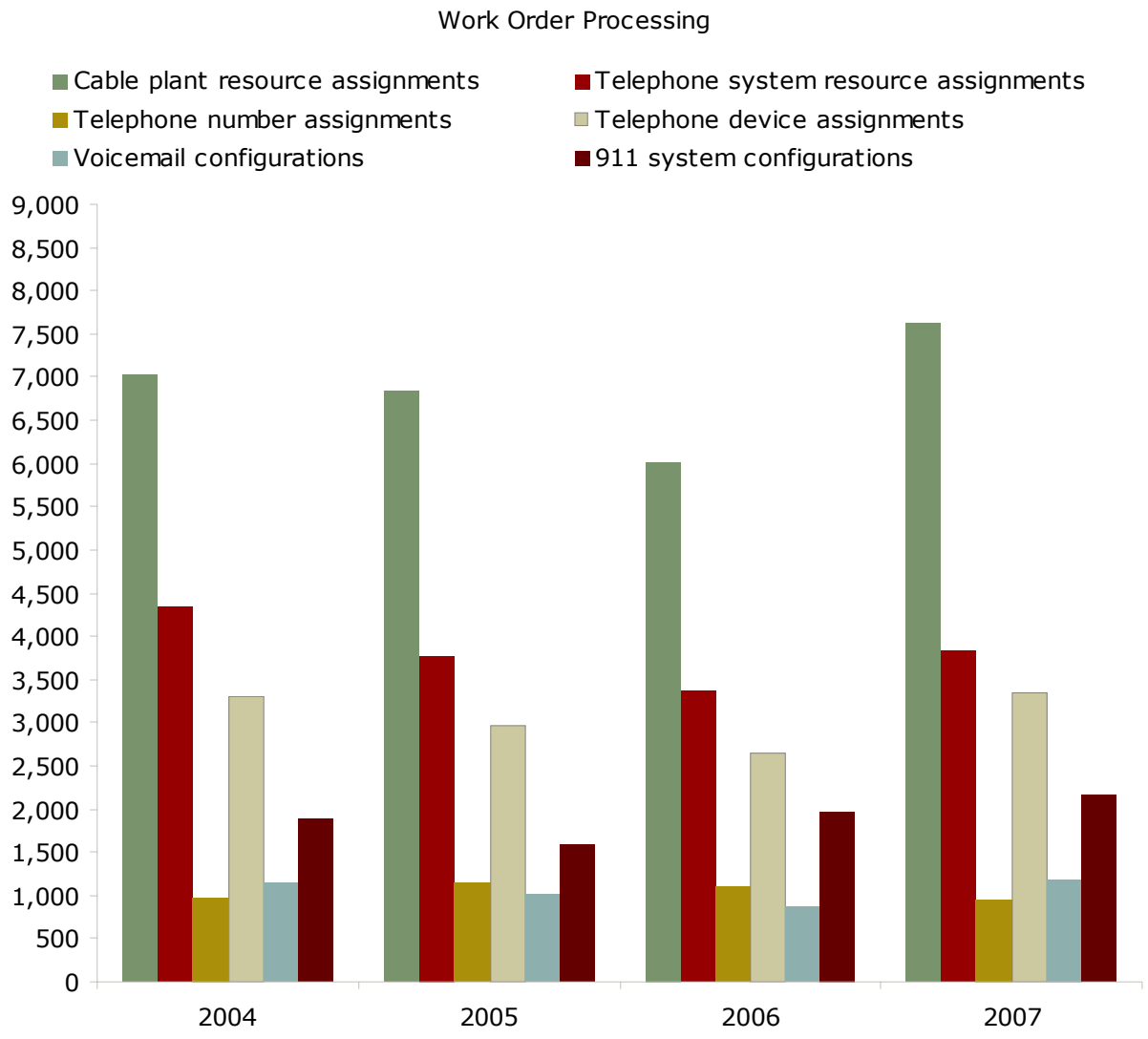
The number of wireless trouble tickets resolved increased and then leveled out as the number of wireless access points installed has increased over the last four years.

Wireless LAN (local area network) service

	2006	2007
Number of on-campus buildings with wireless LAN Service	106	109
Number of off-campus buildings with wireless LAN Service	16	20
Total number of deployed wireless access points	1,179	1,248
Total number of wireless LAN registrations	23,167	26,358

Network Engineering continues its work to improve wireless LAN coverage. In the past year, seven new academic and administrative facilities have received Wireless LAN service. As building renovation projects continue to reshape our campus, access points are continuously 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 choose to use the wireless LAN for mobility and convenience.

Switch Engineering

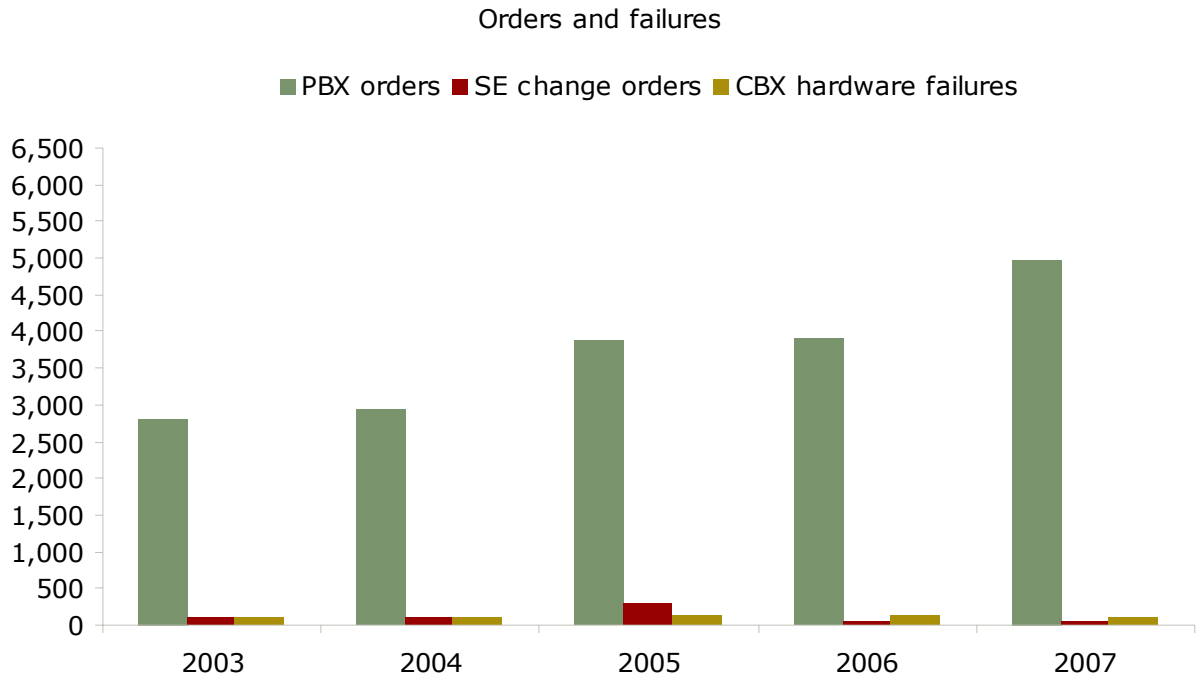


The graph above represents the total number of resource assignment transactions—cable plant, telephone number, telephone system, and telephone device assignments—required to support requests for new telephone and network services.

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

Voicemail configuration tracks the software activity to provision voicemail and call processing services.

The increase in cable plant resource assignments in 2007 can be attributed to the service and support efforts of the communications organization 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.



PBX order statistics represent the total number of move, add, and change (MAC) 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 2005 is associated with the many orders required for the opening of the Inn at Virginia Tech, Skelton Conference Center, and Holtzman Alumni Center. The big increase in 2007 is related to the many orders resulting from the events of April 16th.

Some of the reasons for increased Switch Engineering change orders in 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

	2006	2007
System availability	99.999%	99.999%
System hardware failures resolved	0	2
Operating system and application patches	0	0
User-reported failures resolved	756	591
Hardware architecture modification projects	2	2
Software architecture modification projects	46	49

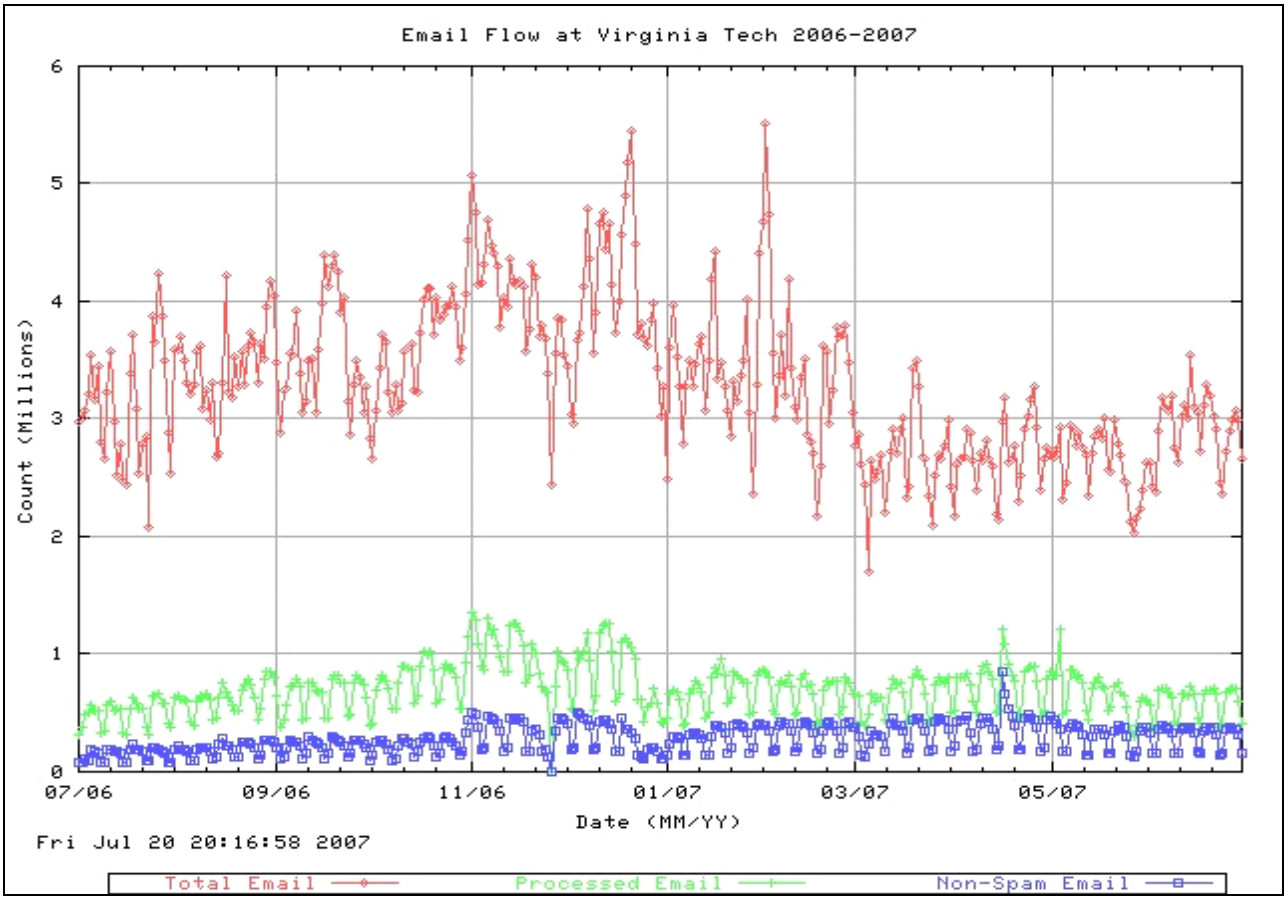
Voicemail System Operation and Maintenance

	2006	2007
System availability	99.982%	99.999%
System hardware failures resolved	3	2
Operating system and application patches	0	0
Hardware architecture modification projects	1	2
Software architecture modification projects	1	2

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.

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

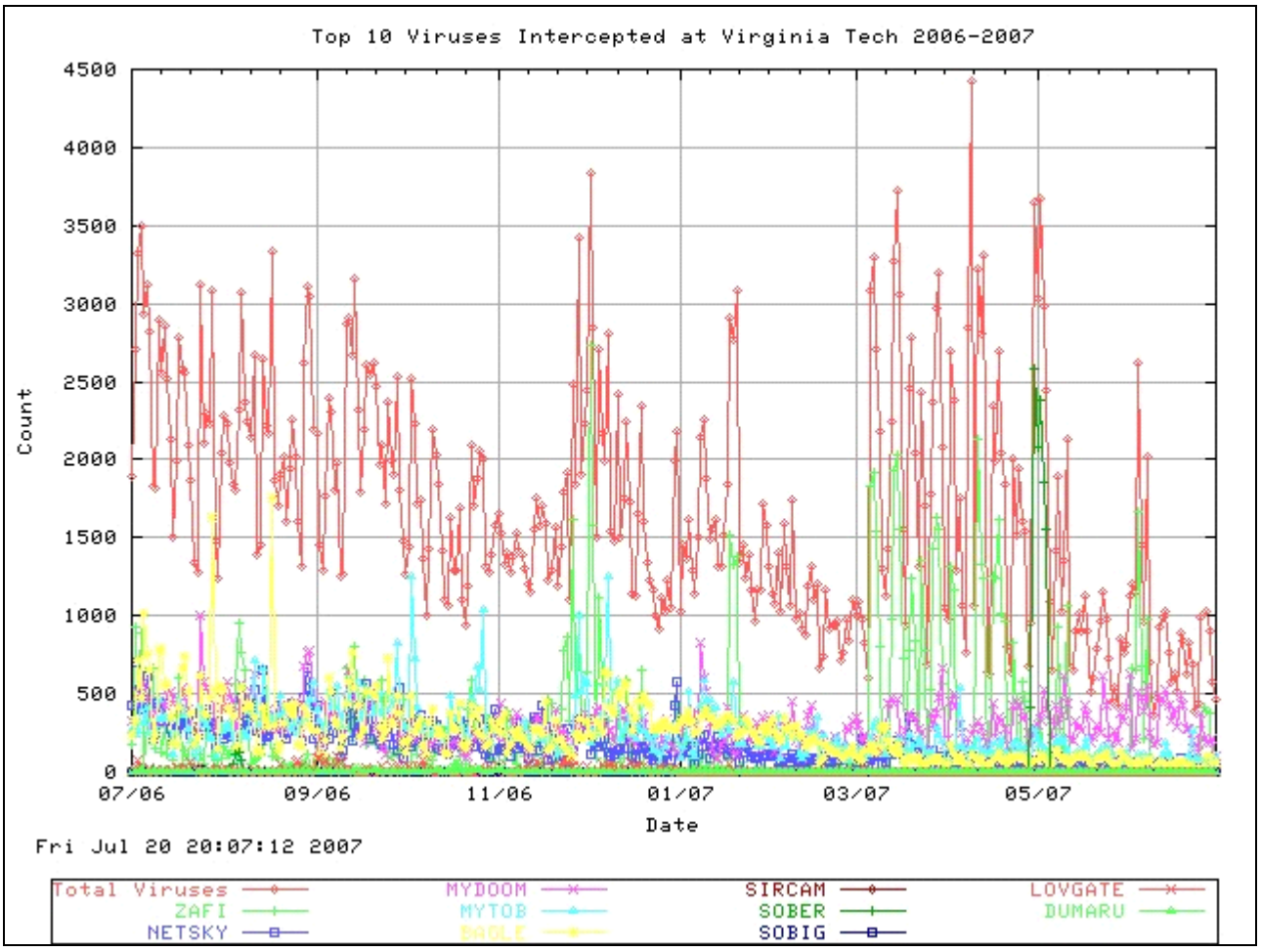
“Emergency telephones installed” represents the number of blue-light emergency phones installed on the campus. Blue-light telephones are strategically positioned on campus to provide fast access to emergency services to members of the university community.



E-mail flow at Virginia Tech 2006-2007

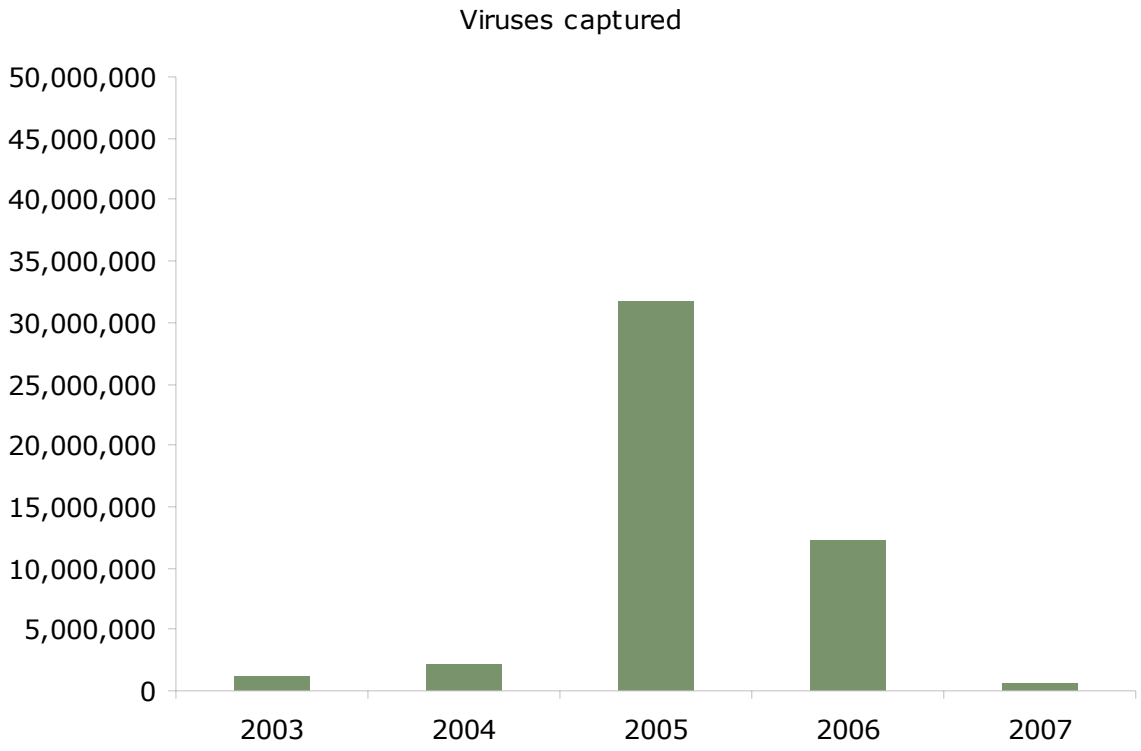
This graph illustrates the flow of all e-mail into the Virginia Tech domain during the fiscal year--July 2006 through June 2007. The red line (which hovers between 3 and 5.5 million) represents all e-mail messages received. The green line (in the 300,000 to 1 million range) represents messages actually processed through the system (not blocked or rejected due to viruses or suspected spam). The blue line (between 100,000 and 500,000 messages) represents those messages that were delivered and not tagged as being potential spam.

Note the spike in the green and blue line with no corresponding spike in the red line between 03/07 and 05/07 on the graph. These spikes show the large volume of legitimate e-mail traffic that took place during and directly after the events of April 16th.



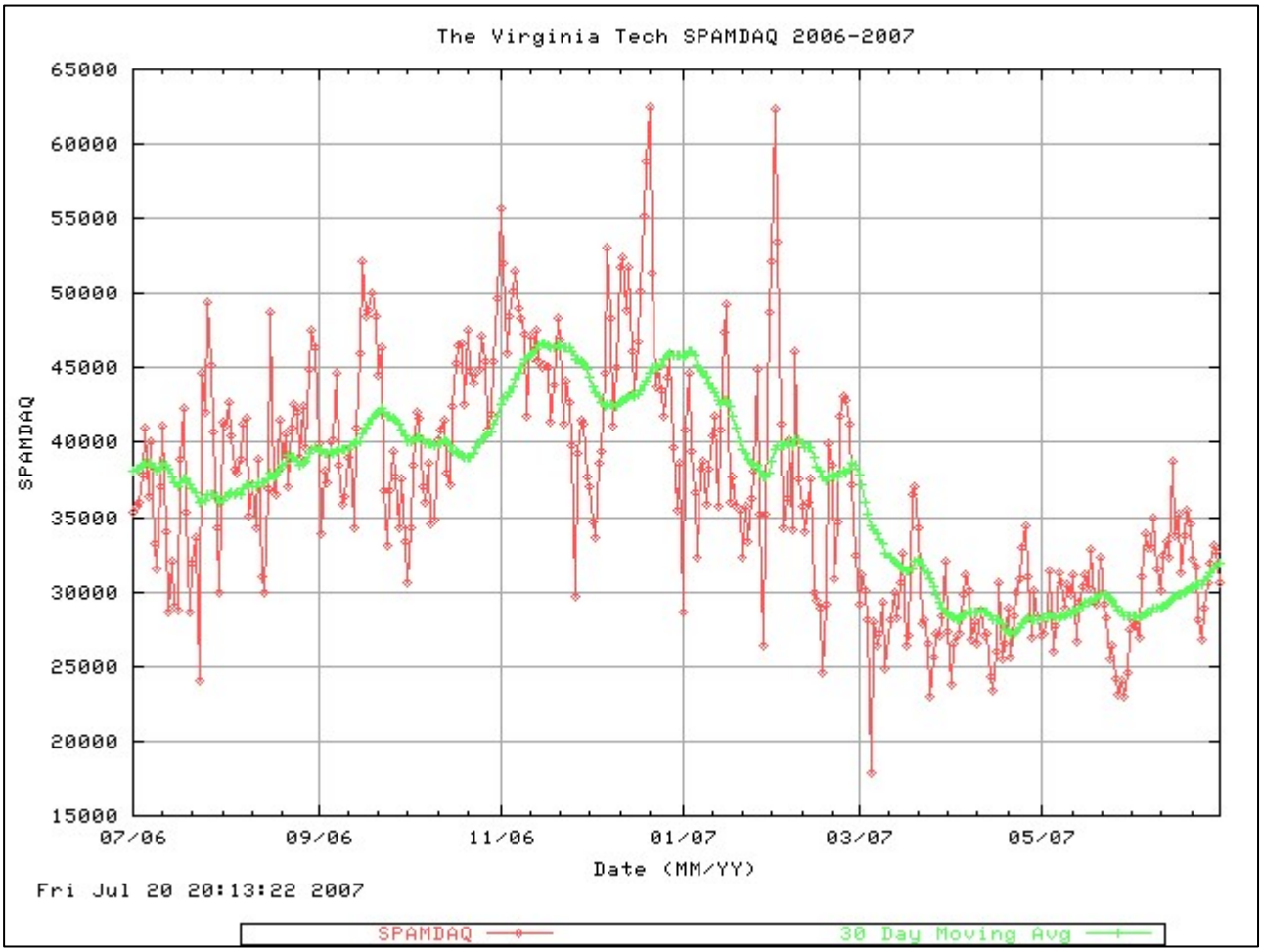
This graph represents the top ten viruses receive at Virginia Tech during the fiscal year. All of these viruses were intercepted by the virus scanners.

Of note here is the fact that many of these viruses are several years old; MYDOOM was released in late 2004 and SIRCAM in early 2002. Viruses are not eradicated; they are only blocked and prevented from doing damage.



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, but 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 2007 is indicative of increased user awareness, improved client software penetration (VT Net 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 Virginia Tech SPAMDAQ 2006-2007

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 over 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 that twice the index amount was received.)

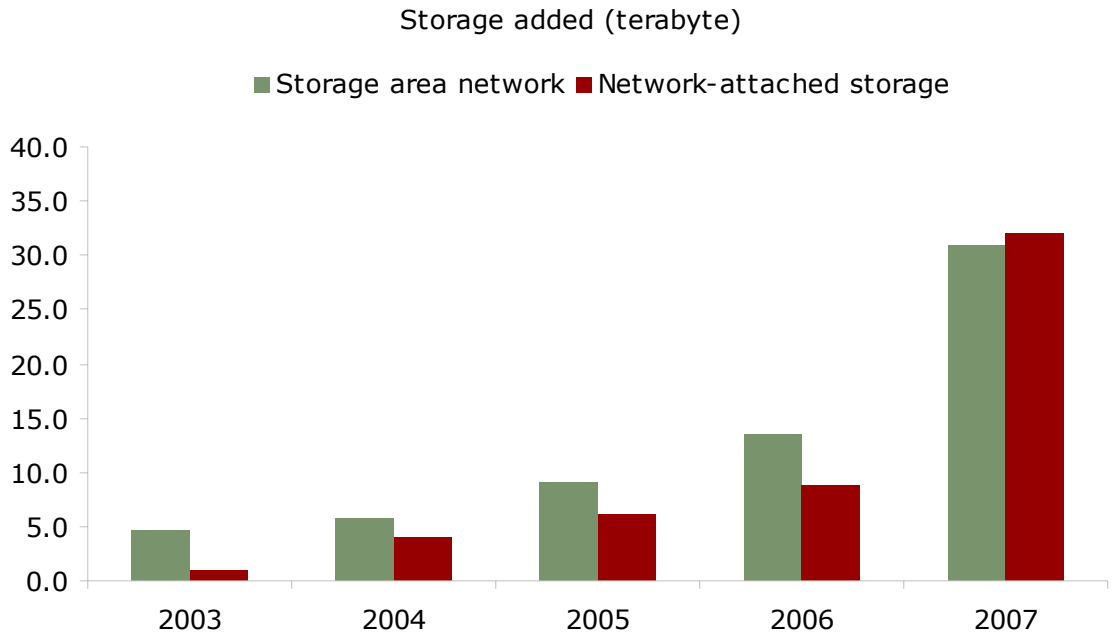
Note the decline in April of this year.

Abuse complaints

	Threats	Harassment	Abusive
January 2007	1	0	0
February 2007	0	0	1
March 2007	1	1	0
April 2007	0	1	0
May 2007	0	0	0
June 2007	0	0	0

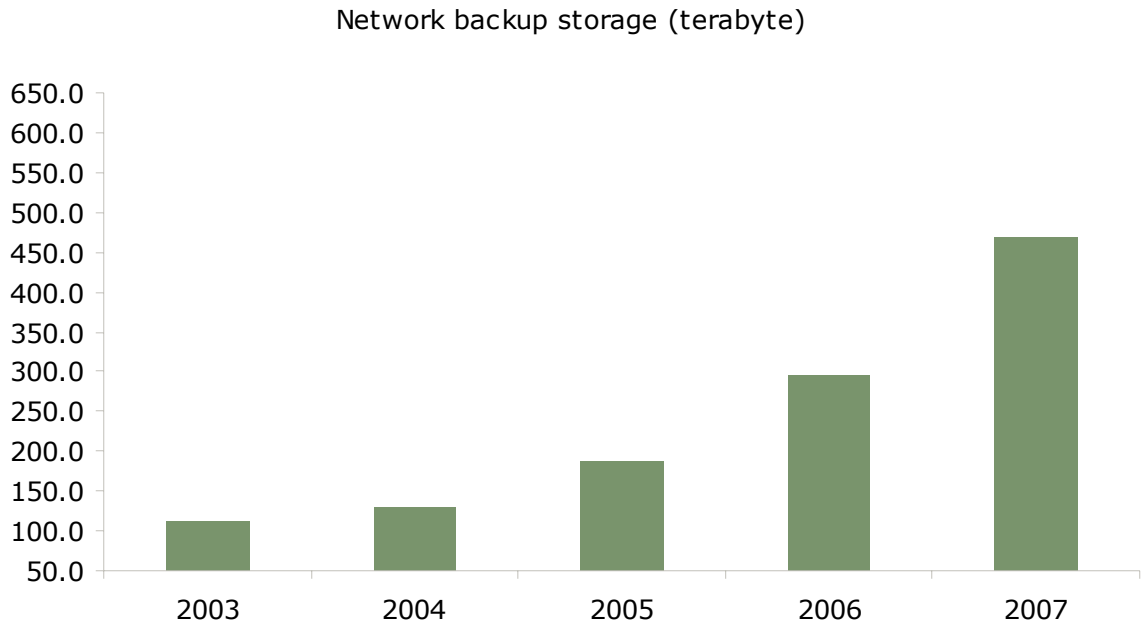
This table illustrates the number of complaints received through the *abuse@vt.edu* account about events not related to unsolicited e-mail (or spam). This table shows, of the thousands of messages received annually, only a handful (5) relate to matters requiring immediate corrective action.

Note: These numbers have just begun to be collected and collated. Breaks (including winter and summer) impact the volume and type of traffic considerably.



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.

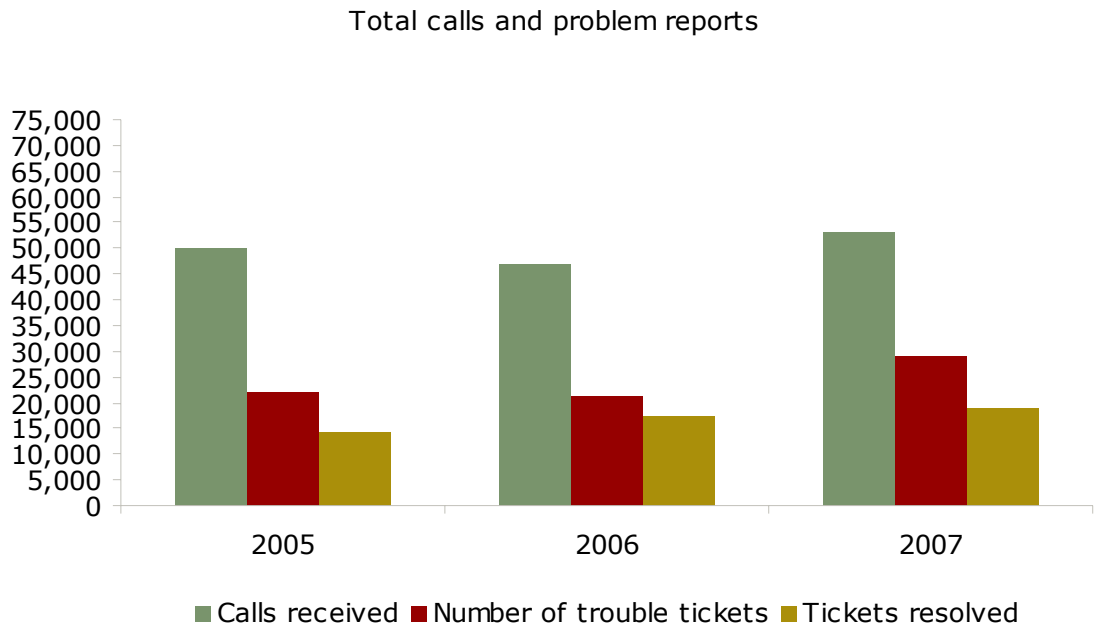
The dramatic increase in 2007 is a direct result of data preservation requirements associated with the events of April 16th.



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 increase in 2007 is a direct result of data preservation requirements associated with the events of April 16th.

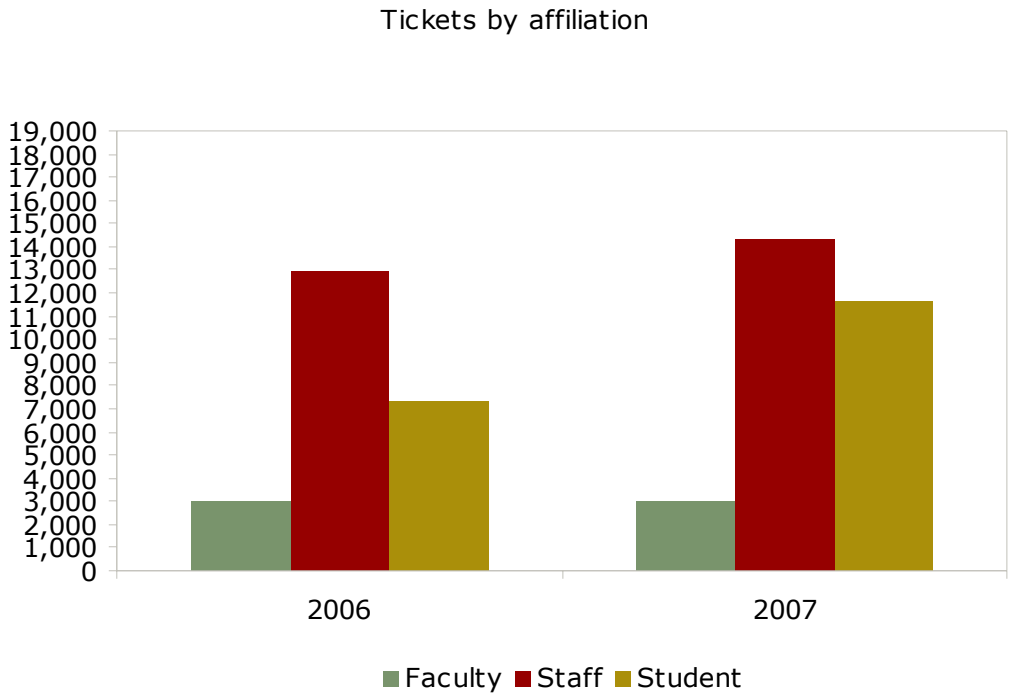
Virginia Tech Operations Center



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

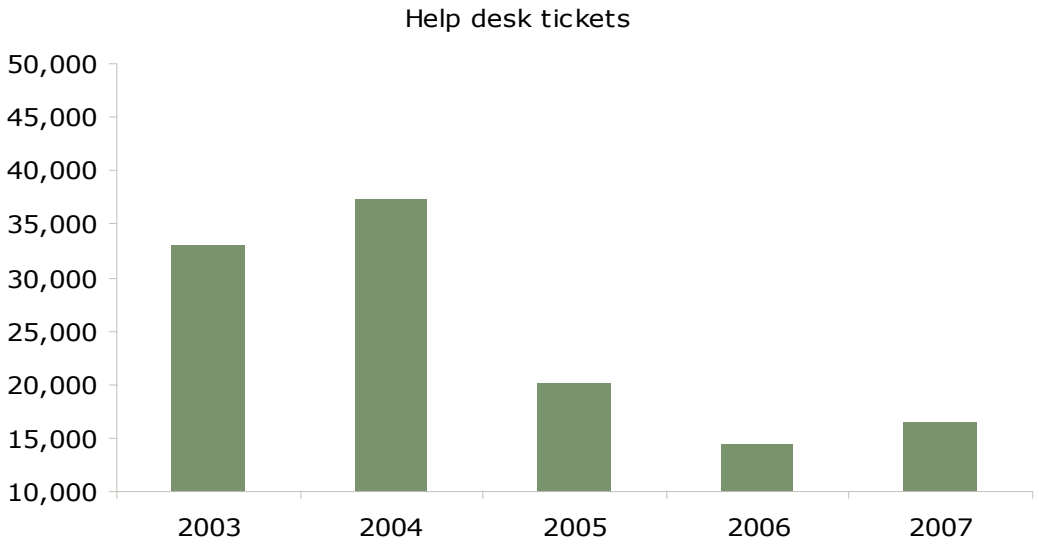


This graph shows the distribution of the majority of the problem tickets received in the VTOC by the affiliation of the caller. (The quantities of calls from some affiliates—alumni, retirees, etc.—are not included here.) There is a substantial increase in student tickets. This increase is most likely 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 volunteer staff members from other Network and Infrastructure groups 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.

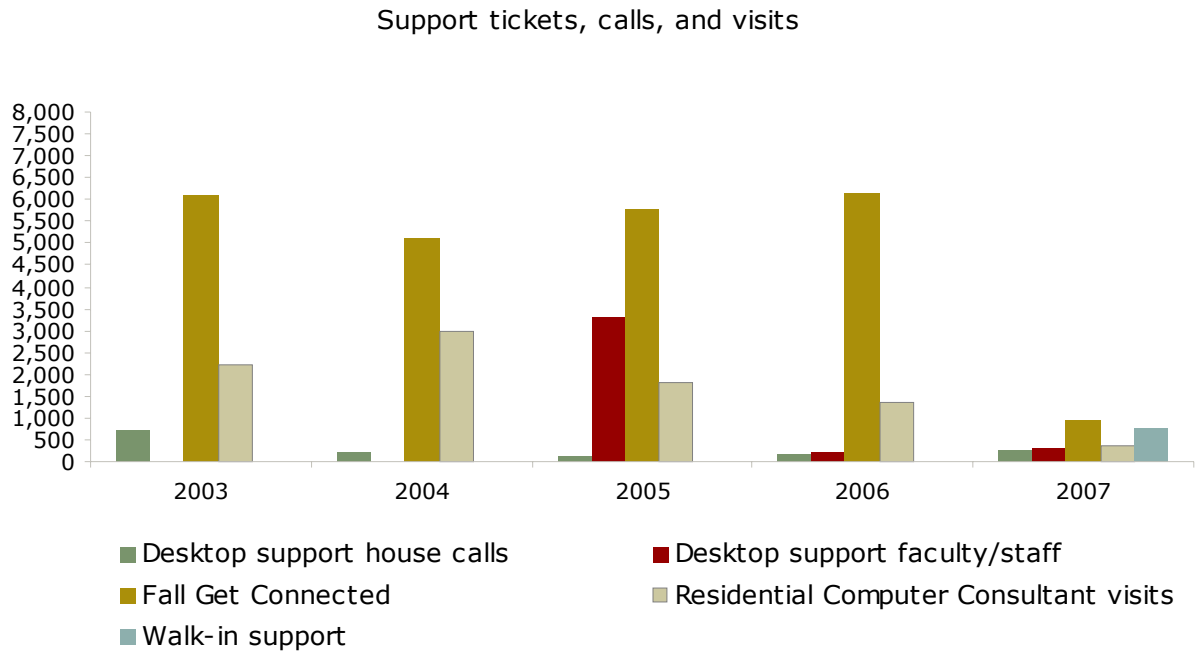
NOTE: A portion of the substantial increase in the number of non-volunteer hours for 2006 is the result of the inclusion of the work hours of some staff members not previously counted for this purpose.

University Computing Support



The graph above shows the number of tickets opened by University Computing Support/4Help over the past five years. 4Help saw a slight increase in ticket volume this year, and UCS made more house calls to faculty/staff offices to provide assistance. In spite of the small increase for 2006-2007, overall, the total number of tickets handled by UCS has declined during the period shown. In part, this decline results from users being more familiar with central Information Technology offerings and better able to support themselves. In addition, Information Technology is more frequently handling virus and network attacks before they affect the end user.

The large number of trouble tickets in 2003 and 2004 is a result of significant virus activity during that period.

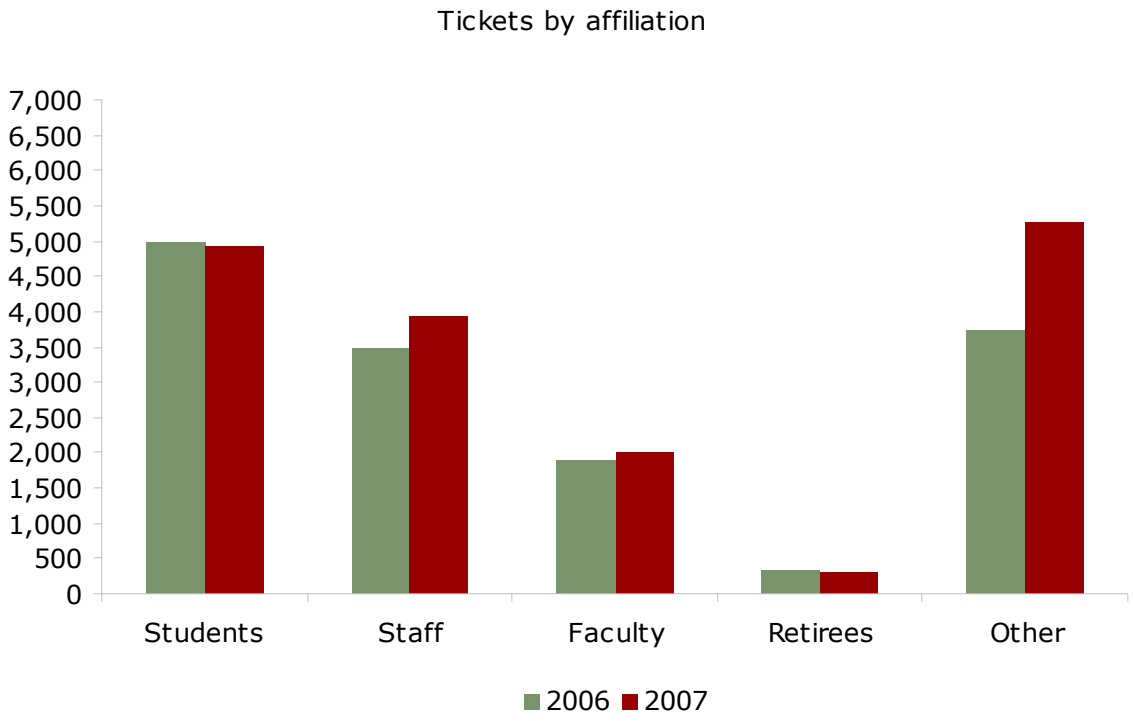


The graph above shows the distribution of support tickets, calls, and visits by type. As shown, the numbers of desktop support house calls and desktop support to faculty and staff has increased. Having two staff members devoted to this activity allows us to provide direct computing assistance to more faculty and staff members.

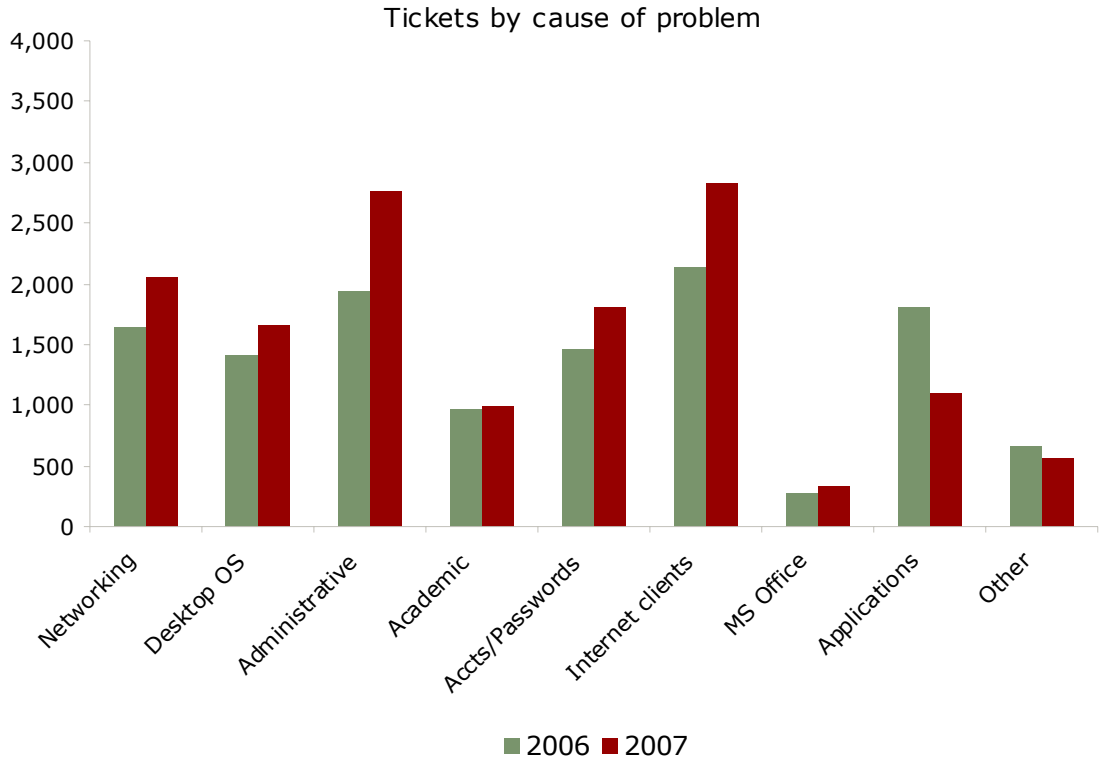
(NOTE: The large number of desktop support faculty/staff tickets for 2005 is the result of counting *all* visits of any kind to a faculty/staff office. This number is now computed by counting only visits where a full-time staff member goes to an office and provides on-site assistance.)

The number of students requiring residence hall room visits during the Get Connected period radically decreased this year because of changes to the program. The model has changed to one of calling 4Help for assistance prior to dispatching a Get Connected staff member to the residence hall.

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 FY 2006-2007, 4Help also replaced the Residential Computing Consultant program with a walk-in service model, assisting both residential and off-campus students.



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. Student requests for assistance declined while those from faculty and staff increased in 2006-2007. The number of questions from retirees showed a slight decrease this year while problem reports and questions from those without an active Virginia Tech affiliation such as alumni, prospective or admitted students, and parents increased significantly.



The graph above displays the various causes for problem tickets. Internet clients, mainly Internet Explorer and e-mail clients, accounted for the largest number. The administrative category includes calls related to Information Technology-provided applications and services such as Banner, mail, Filebox, Hosting, Network Attached Storage, and Hokies Domain issues. Symantec AntiVirus questions dominate within applications. Academic services include Hokie SPA, LISTSERV, and Blackboard.

Blacksburg Electronic Village

TOP: Registered villagers and organizations, 2006-2007

County	Villagers	Organizations	Organization Directory Listings
Cumberland	223	45	108
King and Queen	463	16	260
Louisa	78	6	101
Total	764	67	469

The Blacksburg Electronic Village 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. Three counties have elected to pay BEV an annual fee to continue the service.

Services

	2005	2006	2007
Domain Names Supported	227	296	281
Websites (Full Service)	63	66	56
Websites (Community Connections)	125	123	130
E-mail boxes	503	504	479
E-mail lists	128	157	155
E-mail volume per week (valid messages)	17,000	23,000	30,000
E-mail volume per month (valid messages)	74,000	100,000	130,000
E-mail volume per year (valid messages)	884,000	1,196,000	1,560,000

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 website and e-mail services continue to be popular, although some customers have migrated to nationally based providers such as Google and Yahoo.

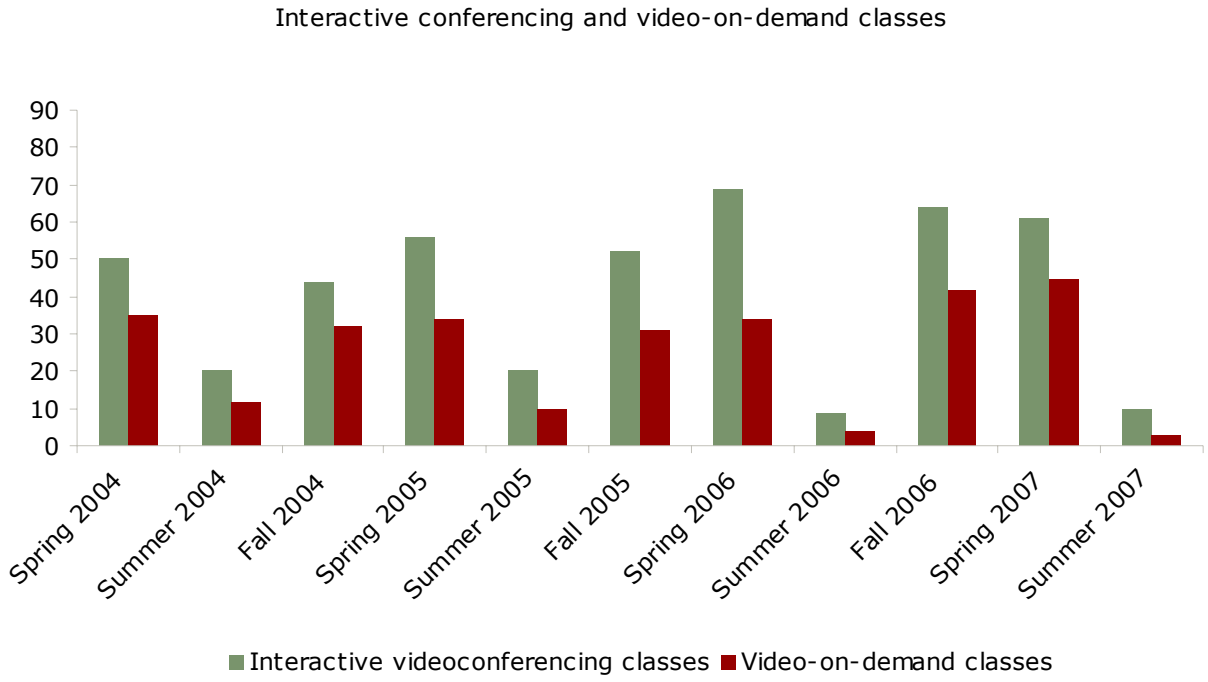
E-mail volume continues to climb as it becomes an increasingly popular form of communication for BEV's customer base.

Web support services projects

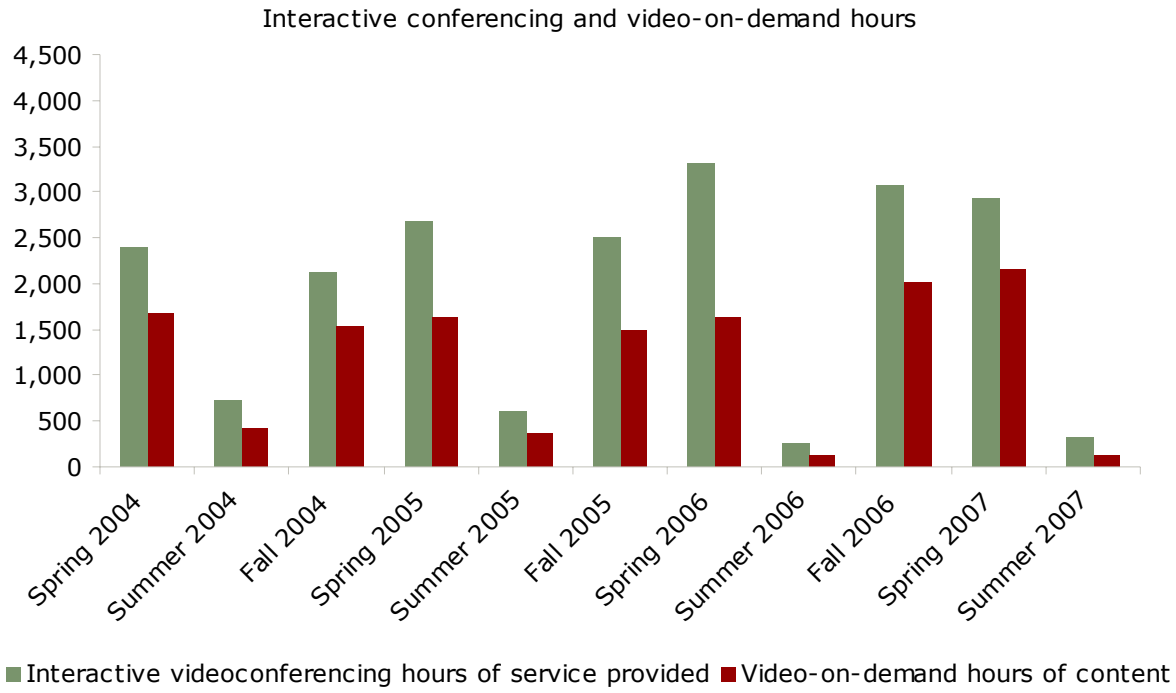
New websites or major redesigns completed	10
Site maintenance or assistance projects completed	6
Projects in progress as of June 2007	4
Proposals in development as of June 2007	1

BEV's new project, Web Support Services (WSS), using undergraduate staff to provide at-cost web development service to campus organizations and area non-profits has gotten off to a great start in its first year.

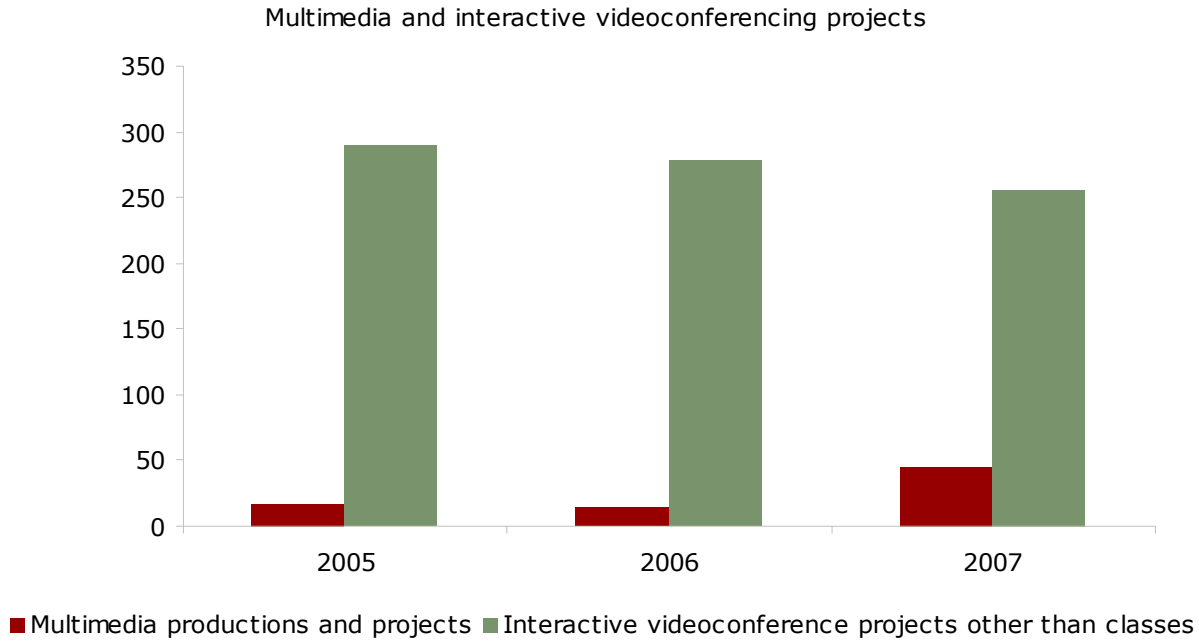
Video/Broadcast Services



Total interactive videoconference classes and video-on-demand classes supported by Video/Broadcast Services (VBS) are shown here. 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.



This graph indicates total number of hours of service provided by VBS for videoconferencing and the total number of 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 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.



The IVC facilities are also used for many "one time event" interactive videoconferences including a full range of instructional use such as connecting guest speakers with Virginia Tech classes as well as assisting with preliminary exams, thesis, and dissertation defenses. The facilities also support administrative meetings among dispersed campuses. The increase in the number of IVC classes supported each year results in fewer hours of availability for the IVC facilities to be used for IVC events.

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. There was an increase in requests for services associated with the events of April 16th. VBS also notes a trend among Virginia Tech faculty to request multimedia assistance with training material in lieu of faculty travel.

Interactive videoconference facilities

	2005	2006	2007
VNOC—ATM video bridges	2	2	0
VNOC—IP video bridges	0	2	3
VNOC—IP VCRs	0	2	3
ATM origination sites	23	23	0
ATM receive sites	18	17	0
IP origination sites	0	0	22
IP receive sites	0	0	10
RAID 5 streaming media storage server (terabytes)	1.1	2.2	7

VBS maintains and operates Virginia Tech's 32 Interactive Videoconference (IVC) classrooms throughout the commonwealth and 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.

In 2006, VBS operated two Codian IP video bridges and two Codian IPVCRs. In early 2007, VBS added an additional video bridge and an additional IPVCR 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. These additional units have the potential to serve as disaster recovery and COOP units if they are housed outside of the Corporate Research Center.

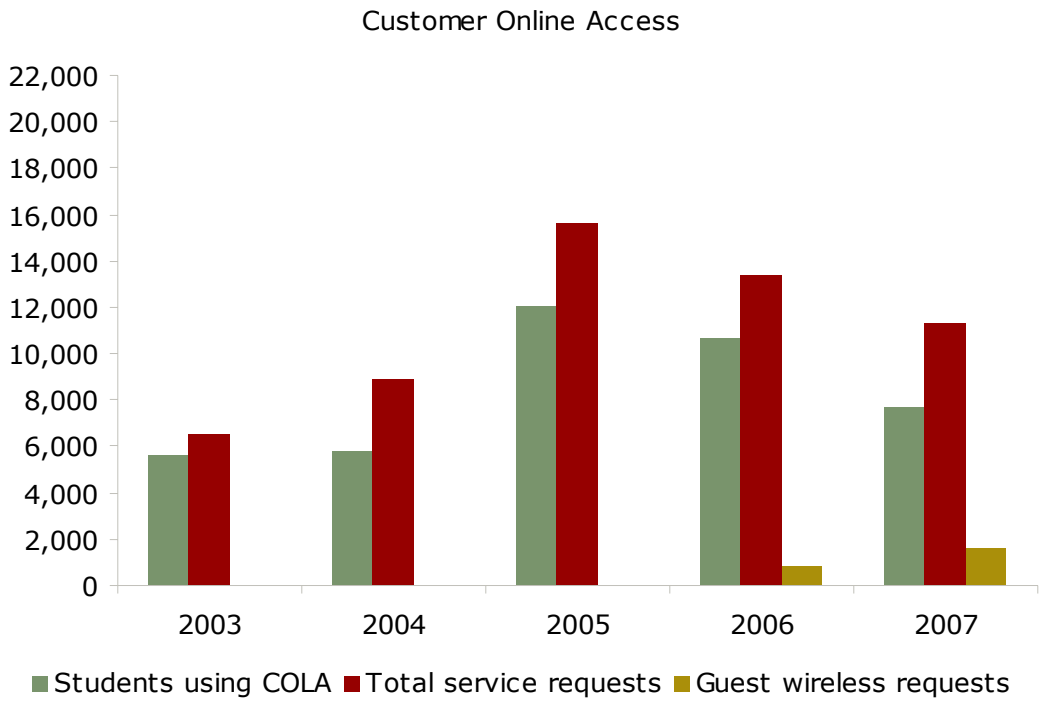
Service calls by VBS engineer

	2006	2007
Off-campus calls resolved by remote access or telephone support	65	53
Off-campus calls resolved by on-site visit	17	10
On-campus calls resolved on-site	21	26

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 in repairing or replacing broken equipment and coordinating 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:

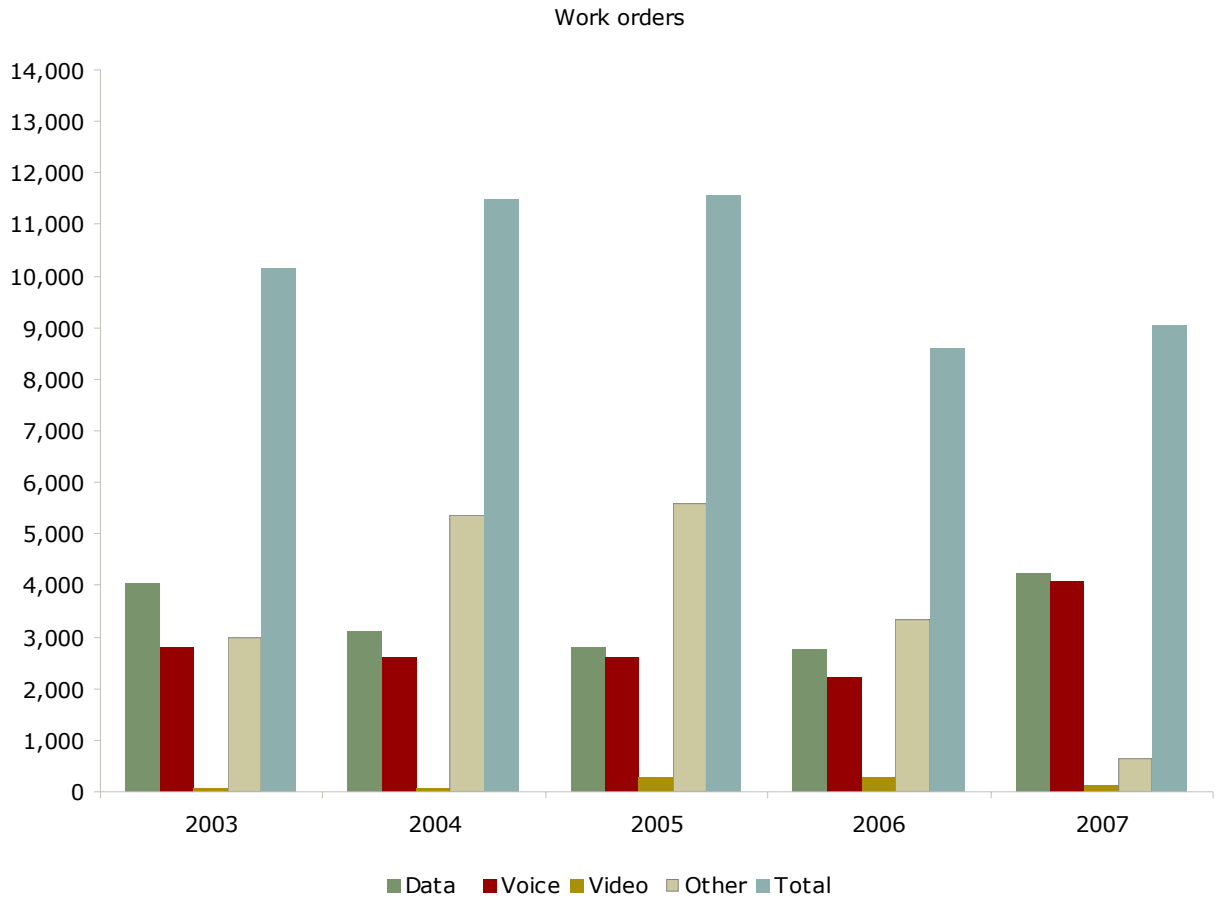
- The number of students who have made at least one service request during the year using COLA
- The number of service requests and/or service updates (wireless LAN or long distance authorization code) made by students using COLA
- The total number of service requests made by university guests, using COLA, to register for sponsored Wireless LAN service

Trend analysis of the two student statistics indicates that the use of COLA by students peaked in 2005 and has decreased in each of the last two years. This decrease is likely due to two factors. First, 2003 through 2005 witnessed a rapid increase in the use of Wireless LAN by students, reaching a near-saturation point. It is to be expected that after a large increase in the number of customers during the first years a service is offered, that 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 New Student Orientation, the Student Telecommunications staff registered many students for Wireless LAN and long distance authorization codes. These numbers would not be reflected in COLA 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 2007 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 Sponsored Programs from Collegiate Square to Research Building 15. Numerous voice/data orders were worked in the days following the April 16th tragedy including the relocation of the Engineering Systems and Mechanics Department and the Dean of Engineering from Norris Hall and supporting the needs of multiple command centers, counselors, and call centers.

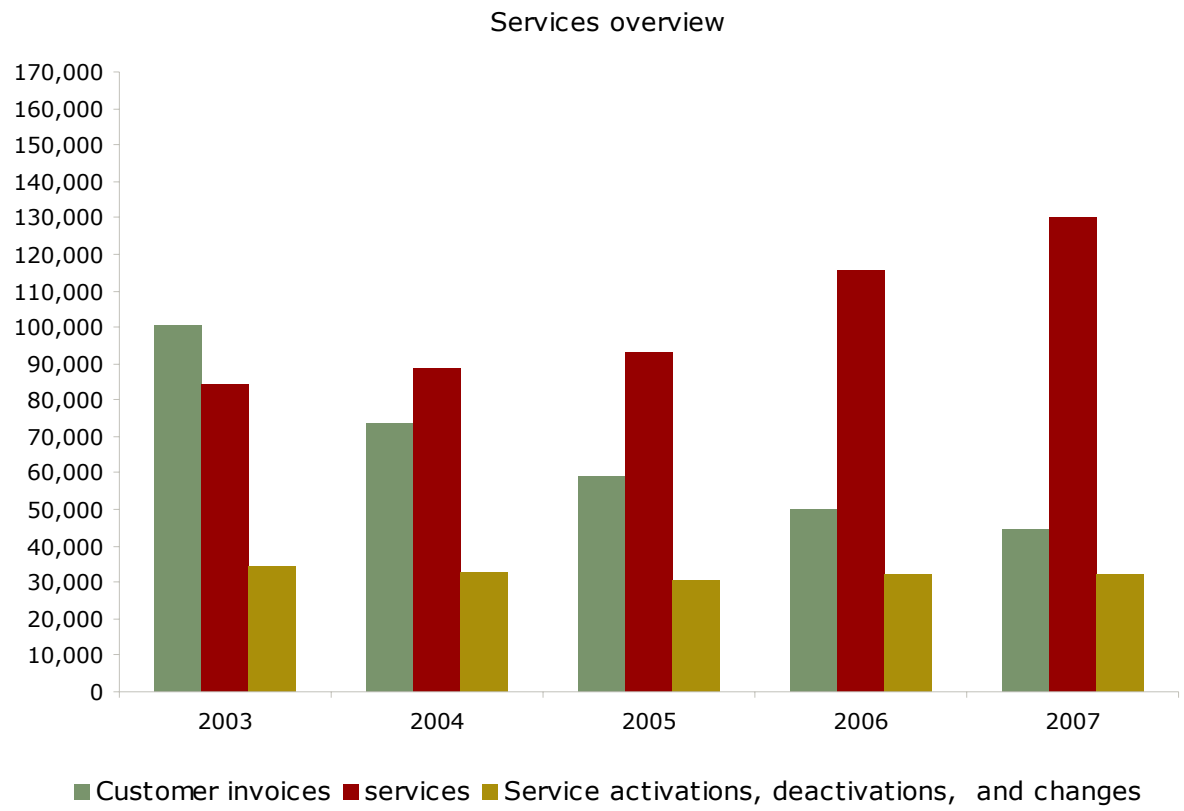
NOTE: In 2003-2006, the graph illustrates total work orders processed and worked by the department. In 2007, work orders completed solely by Field Engineering are illustrated. Examples of non-field work orders include NetworkVirginia, cellular orders, main switch, and PBX software only orders

	Capital projects		
	2005	2006	2007
Total RJ-45 jacks installed (each)	5,548	4,400	1,923
Total Cat 6 station cable installed (feet)	818,400	1,101,000	415,700
Total optical fiber fusion splices (splices)	1,776	1,656	1,136

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. However, construction of these projects typically lasts 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, new network connectivity was provided for Kent Square II, Research Building 16, ICTAS CRC, and the Data Center upgrade. These four projects had a total of 720 fusion splices completed and 420 RJ-4s installed which accounts for the disproportionate ratio of fusion splices to RJ-45s installed.

Business Operations

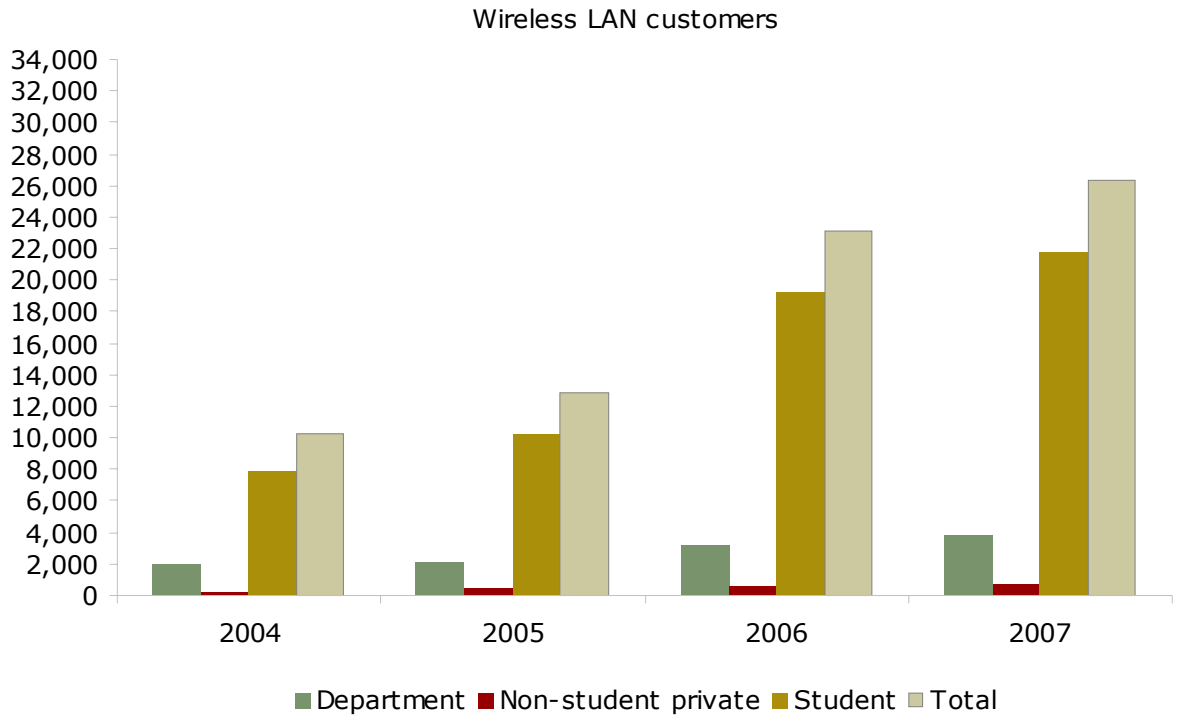


The graph above depicts, by fiscal year, the number of customer invoices issued by Network Infrastructure and Services, the number of current services billed to customers, and the number of service activations, deactivations, and changes.

The decline in the quantity of customer invoices is primarily the result of the decreasing numbers of student telecommunications customers requesting modem pool services and long distance authorization codes.

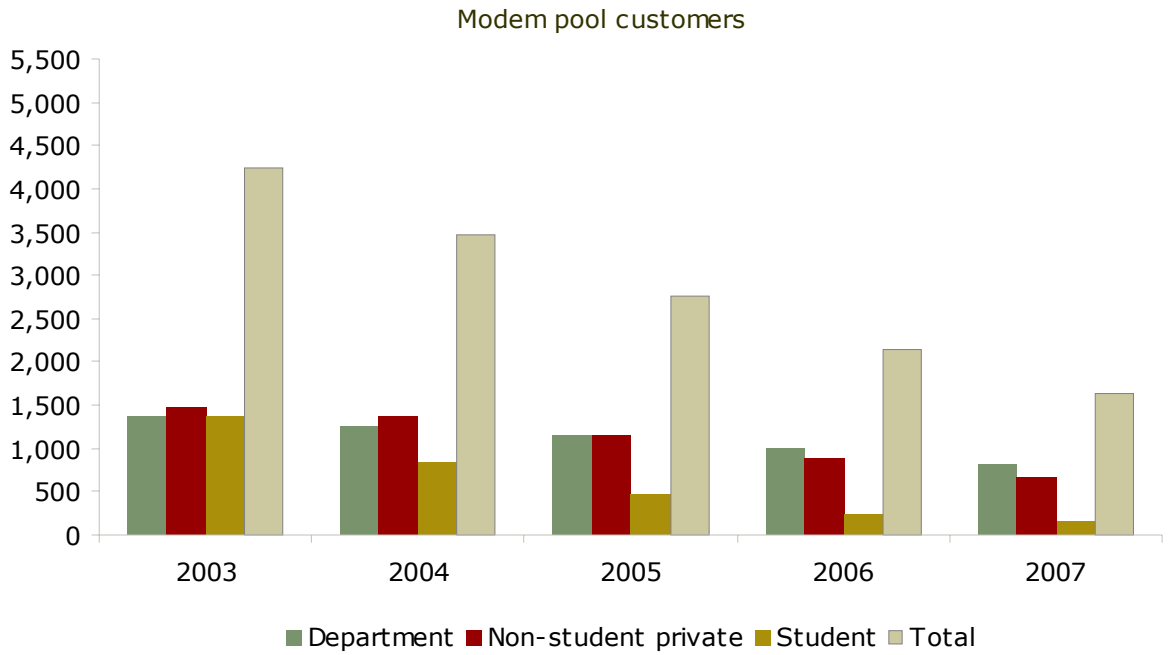
The increase in the number of current services billed to customers is primarily the result of the constantly changing cellular and cellular data service, equipment, and accessory offerings. These changes result in an ever-increasing number of customers ordering new cellular services and equipment. New 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 remains fairly constant and primarily 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.

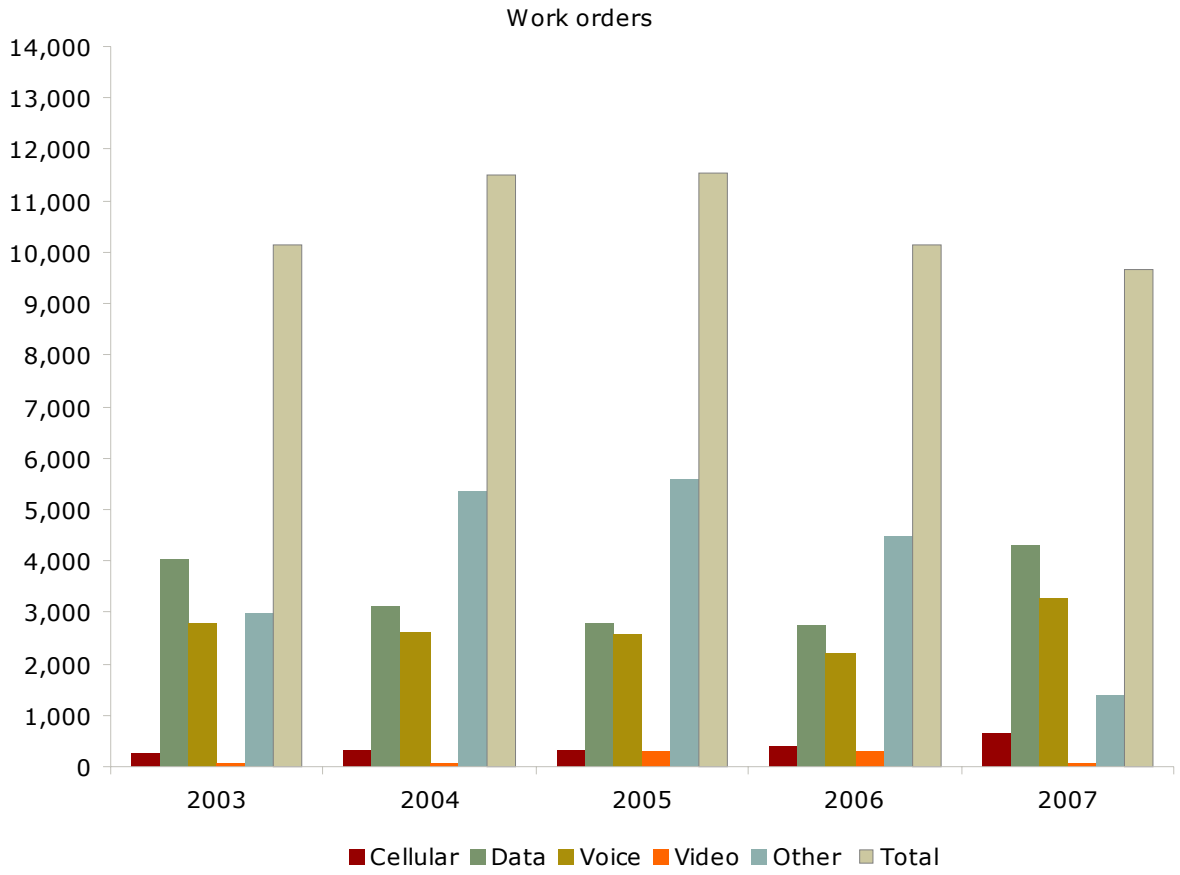
The increase in the number of wireless LAN subscribers is attributed to transitioning the service from a pilot offering to a billable production service, the continuous/ongoing network expansion making the service available to approximately 90% of the academic and administrative spaces across campus, and the availability to campus visitors via a university sponsor.



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. For 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 per year since 2003.

Voice Orders are for digital or analog service. Network 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.

Several trends are illustrated by this graphical information. In 2003, CNS began processing orders for cellular services. During 2004, Virginia Cooperative Extension ordered cellular

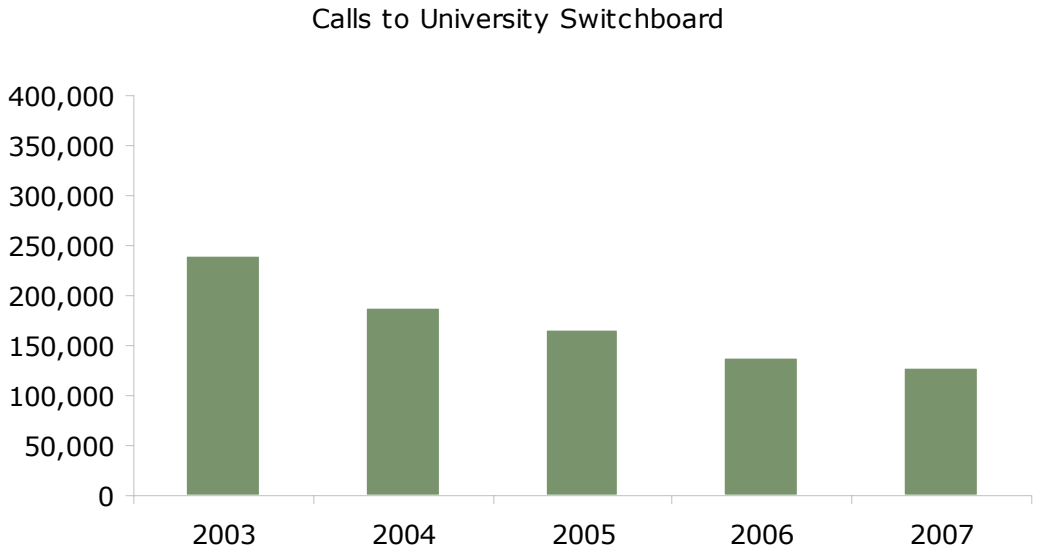
services for most of their field agents and management personnel. During 2005, CNS began offering mobile messaging services resulting in a gain in cellular orders that has peaked in 2007.

The increase in video orders during 2005 and 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 increase in the number of "Other" orders in the above graph. Two additional large projects contributing to the increase 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 2007, increases in network and voice work orders are attributed to several projects. Many renovations are occurring on campus including changes in Burruss Hall that displaced several departments. As these departments moved, other groups were displaced. After the renovation was completed, another round of moves occurred to facilitate the upcoming Henderson Hall renovation. In addition, a complete renovation of Cowgill Hall is underway resulting in moves to the newly completed Surge Building. Also contributing to the increase were a major infrastructure improvement for the Art Department at the Amory, orders related to the April 16th tragedy, and completion of the University Gateway Center.

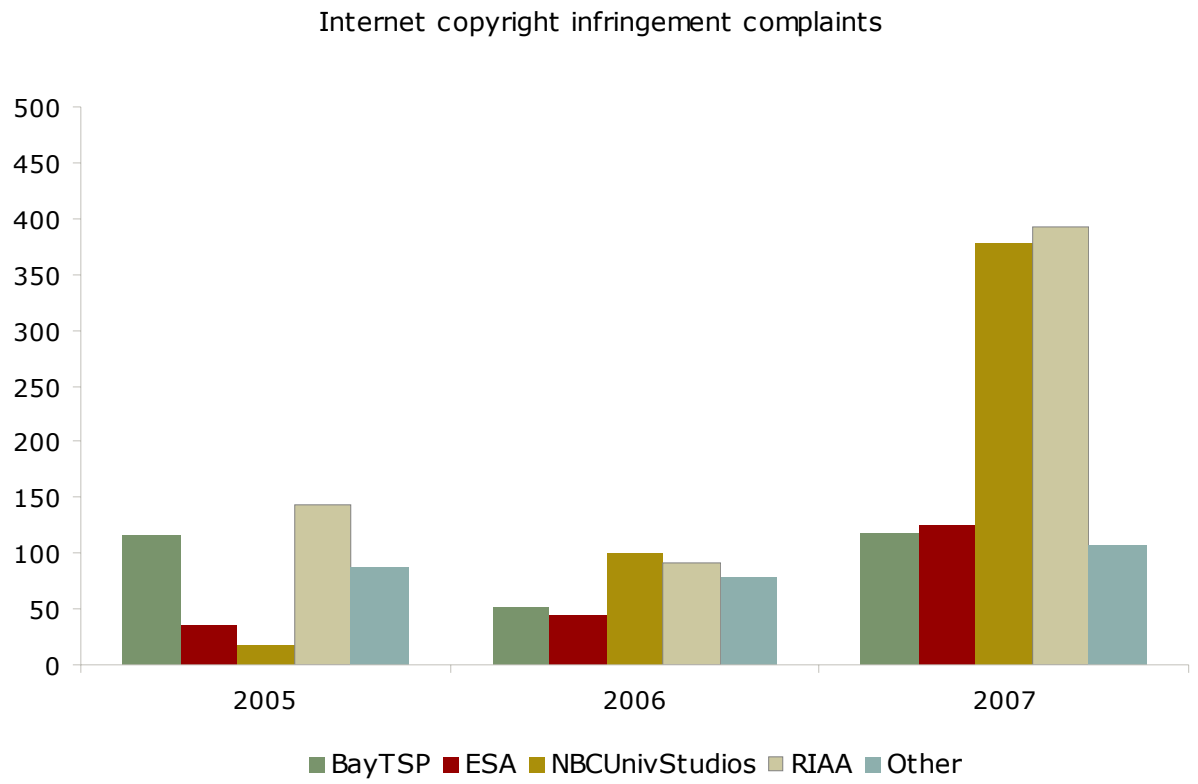
Public Relations



The graph above shows the number of telephone calls received at the University Switchboard. During the past five years, the amount of support per call has increased, while call volume trends lower.

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 proliferation of cellular telephone use with the carriers' information services, along with ready access to an array of directory listing services on the Web, contribute to the trend.

In terms of the demands made on the staff, this shift in the kind of inquiry received adds to the handling time per call while increasing caller satisfaction. The provision of the added service has offset the long-term decrease in call volume in terms of the time required to handle inquiries for switchboard services.



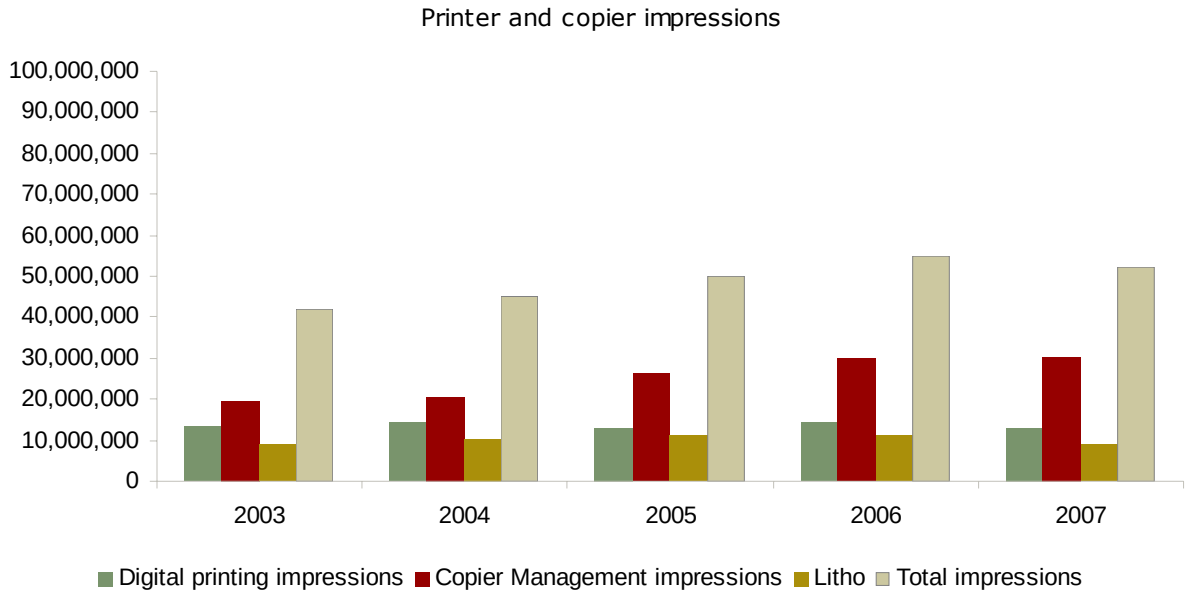
The Digital Millennium Copyright Act (DMCA, 1998) addresses the protection of copyrights for content that can be stored, played, copied, or transmitted in a digital format. The DMCA came about, in part, as a legislative response to the proliferation of file-sharing or peer-to-peer software, a widely popular method for obtaining and sharing music and movies.

DMCA guidelines allow owners (or their agents) of copyrighted music, movies, photos, and software to contact Internet service providers to request they promptly curtail illegal sharing of copyrighted material by a given user. Therefore, Virginia Tech is obligated to address reported cases of alleged Internet-based copyright infringement 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 2004-2007, the principle originators of internet copyright infringement complaints received by Virginia Tech are BayTSP, the Recording Industry Association of America, and NBC Universal Studios. 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.

University Printing Services



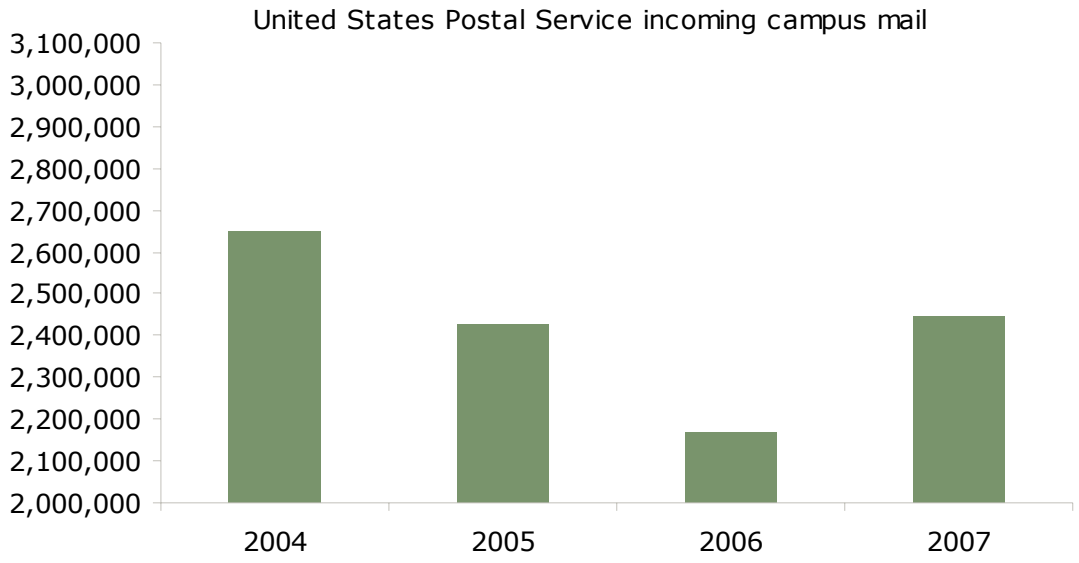
This graph displays the number of printer and copier impressions completed by University Printing Services over the past five fiscal years.

Digital Print Centers produced fewer impressions during the fiscal year because of the maturity of the Copier Management Program, resulting in more impressions created by individual university departments. The Copier Management Program continues to grow with the addition of color printer availability.

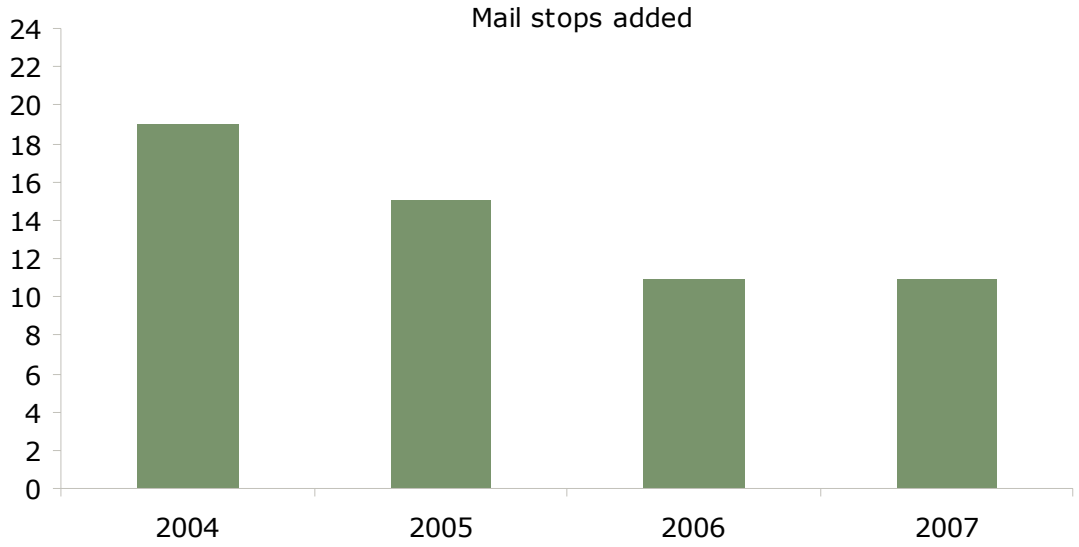
Litho did fewer impressions this year because the customer base requested color printing and other applications they were not able to produce. With the new acquisition of the five-color press with coater, the number of Litho impressions should increase.

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 graphs 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.



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.

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, since July 2003, 56 mail stops have been added. This increase is

consistent with the continued physical expansion of the university including new construction and leased space. Currently, UMS employees provide service to 329 “mail stops” at least once per day.

Projects

Response to the tragedy of April 16, 2007

During any large-scale emergency, reliable, secure, and well-documented communication is paramount. The events of April 16, 2007, and the response, investigation, and recovery that followed at Virginia Tech placed extraordinary demands on telecommunications network resources and the university’s information technology professionals.

The high degree of in-house ownership and direct control of communications resources was crucial to the effectiveness of response and recovery. Network Infrastructure and Services staff members are designated critical employees for emergency response. Training and planning to maintain communications systems integrity 24 hours per day, 365 days per year, are ingrained in the organization. NI&S engineering staff members were able to reconfigure network resources proactively to balance the unusual load experienced during the emergency. NI&S staff from all areas in the organization pitched in around the clock during the days and weeks following the tragedy to equip call and command centers and to meet the communications and cyber-forensics needs of responders, investigators, family members, and the university community.

Commencing with the onset of the crisis and in the immediate aftermath, the campus communications fabric was subjected to dramatically increased load and unusual use requirements caused by the rush of first responders, law enforcement agencies, news media, and inquiries from concerned parties. The university’s primary webpage experienced nearly the same volume of information requests on April 16th as had previously been recorded during the entire busiest MONTH ever experienced. University and commercial-provider telephone systems, data networks, cellular phone systems, and other information services were similarly stretched. The table below summarizes a few of the data highlighting these phenomena.

Communications infrastructure stress factors April 16, 2007

System	Normal	April 16	Effect
University website access	455 gigabytes per MONTH (largest ever)	432 gigabytes in a DAY	3000% increase
Cellular provider capacity and coverage	Designed for non-emergency peak load, limited in-building coverage	Added 3 COLTs, 2 in-building antenna systems, 200 phones	By April 17, temporary coverage/capacity added
Internet gateway capacity	500 Mbps	Added 1 Gbps over 10GE research link	300% increase
University Switchboard	3,200 calls handled per week	9,878 calls handled 4/16-4/21	300% increase
Telephone calls into Blacksburg central office	Reported by local provider		Multifold Increase
Virginia Tech telephone system inbound calls	25,000 calls inbound daily on average	75,000+ calls inbound on April 16	300% increase

Information Technology staff and telecommunications service providers responded to the enormous demands by load-balancing systems and increasing capacities for network services. Lines connecting the campus telephone system to the public network experienced a five percent blocking rate for a short period in the face of a 300 percent increase in the number of call attempts. Staff members equipped 11 temporary, emergency command and communications centers with telephones, computers, wireless hubs, faxes, printers, and other needed accessories.

During the ensuing investigations, NI&S resources and staff were frequently called upon in the pursuit of information-forensic data or cyber-forensics. The collection, storage, and analyses of data regarding all facets of communications and computing for purposes of security and law enforcement are key areas of focus within Information Technology at Virginia Tech. The university is fortunate to have significant expertise in the areas of computing security and information forensics. This expertise was effective in aiding investigation following the tragedy.

Virginia Tech operates a high-performance, Internet Protocol-based (IP), data network providing communication among computers with a diverse, reliable, fiber-optic core and modern wireline and wireless access services throughout campus. Like other major research universities, the capacity and capabilities of Virginia Tech's data network exceed the characteristics of networks at other types of enterprises. Advanced, high- performance computing and high-performance network technology, as well as widespread access, are required for competitiveness in modern scientific and engineering research.

During the crisis response, the Virginia Tech Network Operations Center staff monitored a dramatic increase in load on network resources. Anticipating a shortage of capacity to the Internet, network engineers reconfigured a National LambdaRail research network connection to add 1 Gbps capacity to Level3 commodity Internet service. This change was accomplished in less than 30 minutes avoiding a bottleneck in information-flow over the Internet.

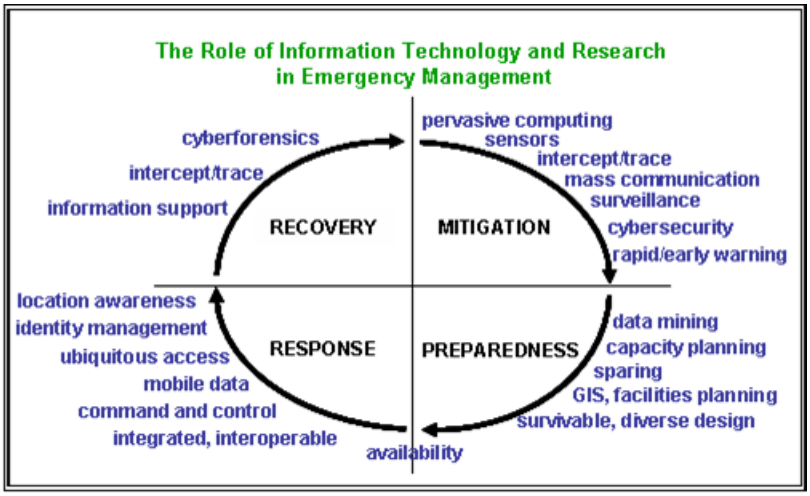
Information Technology support services areas provide centralized management, monitoring, and user support. The Virginia Tech Operations Center (VTOC) is charged with the monitoring and management of all campus communications network infrastructure including the IP network, the telephone system, the cable television system, and centralized Information Technology services. The VTOC also provides monitoring and management support for Virginia Tech's statewide and regional network programs including NetworkVirginia, the Mid-Atlantic Terascale Partnership, VORTEX, and National LambdaRail. University Computing Support provides technical support to the university community for an array of information services.

During the response period, university network infrastructure systems and support services experienced increased load but performed adequately. The campus telephone system processed calls without internal failures or blocking although blocking was experienced on the lines connecting the campus and the town of Blacksburg to outside telephone services. The cable television system was essentially unaffected. Data network engineers were able to make on-the-fly adjustments to increase network capacity where needed and to open access to the campus wireless data network for emergency responders.

During the crisis, university faculty and staff members responsible for development and management of these infrastructure facilities were primarily involved with carrying out requests to install telephone and data communications for temporary command, response, and counseling centers. They adjusted network resources to balance unusual traffic load and did whatever was necessary to assist law enforcement, administration, university community members, and families. Small gaps were identified during the course of the analyses. However, the bottom line is the Virginia Tech data, telephone switching, video, and instructional systems infrastructure was essentially effective in supporting responders and the university community in the face of the substantially increased load. There were no significant breakdowns.

In May 2007, Virginia Tech President Charles Steger charged 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." NI&S personnel contributed heavily to the resulting internal review and report. That report offered over 120 tactical recommendations for short-term improvements many of which were within the area of responsibility of NI&S. Many of these improvements have been fully implemented at the time of this writing and others will be completed during the 2007-2008 fiscal year. A copy of the report is available from the office of the Vice President for Information Technology or from *www.vtnews.vt.edu/documents/2007-08-22_communications_infrastructure.pdf*.

Strategically, NI&S, together with other divisions of Information Technology and university academic programs, has articulated a vision to create a new, next-generation, information architecture capable of going beyond the mode of simply supporting the response phase in an emergency situation. Prior to April 16th, NI&S developed plans to create a new information architecture built from the ground up to provide a platform for all stages of emergency management including mitigation and avoidance.



The university is on the cusp of replacing the legacy, separate data, telephone, and cable television systems with a digital, fully integrated, IP-based, multimedia communications architecture. The new architecture will be based on a diverse fiber core using state-of–the-art, optical technology designed to survive multiple environmental hazards. It will provide ubiquitous, very high capacity access, with a combination of wired and wireless services and will support virtually any type of access device. The traditional distinctions between telephone, video, data, and instructional systems applications will disappear. The new architecture will support integrated multimedia applications, advanced security and authentication capabilities, and new features including sensor networks and pervasive computing models.

With respect to emergency management, the new information architecture will create the capability to integrate virtually all communications infrastructure and information systems to assist with all phases of emergency management, including mitigation and preparedness, in addition to response and recovery. These new capabilities will be under the complete control of university administration, law enforcement, and emergency responders.

VT Alerts Automated Notification System

As a result of the incident that occurred on the first day of fall semester (August 21, 2006) and as part of an assessment of advanced messaging options, a group of representatives from various university departments led by Network Infrastructure and Services was formed to review and analyze vendor-provided automated notification systems. In an effort to reach the mobile university population, the group's goal was to explore options to enhance Virginia Tech's already robust campus communications program. After a thorough analysis and multiple vendor

demonstrations, the committee unanimously selected a product from 3n® (National Notification Network, *www.3nonline.com/*), a leading, global provider of mass notification solutions. The new process will expand 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 phone. Virginia Tech's implementation of this product is branded as "VT Alerts Automated Notification System."

The university believes the automated notification system will enhance operations related to health, safety, and security of students, faculty, and staff—an important component of the university's strategic plan. VT Alerts has been implemented as an "opt-in" process. Individuals are encouraged to subscribe, but are not required to do so. Each subscriber is responsible for entering all contact information and for making any changes that might be necessary. Virginia Tech does not update the information and does not verify the accuracy of the data.

Messages will be sent by either University Relations or the Virginia Tech Police, depending on the nature of the urgent situation. All Virginia Tech students and faculty and staff members, regardless of geographic location, are eligible to subscribe to the service. There is no fee, other than the routine charges from cell phone companies for receiving text messages. In addition to cell phones, subscribers can also choose to be alerted via e-mail or online networks. Though not encouraged, students and faculty and staff members may also sign up friends and family for the service so they can be notified of emergencies on campus.

To subscribe, an individual goes to *www.alerts.vt.edu* and follows the step-by-step instructions. A PID and password are required to access the system. A subscriber can select up to three contact methods, ranking those methods in order of preference. Contact methods include mobile phone, office phone, local residence phone, other phone, instant messaging (SMS), text messaging, and emails. The automated notification system will be used only in the most critical, emergency situations, determined by University Relations or the Virginia Tech Police Department.

Prior to the implementation of the new automated event notification system, University Relations used six methods to communicate urgent messages. All of the methods listed below, which are accessible by the general public, were used on April 16, 2007:

- Broadcast e-mail to @vt.edu addresses
- Broadcast voicemail to campus phones
- Recorded message on the WeatherLine/Hotline
- VT.edu (*www.vt.edu*) and the Virginia Tech News website
- University switchboard
- Public media (TV, radio, news websites)

The automated notification system becomes the seventh method of communication.

In order to protect the privacy of our subscribers, to facilitate entry of contact information, and for other related reasons, NI&S led an effort to develop a user interface and subsystem to collect and format subscriber data. A unique identifier for each subscriber (instead of a name), known

only to Virginia Tech, is added before the information is sent to 3n. The significant development effort was completed in less than two months.

University Relations has deployed a mass marketing campaign to promote the system, to increase awareness, and to emphasize the importance of subscribing. During what was typically the time of the year (July) with the fewest students and employees on campus, Virginia Tech observed a significant and steady increase in subscriptions to the VT Alerts automated notification system. By the end of the first day, the system was available (July 2, 2007), over 2,000 students and faculty and staff members had subscribed. The number of subscribers increased to over 4,000 by the end of the first week. Subscriptions have consistently increased since that time.

Testing of the system will occur at least once a semester.

A new information environment for research and innovation

For the university to realize its mission, a reliable, leading-edge, information environment must be available—any time and any place—to students, researchers, the faculty, and staff members. In early 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, electrical engineering, in the Mobile and Portable Radio Research Group, pervasive computing, high-performance computing, and high-performance networking to develop a customized infrastructure integral to future research, instruction, and engagement efforts. In addition to a myriad of research and instructional uses, Virginia Tech will leverage the new environment as a laboratory to develop technologies and strategies for emergency and crisis response. Other areas of focus will be cybersecurity and cyber-forensics.

Pre-eminence in scientific and engineering research requires uncommon tools and infrastructure. The most influential development of our age is the rapid evolution of the ability to access, store, and use information. Leaders in the advancement of information science and technology will be leaders in innovation. NI&S will create a radically advanced, high-performance, flexible, cost-effective collaboration and analysis infrastructure in addition to tools that will be under the control of and subtly responsive to the needs of researchers, educators, students, and administrators.

This capital project will provide new infrastructure to deliver integrated optical and next-generation mobile technologies. Through our engagement in national and international networks (i.e. National LambdaRail and Internet2) 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.

This 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.

The project includes four key areas of improvement:

- Access spaces
- Distribution
- Intelligent infrastructure
- Pervasive access

Access spaces

The antiquated concept of a “telecommunications closet” (still in the lexicon of outmoded facility designers) 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 system. The facilities must have adequate space, power, cooling, and security to support the new paradigm. Space is a critical requirement.

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 system 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 fifty percent of the campus to enable development of the high-performance information environment. The in-building distribution project will involve infrastructure to 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 and topology 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, (3) spare capacity to provide for future needs.

Intelligent infrastructure

Intelligent infrastructure includes 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 that help implement network policies and facilitate operation.

This project will be the central nervous system of a complex information environment, requiring research-class expertise as well as continual operational management and development. The information environment 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 pervasive 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.

A next-generation, mobile, adaptable, and secure information infrastructure is required for competitiveness, relevance, and to support all the evolving needs of research, education, and invention programs. Dramatic advances in the ability to communicate and to access and manipulate information are at the core of global societal changes. Students already think in concepts related to an unchannelized, communications platform which exceed Internet-age thinking. Infospheres, telepresence, embodied information, ambient virtual art, shared virtual spaces, and location-aware applications are a few of the tools they expect to employ.

The environment of fixed and mobile access is converging over a ubiquitous infrastructure. “On-demand,” real-time access to information has increasingly become a critical component of the university’s day-to-day functions, and the campus community will increasingly rely on an evolving information infrastructure to support teaching and learning, research, and outreach functions. The university community cannot be constrained by limitations such as location of the user or the characteristics of the content being sent. The goal of this project is to build a foundation for a pervasive infrastructure.

Over the past decade, Virginia Tech’s information environment has grown more complex. Each successive surge in innovation creates a new set of challenges. Successful state and national 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.

Virginia Tech has a strong record for effective, productive implementation and use of advanced information technology. The campus infrastructure has grown from small-scale in the 1970’s, providing mainframe access to a select group of researchers and administrators, to an advanced optical infrastructure supporting leading-edge science and research activities. In the mid-80’s, the university built a campus environment to deliver integrated voice and data years in advance of similar capabilities in the public domain. To support this environment, we planned, deployed, and continued to enhance the system over two decades. However, the existing facilities are now inadequate for 21st century applications. Virginia Tech’s current infrastructure supports the needs of roughly 55,000 user devices in over 200 buildings. This usage represents twenty years of growth in a period of rapid technology change. The information environment required for a competitive, world-class, research enterprise on the scale of a major university cannot be supported by current infrastructure or the available, commodity-grade, information infrastructure and services.

The legacy infrastructure was well designed and constructed and its growth managed to support the needs and reliability requirements of the university. However, we are faced with the fact that past processes for managing growth will no longer support the university’s current and emerging needs. Continued incremental growth will result in a disjointed design and operation making it virtually impossible to deliver a reliable and well-performing information environment.

Virginia Tech currently allocates approximately 560 “spaces” to house infrastructure components. The great majority of these spaces are little more than closets, many of which are shared with and routinely accessed by custodial staff and other personnel. Most do not have adequate power, cooling, lighting, and other facilities required to meet industry specifications. Lack of security poses a significant threat. The existing space cannot support an advanced information environment.

Approximately fifty percent of the campus in-building infrastructure is obsolete. The current fiber outside infrastructure needs to be relocated from the campus steam tunnels that were never the desired location for the outside plant. In 1988, use of the steam tunnels in certain parts of the campus was the only means available for developing the needed pathways. At that time, it was recognized that the next-generation of infrastructure would need to reside outside the tunnels. Non-diverse facilities and aggregation within steam tunnels creates the imminent prospect for major disruptions. For reliability, disaster avoidance, and business continuance, the infrastructure needs to provide diverse pathways to major buildings.

Virginia Tech’s current wireless and mobile architecture will not accommodate location-aware applications and other more advanced mobile applications effectively and efficiently. Mobility has increasingly become a critical component of the university’s day-to-day functions. As pervasive access applications have increased, the current infrastructure has fallen short of meeting university needs. Virginia Tech’s use of instructional technology is constrained by the current system. Today’s information environment will not support the demands from instructional and collaborative applications tools used by Virginia Tech faculty members and students.

The funding plan for this $31 million technology environment project calls for full, non-general fund support. At the meeting of the Virginia Tech’s 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.

Campus heat plant steam distribution upgrades

Virginia Tech’s physical campus in Blacksburg is always 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. For more information on this plan, please refer to the executive summary located at *http://facilities.vt.edu/documents/heat_cool_exec_summary.pdf*.

A portion of the plan addresses 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.

NI&S worked closely with Virginia Tech's Capital Design and Construction group (CDC) and the engineering firm hired to plan this project to identify all telecommunications cabling in the affected steam tunnels and to specify methods to protect that cabling during the project. These protection specifications were included in the project bid package.

NI&S is working closely with the project contractor and the CDC project manager to ensure that specified protection methods are properly installed and effective. If we have concerns about inadequate protection, we work with the project manager and contractor, as required, to address the circumstances in question. Due to the mission-critical nature of this infrastructure, NI&S has employees dedicated to monitoring this project for its entire duration.

Even with these protection methods in place, there is still risk of damage to the cabling infrastructure that could result in significant interruptions of university telephone and/or data services. NI&S has prepared contingency plans in the event of such damage and works very closely with the project contractors when work is taking place in areas of greatest risk. Procedures are in place for the NI&S employees monitoring this project to stop work, temporarily, if they believe activity is taking place that jeopardizes the cabling infrastructure. In that event, NI&S will work with CDC and the project contractor to consider less risky alternatives or improved protection methods.

In preparation for this project, NI&S personnel audited all cabling in the campus steam tunnels, affixed new labels to production cabling where old labels had deteriorated and, with the support of Facilities and CDC, removed 91 tons of abandoned cabling in the tunnels. This cabling was recycled. The abandoned cabling was primarily old C&P (now Verizon) telephone cabling for which the university took responsibility, but did not utilize, when the telecommunications auxiliary began to provide telephone service to the university community. Mainframe terminal cabling that predates ubiquitous PCs and data networking was removed as well.

After the abandoned cabling was removed, NI&S "re-racked" the production cabling as neatly and efficiently as possible in a cable rack system along the steam tunnel walls. The combination of removing abandoned cabling and re-racking production cabling has relieved congestion in some sections of steam tunnel, expediting the contractors' work. It will also facilitate future telecommunications and facilities maintenance activities in the tunnels.

Network research

Dr. Mark Gardner, Network Research Manager, focuses on network, communications, and computing issues and coordinates Network Infrastructure and Services efforts in these areas with other research activities on campus. Dr. Gardner is working with NI&S personnel, research faculty members, and other Virginia Tech information technology professionals to develop and implement solutions enabling high-performance computer communications and computing projects.

The past year has been very productive with the establishment of several potentially high-impact research activities.

Virtual Computing Laboratory

The trend toward low-cost, high-performance, multi-core microprocessors, coupled with the continued development of virtualization technologies, makes it possible to provide customized virtual computing environments for students and the faculty to use in their educational and scholarly activities. These virtual environments provide an alternative to the traditional computer laboratory. Using their laptop browsers, students will be able to request and connect to a wealth of preconfigured or customized virtual environments having all the tools needed for completing specific class assignments or a research project.

As a result of the flexibility provided by virtualization, it will appear to each student that they have exclusive use of computing resources even though, in reality, many virtual environments run simultaneously on a single physical computer. The centralized management of computing resources is likely to improve service reliability and may reduce costs to departments and colleges.

The key personnel associated with this project are Dr. Mark K. Gardner, Professor Wu-chun Feng, Chris Arnold, and William Dunn with assistance from Tim Rhodes and Chris McNabb—all from Virginia Tech—Andy Rindos (IBM), and Josh Thompson and Aaron Peeler of North Carolina State University.

PlanetLab

The PlanetLab project, *www.planet-lab.org/*, is a worldwide collaborative effort to provide an infrastructure to perform networking-related research in computing systems and applications. It is often viewed as a test bed for the development of the "Internet of tomorrow." Participating institutions provide the resources that are centrally managed by a staff at Princeton University. Virginia Tech researchers acquire an account locally and are able to do their research using over 800 nodes at nearly 400 sites around the world.

Network Infrastructure and Services, in conjunction with Advanced Research Computing and the Office of the Vice President for Information Technology, has purchased and deployed two PlanetLab nodes. Several faculty members in the computer science department have acquired accounts and are, or will soon be, using the PlanetLab infrastructure for research projects or as laboratory infrastructure in support of classroom pedagogy.

The personnel associated with this project are Dr. Mark K. Gardner, Bill Sydor, and Bill Marmagas at Virginia Tech and the PlanetLab crew throughout the world. Kevin Shinpaugh and William Dougherty dedicate resources to administer the day-to-day operations of the machines.

Desktop grids

Institutions like Virginia Tech have a wealth of untapped computing power in the form of idle time on desktop systems. The desktop grid project hopes to harness the idle cycles across campus to form a virtual supercomputer. Even when systems are being actively used, the need for computing capacity comes in brief bursts. During low use or idle periods, the computing capacity already paid for, but currently unused, could be harnessed to provide a virtualized supercomputing resource to the university community. The vision is to complete the fundamental and applied research necessary to mold the raw capacity into a useable service. It will be especially gratifying if the service is frequently used by faculty members and researchers from non-engineering colleges, who would otherwise not be able to afford access to high-performance computing for their teaching and scholarship.

Key personnel leading this work are Dr. Mark K. Gardner and Professor Wu-chun Feng. Fundamental to the project is the involvement of graduate student, Ajit Kulkarni, and undergraduate student, Tausif Akhtar, both studying Computer Science at Virginia Tech.

Network and system monitoring and measurement

Modern computing and networking systems are highly complex making it difficult to diagnose and correct problems. Existing monitoring tools operate at a high level and often do not provide sufficient detail for a problem's root cause to be discovered. The goal of the monitoring and measurement project is to develop the tools and techniques needed to understand problems and find their cures.

These same tools can be used to develop adaptive applications—those that change their behavior to achieve their goals in the face of changes in the operating environment. One important type of adaptive application allows scientists to visualize and steer through extremely large and complex data sets located at remote sites (e.g., the Large Hadron Collider), adapting to sluggish network conditions and variations in the availability of computing cycles on both ends.

As the trend toward increased virtualization continues, another area of research involves making monitoring and measurement capabilities available to virtualized operating systems. On the one hand, applications should be oblivious to the fact they are running on a virtual machine. On the other hand, multiple applications running on virtual machines do affect the predictability of execution. Thus, the trade-offs between isolation and transparency must be explored, and techniques developed to facilitate our ability to reason about observed behavior in virtual environments.

Dr. Mark K. Gardner, Professor Wu-chun Feng, graduate student, Harshil Shah, and undergraduate student, Kevin Miller, are working on this project.

Optical and hybrid circuit / packet-switched networks

Packet-switched networks have the advantage of flexibility and resilience, and they have driven the development of many Internet services. On the other hand, circuit-switched networks have the advantage of providing quality-of-service guarantees nearly impossible to achieve with packet-switched networks. With recent developments in hardware and protocols, along with the push to provide fiber to the home, it is conceivable that many computers will have access to both kinds of networks within the next 10 years. The goal of the CHEETAH (Circuit-switched High-speed End-to-End Transport ArcHitecture) and Hybrid Circuit/Packet-Switched Networking projects is to allow computing end hosts to utilize the strengths of each type of network seamlessly on demand while avoiding their weaknesses. Such hybrid networks would deliver improved value to computer users.

Dr. Mark K. Gardner, Professor Wu-chun Feng, and Jeff Crowder of Virginia Tech are joined by University of Virginia Professor Malati Veeraraghavan in this work.

Flow migration

People and organizations are increasingly dependent on networked computers for many aspects of their daily activities. At the same time, connectivity is no longer restricted to a single type of network at a known location. Network connectivity is now expected to be available in many locations--both likely and unlikely. Not only is connectivity available in most Blacksburg coffee shops, but even some transit buses are network-enabled. Although "being connected" is critical, *continuous* network connectivity is usually limited to one location.

The goal of the flow migration project is to develop the capability for network connections to shift seamlessly from one network to another. In much the same way that cell phone conversations transfer from cell tower to cell tower without dropping, network connections should migrate across separate networking domains, and back, without dropping.

Dr. Mark K. Gardner, Professor Wu-chun Feng, Eric Brown, Carl Harris, and graduate student, Patrick Butler, are all engaged in this project.

Network routing

Nearly all network protocols in use were developed at a time when security threats were practically nonexistent. As a result, it is extremely difficult to protect today's network infrastructure against certain forms of attack. The goal of the network routing project is to re-think the way hosts establish their identity to the network and how the network establishes routes to the hosts. In addition to increased security, the envisioned approach will make it simpler and easier to administer large and complex networks like Virginia Tech's.

Eric Brown, Carl Harris, Dr. Mark K. Gardner, Professor Wu-chun Feng, and graduate student, Song Huang, are the key personnel working on the network routing research.

High-performance networking and computing for the sciences

The goal of this initiative is to develop technologies making high-performance networking and high-performance computing accessible to faculty members, students, scientists, and researchers without requiring them to become computer science or networking "gurus."

The primary effort has been to provide high-performance computing and networking to the campus bioinformatics community. Initial efforts have been geared towards parallelizing the Basic Local Alignment Search Tool (BLAST), a fundamental mechanism for protein or

nucleotide matching, to run on supercomputers such as System X using the Message Passing Interface (MPI). Success in this area would reduce search times from days to minutes. The initial program is called mpiBLAST. Current efforts are following a two-pronged approach. The first is to develop a new version of mpiBLAST that can be maintained using sound software engineering practice. The second is to extend the tool into a framework for developing broad classes of parallel bioinformatics programs.

Notably, this work has resulted in a best paper nomination: Mark K. Gardner, Wu-chun Feng, Jeremy Archuleta, Heshan Lin and Xiaosong Ma, "Parallel Genomic Sequence-Searching on an Ad-Hoc Grid: Experiences, Lessons Learned, and Implications," Proceedings of IEEE/ACM International Conference High-Performance Computing Networking and Storage (Supercomputing), Tampa FL, November 11-17, 2006.

The Virginia Tech faculty and staff members working on this project are Professor Wu-chun Feng, Dr. Mark K. Gardner, Professor Eli Tilevich, and Jeff Crowder. Jeremy Archuleta, a graduate student at the University of Utah, and Heshan Lin and Professor Xiaosong Ma of North Carolina State are also involved. Professor Xiaosong Ma will soon join the researchers at the Virginia Bioinformatics Institute (VBI).

Network infrastructure and standardization activities

Jeff Crowder and Dr. Mark K. Gardner represent Virginia Tech, the Commonwealth of Virginia, and the broader region at various professional meetings--an important activity for managing network research. Virginia Tech, through the Mid-Atlantic Terascale Partnership is a member of the National LambdaRail, a high-performance research/production network owned and controlled by its members. Virginia Tech is also a member of the Internet2 advanced network consortium. Finally, Virginia Tech is responsible for managing many of the backbone networks in Virginia and the National Capital Region.

The activities highlighted above support the strategic plans of the university, Information Technology, and Network Infrastructure and Services in a variety of ways.

1. Nearly all of the projects provide an opportunity to further the education of undergraduate and graduate students, transforming education into an engaging and active process. Whether or not the students intend to pursue a career in academia, exposure to research increases their capacity for independent thinking and critical analysis. Collaborating with researchers and other students provides experience working as a team member, an important skill in both industry and research. Furthermore, the students are required to give periodic talks in the weekly research group meetings that hone their public-speaking abilities and give them increased confidence.

2. Several of the projects have the potential to transform the educational process radically. For example, the virtual computing laboratory concept makes computing resources available to the faculty and to students "anytime, anywhere, anyhow." Students are able to gain access to resources at any time of the day or night, from their residence hall room or across the world,

utilizing any network-connected computer. Virtual computing allows faculty members and students to perform "cyber-experiments" interactively during lectures. This method gives immediacy to the educational process that is not currently possible due to the separation between faculty exposition and student experimentation in a physical computer laboratory. The key is to make resources conveniently available when opportunities for learning are the most powerful.

3. The projects are intended to increase humankind's understanding of complex systems, through the discovery of knowledge and through the development of innovative technologies in the virtual and distributed computing, high-performance computing, high-performance networking, and bioinformatics domains.

4. Several of the projects have the potential to become additional services the Office of Vice President for Information Technology could provide to the university community and the region. The virtual computing, desktop grid, network infrastructure, and high-performance computing projects will enhance existing services or will become new services. Furthermore, work on these projects increases awareness of the personnel and infrastructure capabilities Information Technology can bring to bear upon problems of concern to faculty members and administrators. In turn, those concerns provide motivation for developing new technologies and services to address them.

5. To magnify the impact of the approaches and technologies being developed by the projects, all artifacts will be made readily available. Software will be released under an open source license. (Dual licensing will also be considered when doing so would allow useful products to be developed and where the funds generated can be returned to support additional research.) Industry partners will also be encouraged to increase the transfer of technology.

Support for research computing

In late 2005, Information Technology began moving research-computing assets, including the MAC OSX-based System X, into a full production environment. The assets included SGI hardware, Sun hardware, and the Apple Cluster known as System X (*www.arc.vt.edu/System-X/systemX.php*). A group of Network Infrastructure and Services staff members was assembled to provide hardware and operating system administration. The UNIX Administration Services Team was assigned responsibility for these hosts.

Providing reliable computing resources for university researchers was the major goal of this effort. Other goals include increasing awareness of researchers' needs, improved planning for testing and implementation of new technology, participating in the drafting of grant proposals with the Research Division and the College of Engineering/Department of Computer Science, and becoming involved with the exciting TeraGrid initiative (see *www.teragrid.org*).

Recently, the group has installed and deployed additional computing systems including the SGI Altix 4700, SGI Prism visualization system, and Sun V490. The team also led the evaluation of SunRay desktop systems and the Sun Global Desktop environment to accommodate diskless workstations.

One of the university's major strategic initiatives involves securing additional research opportunities in innovative technologies and complex systems such as nanotechnology, bioinformatics, biotechnology, power electronics and robotics, wireless, and geographic systems. The high-performance computing resources now available to our researchers provide increased flexibility, enable the use of computer modeling, and encourage large-scale research projects in these areas and others. By offering System X, which provides multiple CPUs (up to 1024 dual processor machines), and the SGI hosts, which provide large "memory footprints" (up to 96GB of RAM on a single machine), a variety of software packages and custom-built codes can be easily accommodated.

Regional and national initiatives

Virginia Tech plays a key role in the development of the latest advanced network infrastructure initiatives at regional and national levels. Through direct and aggressive support for initiatives such as National LambdaRail (NLR), the Mid-Atlantic Terascale Partnership (MATP), and the Virginia Optical Research Technology Exchange (VORTEX), Network Infrastructure and Services plays a crucial role in support of the research competitiveness of Virginia Tech and in the development of new initiatives to meet the emerging needs of Virginia citizens, communities, and government.

2006-2007 was a productive year for many of our strategic initiatives.

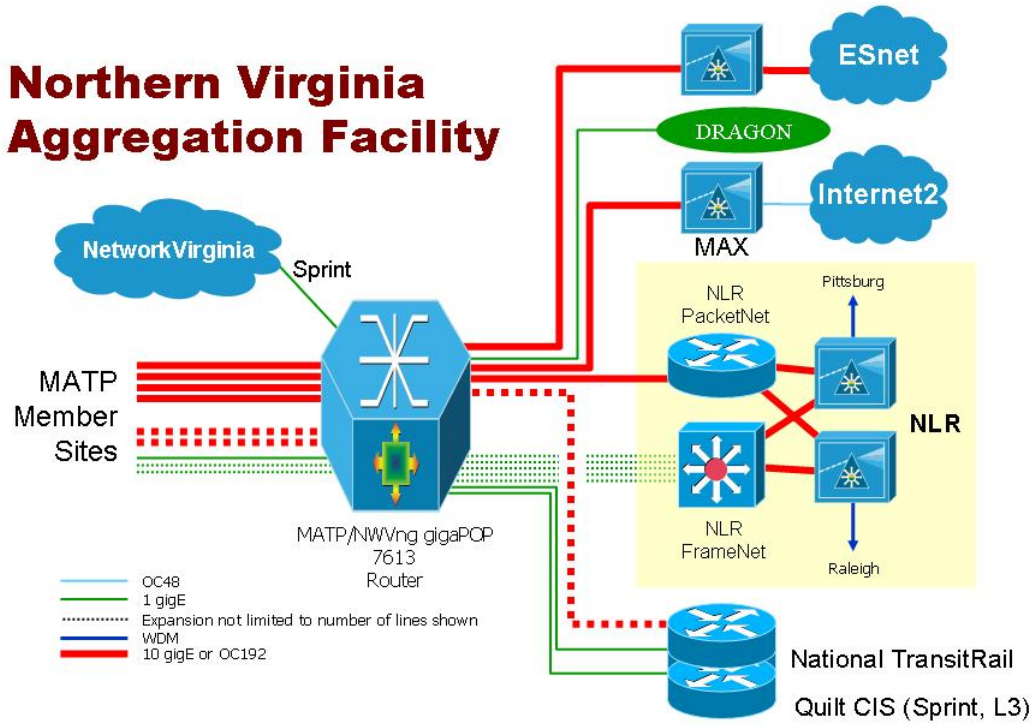
Northern Virginia Aggregation Facility

Multiple regional and national network programs coalesce geographically around the Washington, D.C., metropolitan area. Virginia Tech has established a major network infrastructure hub at 1755 Old Meadow Road in McLean, Virginia, to aggregate access and tie multiple network resources together.

The hub, called the Northern Virginia (NOVA) Aggregation Facility, resides in collocation space in a major carrier building just inside the Capital Beltway. This single, strategic facility provides direct access and interconnection for the following major networks and services:

- National LambdaRail
- Internet2's NewNet
- Mid-Atlantic Crossroads MAX
- United States Department of Energy ESnet
- NASA Research and Engineering Network (NREN)
- Mid-Atlantic Broadband Cooperative (MBC)
- National TransitRail
- NetworkVirginia Gateway
- Virginia Optical Research Network (VORTEX)
- Multiple commodity Internet, VoIP, and other service providers

NI&S designed and constructed the switching and routing facility to provide interconnection among the multiple resources at this facility. It also provides access services to constituencies in research, education, health care, public service, and economic development throughout Virginia. Customers include members of the MATP, NetworkVirginia, the Mid-Atlantic Crossroads, and the Virginia Community College System.



The physical aggregation of services, resources, and access facilities at this node, under university oversight, creates significant advantages in performance and cost avoidance while enabling extremely high capacity and flexible interconnection. All these resources together in one space along with the fiber-optic bundle cables linking our facility to each of them allows us

to essentially increase capacity and provide new services whenever necessary. Virginia Tech also provides universities throughout Virginia with access to this facility thus extending these benefits to the entire commonwealth.

NI&S initiated a cooperative agreement with the Virginia Community College System (VCCS) to help leverage their participation in the Aggregation Facility. Working with NetworkVirginia, VCCS is in the process of updating their statewide network infrastructure. Virginia Tech is hosting a major VCCS backbone node collocated in our facility in McLean. This backbone node will provide VCCS with low-cost Internet access (see Commodity Internet Service project below) as well as direct access to NetworkVirginia, NLR, and Internet2 under the auspices of Network Infrastructure and Services' K20 program (also below).

The NOVA Aggregation Facility will generate a projected revenue stream in excess of $1.85 million to Virginia Tech over five years through port fees and service charges assessed to participants.

Commodity Internet service and National TransitRail

NI&S established a successful new commodity Internet service (CIS) leveraging VORTEX, the NOVA Aggregation Facility, and NLR's National TransitRail program.

NI&S added two gateway connections to the aggregation router in McLean. One is an NxGigabit (N is a variable by) ethernet link to Level 3's transit commodity Internet service. The other is a gigabit link using National LambdaRail's FrameNet service to the National TransitRail peering point located in Ashburn, Virginia.

The Level 3 connection is a low-cost, high-volume service negotiated as part of a master services agreement between Virginia Tech and Level 3 that incorporates Quilt pricing. Quilt is a national association of regional optical networks. Hud Croasdale of Virginia Tech currently serves as Quilt's executive director.

The National TransitRail (NTR) is a national peering fabric operating over NLR's network. It provides direct peering to major content providers and Internet service providers. NTR provides a performance benefit in addition to potential cost advantages by offloading traffic carried by transit providers. Virginia Tech represented the MATP as a Phase 0 participant for the early development of NTR.

Combining Quilt CIS pricing with NTR enables Virginia Tech to offer a Commodity Internet Service to MATP member universities at low cost. CIS program participants currently include the University of Virginia, Old Dominion University, the Virginia Community College System, and Virginia Tech.

CIS represents a savings of at least $1.2 million to the commonwealth compared to the lowest cost alternative for acquisition of the current capacity. In addition to the cost savings, this service

provides critical flexibility and control to participants. The University of Virginia increased total Internet capacity by more than 600% using CIS. In the aftermath of the April 16th events, Virginia Tech increased our own Internet capacity by 300 Mbps in less than one hour to provide additional access to university information services and to provide access for emergency responders and media. By controlling the subscription ratio to access capacity and the physical configuration of the components, we are able to maintain reserve capacity--which can be activated very rapidly--for all participants at no extra cost.

Mid-Atlantic Terascale Partnership

Virginia Tech's NI&S directed operations for the Mid-Atlantic Terascale Partnership (MATP) facilitating access to National LambdaRail and collaboration for terascale computing and networking among research entities throughout Virginia, Maryland, and the District of Columbia. NI&S serves as the operational "agent" for MATP, providing technical and management services in support of the organization and acting as the "pivot point" between MATP and NLR.

Our NOVA Aggregation Facility provides access to NLR's PacketNet and FrameNet services for all NLR participants in the mid-Atlantic region. Virginia Tech management and control of this facility expands the university's regional and national leadership role and provides a significant competitive advantage for university research programs.

Additional information about the MATP may be found at *www.midatlantic-terascale.org/*.

Mid-Atlantic Broadband Cooperative Partnership

NI&S provided support to the Mid-Atlantic Broadband Cooperative (MBC) for connecting their regional fiber infrastructure to tier-one markets in Washington, D.C., Raleigh, N.C., and Atlanta, Ga.

MBC is building a project called "Virginia's Regional Backbone Initiative (RBI)." This program, initially the brainchild of Virginia Tech's eCorridors program, is applying optical network technology to generate long-term economic revitalization. The objective is to promote economic development opportunities, attract technology-based industries, and create new jobs. The RBI will provide an advanced telecommunications infrastructure that will span over 700 miles, connect four cities, 20 counties, and 56 industrial parks, while providing high-speed Internet access to nearly 700,000 citizens and over 19,000 businesses. The initiative stems from a unique collaboration between the Virginia Tobacco Indemnification and Community Revitalization Commission, the U.S. Department of Commerce–Economic Development Administration, and a non-profit organization.

Critical to the success of RBI will be the connection of the regional network to major national and international network hubs located in tier-one areas. Virginia Tech provided direct support to MBC for negotiation and acquisition of long-term leases for dark fiber stretching from Washington, D.C. to Atlanta. The fiber intersects MBC's RBI network creating an access path with major nodes on both ends and one in Raleigh, N.C. Virginia Tech also provided input to enable MBC to procure a dense wavelength division multiplexing (DWDM) system to light the long-haul fiber with multiple 10 Gbps channels.

MBC provided a letter of intent to Virginia Tech to allocate approximately 2,800 fiber-miles to the university from within the RBI and to provide access to the long-haul system at marginal cost. Virginia Tech intends to use this infrastructure to engage in research and educational activities to benefit the Southside region served by MBC and other areas of the commonwealth. Virginia Tech also expects to use these facilities to significantly improve access for the university to network hub facilities and university programs in the National Capital Region as well as North Carolina, Georgia, and nationwide.

Additional information about MBC can be found at *www.mbc-va.com/aboutus.asp*.

NetworkVirginia and the NetworkVirginia (ng) gigaPOP

As one of the department's contributions to the university's outreach mission, NI&S manages the NetworkVirginia contracts with Sprint and Verizon and provides technical support for network management, vendor coordination, and order processing. With an emphasis on a high level of security, availability, and reliability, the unit provides network design and provisioning services for NetworkVirginia customers, and, in conjunction with the Virginia Tech Operations Center (VTOC), provides 24x7 monitoring and fault resolution to ensure any network problems are resolved across multiple service provider boundaries. 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.

NI&S also operates the Network Virginia (ng)—or "next generation"—Internet2 gigaPOP which provides access to the Abilene network (*http://abilene.internet2.edu/*) for all Virginia Internet2 participants including universities and K-20 schools.

During 2006-2007, Network Infrastructure and Services negotiated contract addenda with Verizon and Sprint to provide network service technology updates and lower prices for participants statewide.

Virginia K-20 network program

Through a cooperative program led by NI&S and the Institute for Connecting Science Research to the Classroom, schools, museums, and libraries connected to NetworkVirginia throughout the state may access the National LambdaRail (NLR), Internet2, or both at no additional cost. This project was co-sponsored by a group of Virginia research universities and the Virginia Community College System.

The NLR is the new, national network for research and education that goes beyond Internet technology. It provides enormous capacity to support scientific research for the nation's top research universities, supercomputing centers, and federal research laboratories. The Abilene network, operated by Internet2, is a special purpose Internet for education and research. Linking more than half the nation's colleges and universities and some 46,000 total institutions of research and education nationwide, it supports DVD-quality videoconferencing and provides access to tools such as remotely controlled electron microscopes.

Working with NI&S and the Institute, Thomas Jefferson High School for Science and Technology (TJ) in Fairfax County was the first Virginia K-12 school to connect. Students at TJ are already completing coursework in supercomputing and advanced network protocols directly relevant to NLR and Internet2. Faculty members at TJ and Virginia Tech are developing ideas to augment these programs and expand access to opportunities ranging from distributed performing arts education to instruction in distributed supercomputing for high school students statewide. Virginia students now have access to technology and hands-on educational opportunities previously available only to advanced students at elite universities.

While National LambdaRail provides access to the nation's most powerful research network and computing resources, Internet2 brings a successful K-20 program with a wealth of educational technology program support and collaboration opportunities. Combined access to both gives Virginia researchers and learners an immense advantage. Internet2 programs targeted at K-20 education will be available to schools across Virginia. These programs include Megaconference Jr., a project using advanced videoconferencing technology to bring together thousands of students in elementary and secondary schools around the world for an all-day learning conference. Students can also receive live undersea exploration demonstrations from remote locations with famed oceanographer Bob Ballard, take master music classes from world-renowned instructors, or use remote-controlled instruments to dissect a biology specimen from 1,000 miles away.

NI&S strives to build coalitions with other higher education institutions and with vendors to provide enhanced services for the citizens of Virginia. In this case, Virginia Tech brought together several other universities, the Virginia Community College System, the Virginia Department of Education, and vendor partners Sprint and Verizon to co-sponsor this initiative.

University participants include the College of William and Mary, George Mason University, Old Dominion University, the University of Virginia, Virginia Commonwealth University, and Virginia Tech. These institutions are members of the NLR-related MATP together with NASA and the Southeastern Universities Research Association who also are sponsors. In addition, the Virginia Department of Education is working with Virginia universities to help advance Virginia's K-20 National LambdaRail and Internet2 program.

Sprint and Verizon provide the advanced network services that comprise NetworkVirginia. For this project, Sprint contributed a high-speed link that ties NetworkVirginia to an on-ramp to NLR and Internet2 operated by the MATP. The advanced network hub node providing the on-ramp is located in McLean and operated by Virginia Tech on behalf of NLR, MATP, and the NetworkVirginia Internet2 gigaPOP.

NI&S personnel represented the National LambdaRail and Internet2 at the Virginia Department of Education Innovate 2007 conference. During the program, we demonstrated an uncompressed, high-definition video application used to teach a course in high-performance computing to sites throughout North America and in Czechoslovakia using the NLR network and international peers.

Data Center upgrade

To house critical computing resources, Virginia Tech maintains a robust Data Center facility in the Andrews Information Systems Building (AISB). High-availability power and cooling are provided to ensure optimal performance of academic, administrative, and research systems. In addition to strict environmental controls, the Data Center requires reliable, high-capacity communications to serve computing applications. In the summer of 2006, Network Infrastructure and Services completed a major communications infrastructure upgrade to support the Data Center.

These older racks, with no cable management hardware, also housed modem pool and voice equipment. The new design called for extensive cable management in the racks, as well as consolidating all voice equipment to the ISB switchroom.

With a campus-wide, network infrastructure upgrade on the horizon, it was important to ensure that central

Information Technology services were positioned at the forefront and supplied with adequate capacity to serve growing user demand. The Data Center upgrade permitted computing applications to serve the campus community with the required level of service and performance.

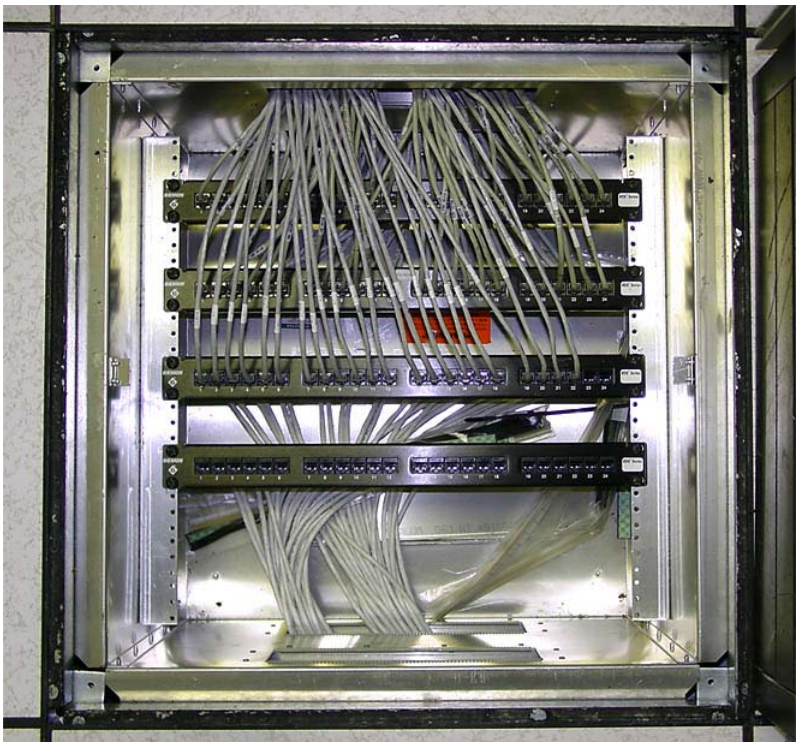
Two major technologies were implemented, bringing enterprise-class network services to all users of the AISB Data Center. First, the network switching architecture was upgraded to deliver Gigabit Ethernet service to every host creating a tenfold improvement in available bandwidth. Previously, while many individual servers were connected at gigabit speeds, connectivity between servers was often limited by slower links. The new network eliminates these bottlenecks.

The second technology focused on improving availability of services to end users. Many centralized services, such as university websites, require multiple servers to function in parallel to meet performance, reliability, and maintenance requirements. This coordination is accomplished through the industry standard practice of server load balancing. Load balancing allows many requests to be processed by multiple servers, mitigating the dependence on any single server. NI&S integrated a robust design for server load balancing into the Data Center network upgrade. The same technology implemented at Virginia Tech has been used by Comcast, America Online, and Yahoo to deliver content worldwide. Over the 2006 - 2007 year, many services have migrated to this centralized resource. Server load balancing played a critical role in the university's ability to respond to the extraordinary traffic demand placed on the network following the events of April 16th.

Old Floor Box

In addition to these network upgrades, new techniques in cable management and wiring infrastructure were piloted in the Data Center project. Field Engineering worked diligently to implement a flexible, manageable, cable plant with the ability to grow with increased demand. Techniques were developed to allow the migration of cable plant while minimizing impact to end users. Given the dynamic nature of changes within the Data Center, this new design allows continuous, manageable change without creating an overly complex system. Many of the practices modeled in the Data Center network upgrade will be duplicated in the larger, campus network infrastructure upgrade.

Collaboration between many groups was a key factor in implementing such a large transition in a short time. With nearly 500 connections to migrate, communication was of the utmost importance. Network Operations worked extensively with system administrators responsible for hosts located in the Data Center to optimize scheduling of transitions and minimize any possible impact on user services. Network Engineering and Operations met with a diverse team, including DBMS, ECS-WAS, UAS, Hosting, Collaborative Technologies, and Middleware, to develop an aggressive migration schedule that afforded a rapid deployment while maximizing service availability.



New Floor Box

During this transition, a number of new tools were leveraged to enhance coordination and communication among project stakeholders. Instant Messaging and Enterprise Wiki collaboration were key factors in the success of the project in such a short timeframe. The Wiki provided a common resource for the organization of project documentation. All project members were given the ability to collaboratively produce and edit materials, speeding the process of disseminating project documents. Using Jabber Instant Messaging, project participants were able to interact dynamically, from diverse locations, while maintaining constant communication with their peers concerning the status of the project. IM communication greatly enhanced activities such as equipment decommissioning where network engineers worked in tandem to update various network management systems.

The new equipment is fully cabled and service is in transition.

Network Engineering (NE) staff were heavily involved in all phases of this project. Responsible for project management, hardware installation, software configuration, and network integration, the NE team was integral to the rapid deployment of this technology. Extensive training courses for

engineers were held on-site in cooperation with the equipment vendor, leading to the development of a new, robust architecture to maximize network performance.

New techniques were developed for the management and documentation of fiber-optic, network interconnects, including improvements in redundant network design. With various cable plant projects taking place on the Data Center network core, it was necessary to minimize the risk of interruption to existing connectivity while new infrastructure was being constructed. Network management systems were continuously updated throughout the project providing a heightened knowledge of system status to ensure optimal network performance during transitions. This continuous, detailed attention to network status minimized risk of interruption to critical services. Procedures developed for documentation and network monitoring during this project have been valuable in improving network awareness throughout the campus infrastructure.

Accomplishments include the following:

- More powerful and capable network architecture
- Robust, full-featured, server load balancing. (Critical role in response to extraordinary traffic loads following April 16th)
- Upgrade to Gigabit Ethernet-connected hosts positioning the university for Gigabit service to desktop computers
- Expanded and improved Data Center cabling infrastructure allowing flexibility and manageability in a highly dynamic environment
- Modeled installation practices that can be repeated across campus for a flexible and manageable network infrastructure
- Modeled an IP-switched, network architecture for greater reliability and more even utilization of resources
- Capacity and room for growth

The Data Center upgrade project has placed our key university systems infrastructure at the forefront of next-generation network technologies. With the implementation of Gigabit Ethernet, redundant server load balancing, and new strategies for cable plant management, we have positioned ourselves to provide the highest quality of service to the most critical university computing resources. As we move forward with an extensive upgrade to all campus network services, the new Data Center network will scale effectively to fulfill ever-increasing user demand.

Virginia Tech wireless network

The wireless local area network at Virginia Tech provides mobile users with convenient, untethered connectivity to Internet resources and services at speeds up to 54Mbps. The service is

currently available in 129 buildings including approximately 95% of all academic and administrative spaces on campus.

Wireless technologies play an increasingly important role at Virginia Tech. Wireless network cards have become a standard item on laptops, tablet PCs, and other portable/mobile devices, and the university now requires that all entering students have a laptop or tablet PC with wireless capabilities. Many in the campus community (86% of students and 53% of faculty and staff members are registered users) consider wireless service to be a necessity for their everyday activities and rely heavily on the flexible access it provides.

Wireless usage Spring Semester 2007

Total logins	838,468
Average logins per day	9,214
Total unique users	21,908

Current trending reveals the wireless network will continue to see increased usage in the future as more users adopt mobile devices and as more applications are developed for use over the wireless network.

In an effort to promote robust and integrated information technology strategies and in anticipation of increased demand, Network Infrastructure and Services has continued to expand wireless network service and to add capacity to existing locations. 104 wireless access points were installed in 17 buildings over the course of the 2006-2007 fiscal year. The total number of wireless access points on campus is now 1248.

In addition to expanding the wireless footprint across campus, NI&S also began to deploy access points capable of providing 802.11a service to complement the existing 802.11b/g service. 802.11a-capable access points provide more bandwidth to a given area by operating in the 5GHz frequency band. The additional bandwidth is especially useful where high concentrations of users gather in locations such as large lecture halls and auditoriums.

Classroom wireless collaboration with College of Engineering

In the fall of 2006, the Virginia Tech's College of Engineering became the first and largest public College of Engineering to require all incoming freshmen to purchase tablet PCs. The tablets, along with the adoption of instructional applications, give the college the ability to transform the traditional classroom environment into a dynamic, interactive session that engages students and encourages classroom participation.

Early trials of the technology demonstrated that utilizing these instructional tools in a classroom over the wireless network provided unsatisfactory results. The problems were especially noticeable in large lecture halls where radio spectrum resources and bandwidth are limited. This issue proved to be a major detriment to further adoption of the technology since poor performance would quickly lead to discouraged instructors and students and the eventual abandonment of the applications altogether. To date, using wireless networks in areas with many simultaneous users has had marginal success and has generally been discouraged. There are no published case studies or industry-accepted guidelines on how to deliver content in such an environment.

The setback resulted in collaboration between NI&S, the College of Engineering, and the Learning Technologies group. A freshman engineering class in a 300-seat auditorium served as a prototype throughout the course of the 2007 spring semester. NI&S engineers developed techniques and best practices culminating in a robust, stable environment that met the needs of instructors and students. The results obtained from these tests are being used to develop a standard architecture for other lecture halls and will function as a guideline for future applications of the wireless network. This collaboration culminated in a 2007 Laureate Medal at the Computerworld Honors Program. (See *https://internal.cns.vt.edu/home/index.html*.)

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. In support of this endeavor, NI&S utilized the wireless architecture developed from the prototype classroom to upgrade the wireless infrastructure in 25 additional classrooms for the start of fall semester 2007. By expanding this service, the technology will be available to more faculty members within the College of Engineering as well as other colleges within the university.

COLA

COLA (*cola.cns.vt.edu*) is the organization's customer Web portal. It provides account management, reporting, and service provisioning for students, departments, and campus visitors. Significant improvements this year included source code refactoring to improve code standardization and maintainability, an improved Guest Wireless Management application suite, and continued work on a pilot Interdepartmental Communications Request (ICR) application.

Code refactoring for COLA included a complete conversion to a standard three-tier architecture consisting of a persistence layer (Spring JDBC), a service layer, and a controller layer. Additionally, Tomcat's DBCP connection pooling using JNDI was added, and the presentation layer was converted from Apache Velocity to JavaServer Pages/JSTL.

As we continue to enhance our customer-service orientation in all business services operations, the COLA Guest Wireless Management suite was rewritten to provide visitors with a significantly improved user interface which was developed by the BEV Web Support team. The new interface is more intuitive and easier to use. Additionally, management of guest identity has been separated from the request for service. The primary advantage of the new model is improved efficiency and ease of use for returning guests. Rather than re-entering identity information every time a guest visits campus, the new system allows them to use the same account/password and simply re-apply for service each time they return. Guests may also see the status of requests they have made. Secret questions have been added to the identity record to allow the guest user and Virginia Tech Operations Center personnel to change the guest account password if necessary.

As work continues to implement enhancements to our enterprise infrastructure to support efficiency and to reduce costs, development progressed this year on a new COLA ICR application to replace the legacy, static HTML-based ICR system. This application will also allow increased productivity and efficiency for end users in the university community. The initial application was released to a pilot group of 13 departments in September 2006, and provided functionality for network orders. Subsequent releases throughout the fiscal year added functionality for voice, calling card, and video orders. In all, the pilot group entered 251 ICRs resulting in 526 telecommunications orders.

Wiki

A wiki is web-based software that manages the publishing and collaboration of content. Wiki is Hawaiian for “quick.” Ward Cunningham came up with the name after he made a trip to Hawaii and was instructed to take the "Wiki Wiki" airport shuttle between terminals. The first system was named the WikiWikiWeb—a name that was eventually shortened to simply “wiki.” One of the most popular and expansive wikis today is wikipedia.org.

A wiki provides a central repository for information. Users can create, edit, and find this information quickly. Other users (with the correct permissions) have access to this information immediately. They can correct and add additional content if they wish. Documents can be edited by multiple people allowing for seamless collaboration. If something is changed or deleted by accident, documents can be reverted back to any earlier version. Additionally, knowledge of HTML or other web technologies is not needed to use a wiki. Creating or editing content is as simple as using a word processor.

Network Infrastructure and Services chose Atlassian Confluence as the software to support our wiki. Several added features of Confluence include e-mail integration, granular security and access control, and support for various file attachments.

The addition of the wiki has touched almost every part of the NI&S organization. Now there is less need to find a particular person for an answer to a question. Anyone can easily find information. With knowledge so easily accessible, workflow has become more efficient.

Project Kestrel

Project Kestrel was established to build a next-generation, telecommunications management system for Network Infrastructure and Services. (*https://webapp.neo.cns.vt.edu:8083/display/KESTREL/Introduction*) It is expected eventually 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 development is network infrastructure documentation. The Kestrel project will develop a network infrastructure documentation system that is significantly more advanced than existing systems. The Kestrel network documentation system 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 will likely take several years to complete. The plan calls for incremental replacement of small, functional pieces of legacy systems as well as the provision of new functionality not previously addressed by legacy systems. During development, Kestrel will continue to interoperate with existing systems so regular work functions outside the scope of current Kestrel development can continue as normal.

The software platform for Kestrel is the industry-leading Java Enterprise Edition (Java EE), which integrates enterprise information systems such as databases with centrally managed business logic, transaction management, and strong security. A user interface tier, implemented using a combination of web technologies or rich desktop clients, will provide access to Kestrel applications developed on the Java EE platform. Additionally, information systems such as GIS and CAD will provide a rich, graphical interface to application data such as network infrastructure documentation.

An important facet of the Kestrel development strategy is a developer-training program to ensure the Kestrel development team has a high degree of competency in the software development techniques, architectures, frameworks, and toolkits needed to realize the Kestrel vision. The first

phase of the Kestrel developer-training program was completed this year. It provided Java web application development training to software developers with competencies in other development environments (such as Oracle PL/SQL, and Oracle Forms). This training is a first step in retooling development skill sets within the NI&S organization. Training program assessment methodologies will be established during the coming cycle that will utilize a combination of self-study, classroom-based study, and professional certification to ensure Kestrel developers have the necessary knowledge, skills, and abilities to meet the challenges of the project.

Early Project Kestrel successes include the following:

- Standardization within the organization's development community on development tools, methods, and architectures
- Improved communication between the organization's development and engineering teams
- Early work on a graph-based, network domain model
- Establishment of a stakeholder team for the project's initial deliverable—a network device management application

Systems Development and Administration is constantly working to identify and assess potential open source solutions. As a result, JasperReports, a Java-based, open source, reporting tool, was chosen as the successor for the organization's ATLAS Oracle Reports solutions. A report server application was developed to integrate JasperReports requests with ATLAS Web forms, and several Oracle Reports have already been migrated to JasperReports.

Project Ghiza

For the 2005-2006 academic year, there were 347 Internet copyright infringement complaints (ICICs) received by the university from outside agencies monitoring peer-to-peer networks and World Wide Web hosting sites. The number of complaints increased dramatically in 2006-2007. By November 2006, the volume had already surpassed that of the entire previous year. By the close of the spring semester 2007, 1107 ICICs had been received and processed.

As a result of this increase in complaints, it was necessary to enhance the business process by which copyright complaints are handled in order to maximize organizational effectiveness. Using only an IP address and timestamp, the initial research to match a complaint to an individual university network user involved working with multiple databases and entering data in spreadsheets. A routine task became an exceedingly time-consuming daily work element for Communications Network Services' Public Relations group.

Project Ghiza was conceived to greatly simplify and expedite the research aspect of copyright complaints. A web application and interface were developed to resolve the evidentiary

information to an end user in one step, immediately reducing the amount of time required to research each complaint. Ghiza has also enabled Public Relations personnel to relate wireless cases to a specific individual, a process that previously required support from the Virginia Tech Operations Center.

Future plans for Ghiza include development of a web-based, e-mail interface to handle the large volume of communications associated with the ICIC process. Currently, this mail is tied to the Exchange accounts of the Public Relations group and requires careful coordination to maintain accurate logs and records of both e-mail and evidentiary information. The improvements to Ghiza will eliminate the Exchange dependency and the limitations associated with logging data in a spreadsheet. Instead, there will be an online database resulting in improved productivity and accuracy in managing these complaints.

JIRA

Network Operations procured and implemented Atlassian's JIRA bug tracking, issue tracking, and project management system. Network Operations worked with Systems Development and Administration to deploy the system in January 2007 and establish it as the organization's standard, software-issue, tracking system. This implementation is another method of promoting robust and integrated information technology strategies to increase efficiency and effectiveness. Important features of the Web-based system include customizable workflows and dashboards, authentication integration with Enterprise Directory, powerful authorization management, voting functionality, and highly configurable notification options. JIRA is also capable of integration with the organization's Wiki and with Subversion, the organization's source code, version-control system.

To date, 22 projects have been defined in JIRA and 303 issues created. Though some progress has been made to enable end users to create and monitor issues via the system, most of the issues to date have been entered by developers. A goal for the coming year will be to enable all end users to use JIRA to log software issues and track their progress. The system promises to become more widely used for project management as well.

Support for the National Capital Region

Virginia Tech facilities in the National Capital Region offer opportunities for research and graduate studies. University research centers in the region are expanding and include many subject areas. They provide opportunities for partnerships and collaborations with private industry, local and federal agencies, and other higher education institutions in the vicinity.

Graduate degree and certificate programs in the National Capital Region are taught by internationally recognized faculty members at two locations—Old Town Alexandria and the Northern Virginia Center in Falls Church. *Commonwealth Campus* facilities allow local residents to take classes of interest to them without being formally admitted to a degree program.

As Virginia Tech continues to expand its presence and offer additional services in the National Capital Region, Network Infrastructure and Services responds to their special needs for telecommunications services to support their research, teaching, and outreach initiatives.

Northern Virginia Center telecommunications services

NI&S is responsible for providing and maintaining telecommunications and distance learning services at the Northern Virginia Center (NVC). During the 2006-2007 school year, over 100 service orders were completed to manage voice and data services at the facility. In addition, wireless services were installed for the entire NVC complex. CNS replaced the HVAC units in all locations housing NVC telecommunications equipment.

Video/Broadcast Services support

Video/Broadcast Services (VBS) maintains and operates Virginia Tech's interactive videoconference (IVC) classrooms throughout the commonwealth, including five classrooms located at the NVC and two at Virginia Tech locations in Alexandria. VBS provides a variety of support and services associated with IVC classes and events. During the 06-07 academic year, VBS supported 72 classes at the NVC and an additional 7 in Alexandria.

In support of university initiatives to strengthen the role of distance and distributed learning, VBS coordinates the scheduling of on- and off-campus IVC classrooms and schedules access to video bridging services. VBS personnel in Blacksburg and at the NVC coordinate efforts to

conduct daily operational tests and provide technical support to ensure the IVC systems are ready for use. The VBS support staff located at NVC provides daily, on-site equipment preparation and operation of Virginia Tech's videoconferencing classrooms at the center. VBS personnel are also available for routine assistance to clients in the loading of software or files needed for presentations.

In addition, the IVC facilities at the NVC are used for many "one-time event" interactive videoconferences:

- A full range of instructional uses such as connecting guest speakers with Virginia Tech classes
- Assisting with preliminary exams, thesis, and dissertation defenses
- Supporting administrative meetings among dispersed campuses

To facilitate the integration of advanced learning technologies across the curriculum, the VBS staff assists with NVC faculty workshops and training and provides group and individualized training in the effective use of videoconference room presentation equipment. VBS regularly demonstrates conferencing and instructional strategies and capabilities to promote effective use of interactive videoconference facilities and to train and prepare students and faculty members to use the facilities for class presentations.

Wireless networks at the Northern Virginia Center

In March 2007, Virginia Tech's Network Infrastructure and Services department enhanced the wireless local area network (LAN) at the Northern Virginia Center by providing wall-to-wall coverage in the entire building to accommodate an identified need. With this enhancement, NI&S also configured this single wireless infrastructure to provide distinct wireless services on independent networks to both University of Virginia and Virginia Tech constituents. This effort is another example of our work to leverage collaboration with other higher education institutions.

By utilizing a single infrastructure, efficiencies were gained for both universities in the following ways:

- Reduction of the potential for radio interference between the equipment of the two groups
- A more stable, reliable, and available service leading to reduced support costs
- Reduction in capital costs by minimizing the amount of network equipment needed
- Extending and enhancing the wireless coverage for both universities throughout the facility
- Greatly simplified management of the service

Networked geographic information systems implementation

Geographic information systems (GIS) technology has become a crucial 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. Multiple milestones were achieved in 2006 and 2007 as Network Infrastructure and Services 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 34 tobacco-growing counties in Southside and Southwest Virginia. This was part of a Virginia Tech outreach project to assist those regions in developing telecommunications infrastructure to support economic development. Later, NI&S, eCorridors, and the Blacksburg Electronic Village (BEV) applied GIS tools for other outreach efforts. Notable examples have included work funded through the National Telecommunications and Information Administration (NTIA) Technology Opportunities Program to develop technology plans for seven rural counties and assistance to the New River Planning District Commission for development of a regional Fiber to the Premises (FTTP) project.

Since NI&S began using GIS, a constant objective has been to share common maps, drawings, and datasets with others via a networked server. Typical data include the university campus base-map, street maps, site/building locations, populations, telecommunication cable routes, utility routes, orthophotography, various boundaries, parcels, service areas, and other geographic/demographic information.

During the summer of 2006, eCorridors and NI&S began 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. Stakeholders invited included individuals from the Library, Capital Design and Construction, CGIT (Center for Geospatial Technologies), Environmental Health and Safety Services, SID (Site and Infrastructure Development), and Utility Survey Group. Experiences with the integration of GIS, CAD (Computer Aided Design), and university enterprise databases were discussed, and we began promoting the sharing of common master data. Meetings with GIS staff at the Town of Blacksburg were also held.

In late 2006, a major milestone was reached. NI&S Systems Development and Administration Group acquired two new server machines to support ESRI ArcSDE and ArcIMS Web GIS applications. One server named "latitude" became operational in March 2007 running ArcSDE version 9.2 software. The other server named “longitude” is running ArcGIS 9.2 Server that supports Web GIS services. These machines, along with NI&S Oracle databases, form the foundation for a networked, enterprise GIS system, including Web services.

In April 2007, eCorridors and NI&S met with the Director of Virginia Tech Real Estate Management to discuss how enterprise GIS could be used to support their parcel mapping application. Later, eCorridors was able to recover previous Real Estate GIS parcel data that was in Autodesk Map format from an inactive server and import it into ArcGIS for future ESRI Web GIS access.

In June 2007, eCorridors and NI&S were asked to demonstrate to the University Space Management Committee how GIS could be used for space facilities management. The demonstration is to occur sometime after July 2007.

Internet copyright infringement complaints

The Digital Millennium Copyright Act (DMCA, 1998), addresses the protection of copyrights for content that can be stored, played, copied, or transmitted in a digital format. Although Virginia Tech does not monitor the *content* of network traffic, in order to comply with the DMCA, the university is required to curtail quickly any reported illegal sharing of copyrighted files over its network. Communications Network Services (CNS) is responsible for resolving each complaint by identifying the network connection involved, determining the user's identity, and ensuring the copyright infringement is quickly terminated. CNS is also required to make sure relevant communications to the user and other appropriate university groups are completed.

Agencies making such complaints to Virginia Tech include, but are not limited to, the following:

- The Recording Industry Association of America (RIAA)
- The Motion Picture Association of America (MPAA)
- Sony
- NBC Universal Studios
- MediaForce
- Interactive Digital Software Alliance
- Business Software Alliance
- Microsoft
- BayTSP
- Entertainment Software Association
- Electronic Arts
- NetPD

During fiscal year 2006-2007, Virginia Tech, as well as many other colleges and universities, experienced a significant increase in DMCA violation reports. The RIAA developed a new strategy for addressing copyright violations. Universities, including Virginia Tech, began to receive RIAA "settlement letters" including Internet Protocol addresses of alleged offenders.

RIAA requested that the letters be forwarded to users whom they allege have infringed on RIAA member recording companies' copyrights.

In response, the Vice President of Student Affairs sent a letter to all Virginia Tech students advising them as follows: "…..if you receive one of these 'settlement letters,' it is your responsibility to decide how to respond to the RIAA. You may wish to consult with your legal counsel before making a decision, or you may wish to first consult with Student Legal Services to ensure you understand your rights and responsibilities in this matter. Virginia Tech is not a party to this action." Students were also asked to reconsider any network activity involving copyright infringement. A copy of the memorandum about the RIAA's new strategy, from Virginia Tech's Vice President for Student Affairs, Dr. Zenobia L. Hikes, is available at *www.vtnews.vt.edu/statements/DMCA-Memorandum.pdf*

In an effort to increase efficiency and reduce the costs of business processes—an objective of the Information Technology Strategic Plan--CNS began a project to automate the procedures used for processing complaints so they could be handled in a more expeditious and efficient manner. The project, named "Ghiza," involves a web application to facilitate the handling of infringement complaints, including an initial, unified, automated lookup tool for all case types. In future iterations, the project will create an e-mail system to eliminate dependency on one person's e-mail account and create a case information database. These enhancements will support a component of the NI&S Strategic Plan that involves evaluating and leveraging business systems technology to increase efficiency and effectiveness.

Additional information on the topic of Internet copyright infringement and Virginia Tech's role is available at *www.cns.vt.edu/docs/copyright.pdf*.

H.323 conversion

At the beginning of the fall 2006 semester, after identifying needed improvements in instructional delivery methods, Video/Broadcast Services completed the transition of the Commonwealth Graduate Engineering Program (CGEP) courseware from ATM (Asynchronous Transfer Mode) to state-of-the-art Internet Protocol H.323 which offers dual-video stream capability. The change to H.323 was necessary because of the age and limited capabilities of the older ATM system, and it supports the university's plan to provide more robust and integrated information technology strategies.

The upgrade was seen as an opportunity to provide improvements to benefit instruction and learning. It included new video encoding equipment (codecs), upgraded media players for both tape and DVD presentations, and the installation of high-resolution computer displays in all rooms. Internet delivery now makes Virginia Tech courseware available worldwide at high

speed. The result is that the university's position in the increasingly competitive market surrounding distance learning has been enhanced.

The instructional advantages of H.323 are impressive. They include the following:

- Enhanced display of computer graphics and data
  Having twin video channels available means instructors and students have the benefit of high-quality graphics including diagrams, photographs, and equations. Everything is clearer and easier to read.
- Students can now make presentations from remote sites.
- Instructors can see several remote classrooms at once.
- On-screen display is enhanced. Previously the choice was either to see the instructor or the graphic material. Now, instructors can share the screen with graphics making a more personal and nuanced connection with students.
- VBS installed remote, monitoring capability through Crestron controllers in each on-campus and remotely located conference/classroom allowing a technician in the Virginia Tech Network Operations Center (VNOC) to monitor distant sites and troubleshoot problems remotely.
- A streaming archive of class material allows students to review a class at any time.

Streaming also allows the use of rich-media content in classes as well as for other Virginia Tech special events via the use of Accordent™ software. The software streams a Real Media file, and a QuickTime alternative has also been developed by VBS systems analyst, Joe Schottman. To facilitate the move to IP, VBS upgraded its streaming media server capacity from seven terabytes to 16 terabytes. In the coming year, it is anticipated VBS will develop automatic, real-time archiving of class files in support of a university strategic initiative to provide the necessary infrastructure, expertise, and digital repositories to allow course management integration.

The H.323 conversion has helped solidify the university's educational partnerships and joint degree programs both in the United States and abroad and helps to enhance graduate and professional degree value. These partnerships also allow Virginia Tech to support a more diverse student body and expand educational offerings. Some examples follow.

- *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 in providing graduate degree offerings for both on-campus students and working engineers.
- *Virginia Tech Middle East-North Africa (VT MENA) Program.* Sponsored by UNESCO, the program helps Middle Eastern students pursue graduate studies in Electrical (Communications) Engineering and in Computer Engineering and Computer Science through the Arab Academy of Science & Technology in Cairo, Egypt. The program was founded in 2005 and graduated its first two students in May 2007.
- *The School of Biomedical Engineering Sciences (BMES)* is a joint program between Virginia Tech and Wake Forest University in Winston Salem, N.C. The program

integrates Virginia Tech engineering and veterinary medicine classes and research programs with programs at the Wake Forest medical school.
- *The National Institute of Aerospace (NIA)* offers classes from a number of universities including Virginia Tech. This program supports a graduate-level distance-learning program for students seeking degrees in aerospace engineering, mechanical engineering, ocean engineering, engineering physics and mechanics, and materials science and engineering.

Storage and backup infrastructure

Network attached storage (NAS), storage attached network (SAN), and networked backup system technology have been in use at Virginia Tech since the late 1990's. In support of a university strategic initiative to promote robust and integrated information technology, major upgrades and improvements in all three areas were completed during the 2006-07 fiscal year.

Providing centrally managed, high-performance storage and backup facilities is the major goal of this effort. Increasing overall information technology security by allowing departments to ensure proper backup of their client and server computers and offering secure storage are important, secondary goals.

Additional NAS storage, for both personal and departmental file shares, was added. A new SAN from EMC Corporation was purchased to replace the IBM SAN that was installed in 2000. The complete migration of data and users is expected to be completed in August 2007. A new, larger SUN tape library was purchased to replace the Sun and IBM tape libraries serving the backup and archive processes. Complete migration of data and users will be finished when the data collection and preservation efforts associated with the events of April 16th are concluded.

Continued adoption of networked storage and backup technology is anticipated. The increased NAS space will aid in both instructional and administrative areas, particularly as mobile computing becomes more pervasive. The EMC SAN uses state-of-the-art monitoring and administration interfaces to ensure high availability and reliability. The new tape library not only expands the university's backup and archive capabilities, but it also provides for larger volumes of data to be stored on tape media enabling the university to archive larger amounts of information without expanding the physical storage space.

WebMail infrastructure and software improvements

In order to provide robust and integrated systems, the university must continue to invest in the campus information technology infrastructure. After a thorough evaluation, NI&S determined an upgrade to the university's WebMail infrastructure and software was needed. Although a web interface for e-mail was available as part of the Sun iPlanet Messenger Suite (now Java Enterprise Messenger Suite) software bundle, the user interface was not adequate nor appropriate for general campus use. A vendor-supplied product, WebMail by Captaris, had been used initially, and it worked well for almost seven years. However, the vendor was purchased by another company, and the WebMail product was discontinued. In 2005, an open source product (Internet Messaging Program or IMP by Horde) was evaluated and chosen for implementation at Virginia Tech. The new infrastructure was put into production for all university users in the fall of 2006 using new Dell "blade" (PowerEdge 1855 model) hardware.

Providing a secure, yet robust, web interface to university-provided e-mail was the major project goal. Statistics show as much as 80% of our non-Exchange e-mail user population accesses the WebMail server at least once per week so it was critical to implement an architecture that could be expanded as use increases. The upgrade provided an open source application framework and new hardware. It increased the performance, redundancy, and expandability of the system, while implementing features such as folder allocation (under the Internet Message Access Protocol or IMAP) and spam filtering. The new WebMail system will continue to allow additional features to be implemented regardless of what "back-end" e-mail system is deployed.

Five-year plan for storage infrastructure and server replacement

In an effort to forecast equipment needs more effectively and to improve the accuracy of budget estimates, Systems Support staff has worked with various information technology units to review the status of our existing servers and to discuss anticipated projects. This planning effort began in earnest in the 2004-05 fiscal year and is continuing.

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. Benefits from this process include decreased maintenance fees as well as improved performance of most applications. This work supports one of the core initiatives of the

Foundation Strategies in the university's Strategic Plan—"Investment in the Campus Infrastructure"—as it helps us to promote robust and integrated information technology strategies.

Providing a structured review of all equipment and storage requests serving the administrative, instructional, and research computing needs of the university is the major goal of this effort. Ensuring a high return on investment (ROI) for existing equipment--often by moving older equipment being replaced into the test or development tier of the server environment--is another very important goal.

During the 2006-07 fiscal year, server replacement was completed in all major support areas including Learning Technologies, Collaborative Technologies, and Database Management Systems. Servers that interface with the storage and backup system (see Storage and Backup Infrastructure section) were also replaced and upgraded providing additional overall improvement in that environment.

Web Support Services

Web Support Services (WSS), a unit of the Blacksburg Electronic Village (BEV), seeks to fulfill the demonstrated need for sustainable, affordable, and high-quality web development and support services. The business objectives of this project were

- to create a team of primarily student workers to follow systematic procedures and standards to create, document, and perpetually maintain websites;
- to recover the costs of the service while reducing current website costs for customers;
- to operate in collaboration, not competition, with private sector providers.

The team uses secure, standards-compliant web design and development practices consistent with Virginia Tech's Web guidelines for university customers and provides similar services to nonprofit community groups.

During the 2006-07 pilot year, BEV assigned one staff position as the WSS manager to recruit and develop the first student team. In support of Information Technology strategic initiatives, WSS provides students with valuable job experience before they graduate.

The initial development project was the website for the Vice President of Information Technology and several subunits. The success of these efforts led to additional work on other Information Technology websites through which the team solidified business processes, operating procedures, and project methodologies.

Concurrently, BEV established relationships with

- The Department of Art and Art History's Visual Design Studio (VDS4)
  WSS refers customers with high-end graphics needs to VDS4. VDS4 reciprocates by referring its customers needing more sophisticated programming to WSS.
- University Relations
  For university customers, WSS is knowledgeable about new Virginia Tech website templates and branding standards.
- New City Media, the local contractor who produced the new university templates
  The company refers departmental and local nonprofit projects that it cannot undertake but which may be suitable for WSS.
- The university's Web Hosting Service
  WSS assures a smooth implementation for its university customers and eliminates the need for them to operate servers within their departments.

At the end of its first full year of operation, WSS has implemented a model that meets its objectives and offers its customers complete life-cycle support for branded, accessible, secure websites including design, development, implementation, and ongoing maintenance on the hosting service.

From word-of-mouth referrals alone, WSS has nine projects active during the 2007 summer sessions and another eight customers have requested estimates.

For the 2007-08 year, WSS's goals are

- to fully recover costs;
- to scale up, obtaining better turnaround on projects;
- to incorporate the university's new content management system as a tool for university customers;
- to use open source tools to create and offer to external, not-for-profit customers the same life-cycle website support university customers are beginning to enjoy.

Educational broadband service

Educational broadband service (EBS), which until 2005 was known as instructional fixed television service (ITFS), is a wireless service used by institutions of higher education and education-related, non-profit organizations. Utilizing microwave frequencies, it can be used to provide educational programs and instruction in fixed, portable, or mobile environments. Virginia Tech is a license holder and, in the past, has leased its excess capacity to a firm providing digital wireless television services and educational programming.

The Federal Communications Commission has adopted new rules and developed a plan to promote more efficient use of the spectrum and accelerate the growth of communication technologies. Commercial vendors of broadband radio service (BRS), formerly multipoint distribution service (MDS)/multichannel multipoint distribution service (MMDS), provide consumer services and share the spectrum with EBS. Under the new plan, EBS will continue to provide educational programming and, perhaps, other services related to teaching and learning.

The transition from current channel locations to the new spectrum blocks is currently underway. Under the new rules, the transition for any given area (a basic trading area, or BTA) will be planned, initiated, and coordinated by a "proponent" who will also be responsible, at its cost, to relocate EBS video operations to the middle band segment (MBS) and to replace all downconverters at EBS receive sites. Network Infrastructure and Services has worked with the proponent for our area in the initiation phase and transition-planning phase. This work supports one of the university's strategic planning initiatives to further develop existing partnerships and create opportunities for new partnerships with business, industry, and corporations.

NI&S will be discussing instructional services and new uses of the wireless spectrum with commercial providers as the transition continues. In addition to the transmission of video, the new spectrum band plan may make possible the following:

- Two-way wireless broadband services
- Ongoing lease of excess capacity
- Some mixture of community wireless projects
- Broadband services
- Revenue opportunities

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, Virginia. It is a non-profit, private corporation initially funded through several foundations 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's Board of Visitors during the time VCOM was founded and was 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/*).

VCOM operates under a collaborative agreement with Virginia Tech. This cooperative effort creates an environment that promotes excellence in education and research. In October 2001,

Virginia Tech and VCOM signed an initial collaboration agreement. Both Virginia Tech and VCOM recognized the contributions each would make to the other's mission and goals, and they both agreed to provide certain services and resources to the other. Information Technology has worked closely with VCOM over the last seven years to provide services necessary to support their ever-changing environment. Services currently provided by Information Technology to VCOM include support and backup of some servers, web hosting, course management services, and network connectivity.

The collaborative relationship between VCOM and Information Technology supports the following goals and objectives of the university:

- Achieve transformative graduate education
- Expand and support the holistic and transformative educational experiences of students
- Further develop existing partnerships and create opportunities for new partnerships with business, industry, and corporations
- Leverage collaboration with other higher education institutions
- Effectively manage the infrastructure and services in order to provide maximum stability, availability, and reliability of services for the university community
- Continually review the effectiveness of services in meeting user needs with a focus on quality of service

Cellular telephone service

Communications Network Services (CNS) provides cellular telephone services for the faculty and the staff under a statewide cellular contract. The contract includes both cellular service and equipment, and it is administered through the auxiliary. A consortium of providers led by Alltel provides the service and equipment. In Blacksburg, U.S. Cellular provides the calling plans.

As part of a continued pursuit of integrated information technology strategies, CNS also operates a system supporting multiple e-mail-capable cellular phones, wireless handhelds, and device operating systems providing secure, real-time, reliable, wireless information access on a variety of palmOne™ and Microsoft® Windows Mobile™ handhelds. The service and equipment is supplied by several wireless providers under cooperative procurement agreements. The program uses a CNS-provided enterprise server to support continuous, wireless synchronization in order to access and update e-mail, address lists, and other information from the Exchange server.

CNS does not currently provide cellular telephone service for students.

An important objective of the Network Infrastructure and Services strategic plan is to manage the campus infrastructure and services effectively in order to provide maximum stability,

availability, and reliability of services for the university community. NI&S also seeks to review the effectiveness of services continually in meeting user needs with a focus on quality of service. Therefore, in the long term, NI&S will develop solutions to enhance cellular coverage on the university campus. These solutions will be targeted toward expanded coverage areas and improved in-building coverage. They may include distributed, wireless systems to enhance the carrier macrocell networks that currently serve the campus.

Virtual private network

Virtual private networking (VPN) is a method of tunneling data communications through another network. Common VPN applications include the provision of secure communications between remote users and central computing facilities as well as allowing remote users to appear as though they are on the same local area network (LAN) as if they were *in* their office. Virginia Tech has been providing VPN services to fill these needs for several years.

VPN services use authentication algorithms to provide access control to the VPN server. One of the methods used at Virginia Tech is the challenge-handshake authentication protocol (CHAP) and its derivatives. Microsoft developed MS-CHAP, which is commonly used to authenticate VPN sessions from computers using the Windows operating system. There are two versions of the protocol--MS-CHAPv1 (often referred to MS-CHAP) and MS-CHAPv2. MS-CHAPv2 addresses several security issues associated with the older MS-CHAPv1.

Network Infrastructure and Services has supported MS-CHAPv1 and CHAP as authentication protocols for VPN access in the past. With Microsoft's introduction of the new Vista operating system, support for MS-CHAPv1 has been entirely discontinued. Vista uses MS-CHAPv2 as the default authentication protocol for VPN access. Vista still allows the use of standard CHAP as an authentication protocol, but manual configuration by the user is required for its use.

To mitigate the need for users to make configuration changes and to eliminate the additional support requests to assist in those configuration changes, NI&S has added support to the campus VPN service for MS-CHAPv2. Network engineers made changes to the routers providing the VPN service without impacting service to the users. Our internally developed Remote Authentication Dial-In User Service (RADIUS) system already supported MS-CHAPv2 but required minor reprogramming to improve accounting. Expansion and enhancement of Virginia Tech's VPN services gave users of the Vista operating system access to university services with the need for minimal configuration changes. The new service has been very reliable.

Certification for water treatment plant operators

In Virginia, a waterworks operator is any person with responsibility for a public water supply system. To get a Virginia waterworks operator license, an individual must demonstrate a specified amount of actual experience working at a public water supply system. Experience may include time spent learning how to operate the waterworks or wastewater works physically and theoretically, and the ability to pass a multiple-choice, open-book examination. Actual experience requires at least 1,760 hours or 220 days each year, essentially a full-time job. These licenses expire and must be renewed at the end of February every other year, so individuals must often maintain proficiency through certification classes.

The federal Safe Drinking Water Act, as amended in 1996, established the Drinking Water State Revolving Fund to make funds available to drinking water systems in order to finance infrastructure improvements. The program also provides funds to small and disadvantaged communities and to programs encouraging pollution-prevention as a tool for ensuring safe drinking water. For several years, Associate Director Jack Lilly, Continuing and Professional Education, has secured a series of State Revolving Funds Capitalization Grants. The purpose of these grants is to provide a long-term source of financing to states for the construction of wastewater treatment facilities and the implementation of other water quality management activities. In support of one of the university's strategic initiatives to develop the workforce through training and continuing education, this funding has been used to establish Continuing and Professional Education for Water Utility Owners, Managers, and Operators workshops. The workshops bring in experts to discuss current issues and new developments in the water treatment industry.

Each broadcast provides three contact hours, or 0.3 continuing education units (CEUs) to participants. The total number of contact hours required during each license renewal cycle is determined by the class of the waterworks license sought. The workshops are offered to owners, managers, and operators of all water utilities in Virginia—from the smallest to the largest. They are broadcast simultaneously to 14 locations throughout the commonwealth. These sites include all of the Virginia Tech/VBS off-campus facilities—Northern Virginia, Richmond, Roanoke ,and Hampton Roads—as well as the community college system and a handful of other universities.

Since July 2004, VBS has supported 20 workshops. Because of the wide basis for participation, these classes have drawn an attendance of over 1500. This fiscal year, VBS supported five "Water Quality" broadcasts with approximately 420 participants statewide. A new grant has been secured, and a series of program dates confirmed for the 07-08 fiscal year.

A separate grant from the Environmental Protection Agency, also secured by Mr. Lilly, has funded the Class VI Operators Training Program. This grant was designed to help fund the necessary training for the smallest class of water treatment facilities—those servicing fewer than 3300 people including churches, trailer parks, and daycare centers. Because these facilities are so small, the operation of the water utilities supporting them is not usually a full-time job. The grant funded the creation of the Class VI Operators Training Manual (to standardize operational practices), the ongoing broadcasts, and the short courses to assist operators in attaining their licenses. To prepare operators for the Class VI examination, the broadcasts and short courses (two days of on-site, intensive classes) cover the chapter topics of the manual, providing extensive information about the operation, maintenance, and administration of Class VI waterworks.

The Class VI Operators Training Program began in July 2004 and concluded in June 2007. Since its inception, VBS has supported more than 25 workshops with over 650 participants statewide. In the last fiscal year, VBS provided eight Class VI broadcasts drawing an attendance of approximately 200.

The use of interactive videoconferencing (IVC) technology affords these professionals convenient access to real-time, high-quality instruction and minimizes the disruptions to their work schedules. VBS assists in the planning and coordinating of the IVC delivery, training sessions with individual instructors for each conference, and research about potential sites. The VNOC provides in-depth testing before and extensive monitoring during each conference. Additional VBS-provided services include videotapes and DVDs of the individual lectures, which are made available to students in the event of a missed class.

Video/Broadcast Services—production

The Video/Broadcast Services (VBS) Production Unit produces highly acclaimed, instructional video and multimedia for Virginia Tech. These services allow the university to strengthen the role of distance and distributed learning throughout many curriculums. VBS provides remote-location video production and maintains a television studio for both live and recorded programming. For live distribution, VBS provides both satellite and Internet (Web) broadcasting. For recorded programming, VBS can master to videotape and DVD. The studio and its equipment allow live connections via satellite to media outlets around the world--a function that proved valuable in the days following the events of April 16, 2007.

VBS Production offers a variety of video and multimedia services that vary in complexity. A simple project, such as the single-camera recording of a lecture, can be done in a studio or in a classroom. These recordings can be encoded for delivery as a DVD or for online delivery via the Web. In some cases, the playback can include online presentation graphics allowing the viewer to see both the presenter and their graphic material at the same time.

For a more complex production, such as a live webcast of a town hall meeting, VBS Production provides live audio and video to an internet address so interested people in other locations can view the program. Typically this type of production requires several staff members—video and audio operators, a computer technician, and a coordinating producer. These productions also require sufficient lead-time to organize the various components. To shorten the necessary lead time, VBS has put together a portable, production control room which, coupled with the more stable Internet connections provided by the H.323 videoconferencing standard, often allows the program to be "on the air" in just a few hours. An example of this type of production would be the College of Engineering departmental meeting held after the events of April 16th that connected the faculty on the Blacksburg campus with the faculty in Northern Virginia.

The skills required for a highly complex, multimedia production include concept development for a class, scriptwriting, set construction, broadcast-quality videography, editing, graphics construction, multiple-camera studio production, and film-style production either on location or in the studio. VBS Production also offers full post-production services including mastering for DVD or online delivery. Programs that require the full range of services are time- and labor-intensive and usually take several weeks to complete.

An example of this kind of program would be the award-winning, "Engineering Cultures" project that began in 2002 as little more than an idea. Supported by international and cross-cultural content, the thrust of the course is to demonstrate how the arts and sciences of engineering instruction and practice have affected the evolution of societies around the world. The program has gone through annual enhancements as technology improved – from CD to DVD delivery with online components, to its current status of more than a full semester's worth of material each supported by graphics, photographs, and streaming audio and video. More importantly, beginning this year, "Engineering Cultures" resides entirely on VBS video servers providing three major benefits:

- An online presence allows the program's authors to augment the material as new information becomes available
- A broader selection of topics from which instructors can design a syllabus
- The class and related materials are now available to both on- and off-campus students

Virginia Tech Operations Center enhancements

The Virginia Tech Operations Center (VTOC) provides support for centralized Information Technology services for the Blacksburg campus community as well as other Virginia Tech locations around the commonwealth. The VTOC merges traditional call center and computing help desk functions with network operations, video operations, and systems support in an integrated operations center.

The VTOC provides a single point of contact for support 24 hours a day, seven days a week for the following areas:

- Telecommunications
- Information Technology services
- Cable television
- Uplink operations
- Video/Broadcast Services
- Proactive monitoring of faults and service degradation for Information Technology services, network hardware, and network connectivity components
- Support and consultation on computer desktops/laptops
- NetworkVirginia problem-reporting
- Tape backup/inventory monitoring/data

The VTOC Call Center staff is tasked with taking initial calls to the 4Help phone number at any time. During non-business hours, they also provide the initial response for inquiries submitted over the Web from faculty and staff members, students, alumni, retirees, or prospective students. Problem tickets are opened to track the diagnosis, escalation (if required), and resolution of each reported problem. A call center "hotline" provides immediate access to the VTOC for NI&S technical support staff and management.

VTOC management and staff strive 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 VTOC's ability to respond to user needs in a timely and effective manner and to ensure the university community is able to access the university network and resolve any difficulties. Some of the recent changes and enhancements implemented in the VTOC to support these goals and objectives are listed below:

- Business continuity planning with Information Technology staff and consultants including VTOC backup location planning

- Incoming call distribution methods and problem-report flow methods redesigned to improve efficiency in handling user inquiries
- PCs used by the staff reconfigured to provide improved troubleshooting tools for multiple operating systems
- Support calls for classroom video playback now received in the VTOC Diagnosticians are able to initiate and terminate teleport uplinks and downlinks and are available to provide support whenever needed.
- Staff access to all VTOC-supported applications, including new software acquisitions, provided
- Staff members encouraged to take advantage of free online and classroom training available at Virginia Tech to develop job-related skills
- Information Technology staff presentations (SETI, PKI, Middleware, etc) help VTOC staff keep abreast of broader Virginia Tech information technology landscape and support requirements
- Increased use of the wiki including changing logs of issue escalation from paper to an online wiki form and converting the in-house Dashboard to the wiki
- Involved in testing and pilot phases for an Information Technology wiki
- Serves as communications hub for campus computer professionals through e-mail, website, and in-person visits
- Guides, flowcharts, and training materials available online to be used as staff tutorials
- Completed significant formal and on-the-job training in areas of customer support and infrastructure monitoring, configuration, and management
- Security checks performed three times daily for all RB14 Sonitrol doors and operational windows using CAD drawings with a legend in order to keep a detailed record of any issues, when they occurred, frequency, etc.
- Improved Data Center outage communication plan as well as central Information Technology maintenance scheduling and notification—as required, VTOC management can now adjust online message notification on the wiki and messages can be received as an RSS feed for those wishing to participate
- Implemented "virtual office" concept including online, instant messaging “chat room” to post questions quickly to a larger group of technical experts allowing VTOC and 4Help staff to quickly communicate problems, post questions, and collaborate on solutions
- Online contact lists and procedures developed and improved allowing immediate access to other Information Technology groups including Middleware, Microsoft Implementation Group, Content and Knowledge Management, and Online Course Support
- Support new tape backup system services including loading/unloading of tapes, off-site rotation, location documentation, tape inventory monitoring, and data restores. Assisted with new tape/backup requirements related to the April 16th events.
- Update and maintain Big Brother information—a monitoring application utilized by central Information Technology to ensure critical services are continuously tracked for optimal operation and availability
- Began transition of day-to-day tasks and necessary escalation procedures related to monitoring applications, such as Smarts and eHealth, to VTOC staff

- Additional, large display units, used to project the software, purchased to increase the VTOC's ability to monitor the status of critical systems, services, and infrastructure
- VTOC equipment and workstation layouts redesigned to provide better access to the enhanced infrastructure monitoring system
- Assumed ATLAS resource assignment function

University Computing Support walk-in service

"In a mobile computing environment computers and users are no longer defined by the buildings computers used to reside in. This is going to force academic institutions to take a real enterprise vision of computing and computer support. As computers roam across campus roaming to various wired and wireless networks with users expecting to be able to access resources everywhere easily and intuitively, IT support structures need to redefine themselves across the entire campus and uniform security practices need to be implemented campus wide. In my opinion the handwriting is on the wall! The sooner the campus realizes the need to restructure support services to an enterprise model, the more prepared we will be to offer our students a computing environment that is robust and prepared to meet the needs of mobile users."
Steve Sloan, Information Technology Consultant, San José State University

At Virginia Tech, University Computing Support/4Help is tasked with providing computer support and technical assistance to members of the university community. In the past, because computer systems were large and not easily moved, students called 4Help for assistance with technical problems by telephone or they were referred to their computer vendor.

Each year, the university establishes baseline computer specifications for the entering class. Several of the university's academic programs have had computer requirements for almost twenty years. In 1998, Virginia Tech instituted a university-wide computer requirement for incoming freshmen. Beginning with the 2006-07 academic year, all incoming students were required to bring a laptop or tablet PC. Today, the university's computer requirement website, *www.compreq.vt.edu* states:

> Virginia Tech is committed to the education of the whole person. We recognize computers to be an extension of the learning tools needed to compete professionally and to co-exist socially. The training and computer interaction students receive at Virginia Tech will provide them with the skills necessary to achieve a high degree of success after leaving the University.

In 1999, in order to provide on-site support and computer education to on-campus student residents, the Resident Computer Consultant (RCC) Program was established. Each RCC lived in one of the residence halls. Jointly sponsored by Information Technology and Student Programs,

the RCCs were upper class students—usually majoring in technical or engineering fields—with in-depth knowledge of computer hardware, as well as experience with PC operating systems, the Virginia Tech Ethernet network, and anti-virus software.

Each year between 2001 and 2005, approximately 18 to 20 students were employed by the RCC program. Much of the work involved computer cleanup and security education as a result of a large number of computer viruses. However, after a series of proactive security measures—including the distribution of the VTnet CD—the need for RCC services began to decline. From 2003 to 2005, service calls for RCCs were reduced by fifty-four (54) percent.

In response to the continued decline in demand for RCC services and Virginia Tech's laptop requirement for incoming freshman, a pilot walk-in service model was developed by 4Help with the goal of replacing the RCC program. In preparation for the walk-in support model, the number of RCCs was reduced to just fourteen for the fall of 2006.

During the the scheduled hours of 9:00 a.m. to 4:00 p.m., Monday through Friday, the walk-in model not only provides one-on-one computer assistance for the on-campus population, but offers the same service to off-campus students, faculty and staff members, and retirees. Support is provided for wired and wireless connectivity, the university's modem pool, DMCA complaints/uploading violations, recovery from viruses, complete computer restore, and data backup and recovery. Dispatch services to residence halls and accommodations for disabled constituents as necessary are also offered. The benefits of the walk-in model include

- a mechanism to better educate users about critical security issues;
- an expansion of services to off-campus students, faculty and staff members, and retirees;
- cost savings over the RCC program;
- consolidation of student support personnel.

Computers are now heavily integrated into the university's learning environment. Including a walk-in model as one of our support services has enabled us to assist our growing number of mobile users and serve all populations more efficiently. Walk-in service provides an escalation path for issues that have proved to be better diagnosed in person rather than over the phone. As technology has evolved, the campus community no longer uses a computer only as a computational tool. Computer technology is now embedded into many of our daily tasks and, consequently, it has been critical to change our support methods as well.

Information Technology's Strategic Plan challenges us to "Provide and enhance user support to ensure university community is able to access the university network and resolve difficulties." By creating a service that serves both residential and off-campus students at the undergraduate and graduate levels, as well as faculty and staff members and retirees, University Computing Support (UCS) is helping to meet this objective. UCS is committed to designing programs that contribute to an improved educational experience for all Virginia Tech students. The new model also supports the university's strategic objectives by creating an environment that is welcoming, accessible, and able to address the needs of all our constituents.

Public key infrastructure

In late 2006, the Virginia Tech Policy Management Authority for its public key infrastructure approved policy and operating procedures for the issuance and management of personal, digital certificates. These electronic certificates are installed on eTokens and can be used for authenticating oneself to web applications as well as sending or receiving secure e-mail. Leveraging business systems technology to increase efficiency and effectiveness, the PKI initiative is an important step toward the achievement of the Information Technology strategic goal of implementing systems to secure critical data.

Certificates were issued to all employees in Information Technology and to some individuals in selected administrative departments. The first widespread use of these certificates has been to sign university leave reports digitally. Ultimately, certificates will be issued to all Virginia Tech students and faculty and staff members, and additional applications for use will be identified. See *www.pki.vt.edu* for more information.

Student Telecommunications (StuTel) is the group responsible for issuing personal, digital certificates. Guidance from the Department of Internal Audit indicates the issuance process should involve two individuals—one person to authenticate the applicant (that is, to determine the person is who he or she claims to be), and a second person to issue the certificate. After certificates were issued to employees in Information Technology, the project management team asked Internal Audit to review the Virginia Tech Certification Authority. The authority is the service at Virginia Tech that is responsible for issuing and managing digital certificates and public keys for Virginia Tech. The purpose of the review was to determine if appropriate controls are in place to continue to issue personal digital certificates to the rest of the university community, and if applications, other than university leave reports, can be considered.

Processes and procedures used by StuTel to issue certificates were reviewed. Internal Audit was satisfied that sufficient controls were in place to issue personal, digital certificates accurately. Once Internal Audit has completed their audit of other areas involved in the process, StuTel employees will continue to issue certificates as the program expands.

Fixed assets review

The Virginia Tech Controller's Office completed a successful Fixed Assets Equipment Verification at Communications Network Services (CNS) in the fall of 2006. While CNS has worked with the Controller's Office to conduct reviews in the past, this review, as well as one completed in 2005, were performed under more rigorous guidelines implemented by the Controller's Office.

Such a review is significant because over 1,800 assets, assigned to CNS, were located and verified by the Controller's Office. In addition to the large quantity of items, additional complexity is involved because these assets are physically distributed across many facilities at various university campuses, primarily in Blacksburg and Northern Virginia. While CNS has substantial controls in place to track these assets, the time required to see each asset—as proof of its existence and verification of its location—during such a review is considerable.

For this verification, CNS worked with the Controller's Office to develop alternate methods to verify the existence and location of the assets. This undertaking demonstrated effective management of the university's resources through the development of innovative administrative processes. Such enhancements support efficiency and reduce the costs of business processes—a key objective of both the Information Technology and Network Infrastructure and Services strategic plans.

Instead of traveling to multiple locations to look physically at the asset and its associated inventory tag number, we were able to remain in one location and, by use of a computer, verify the existence, identification, and location of many assets attached to the network. Not only was this process more efficient, but the amount of required time to complete the review was substantially decreased.

Innovative technology in Field Engineering

For the past year, Network Infrastructure and Services field technicians have been using PDAs to update work orders on a real-time basis when telecommunications services are activated or other work is completed. This technology provides an accurate time-stamp on work orders enabling

more accurate reporting of work order statistics and increases the efficiency and effectiveness of the technicians in the field.

Development groups within the department are performing ongoing investigations into further enhancements in automated workflow processes by taking advantage of other applications that can be performed across the wireless network. One goal of these efforts is to improve customer service by decreasing the time required to deploy telecommunications services. Applications currently being investigated include the following:

- Infrastructure resource assignments
- Hub and router configuration
- Dispatching work and repair (trouble ticket) orders
- Expanded access to work and repair order information
- Automating the generation of materials “pick lists” to increase efficiencies in our warehousing and logistics materials staging and reordering

As part of the continuing efforts at NI&S to implement “best practices” into business operations and systems, next-generation wireless devices—including tablet PCs and specialized laptops—are also being investigated for use by field technicians. All of these efforts to integrate innovative technology into NI&S daily practices help to support the goals and initiatives identified in the university, Information Technology, and NI&S strategic plans:

- Enhance health, safety, and security operations
- Promote robust and integrated information technology strategies
- Promote and reward innovative administrative processes
- Enhance customer-service orientation in all business services operations
- Implement enhancements to the enterprise infrastructure to support efficiency and reduce costs of business processes
- Effectively manage the infrastructure and services in order to provide maximum stability, availability, and reliability of services for the university community
- Advance “Best Practices" concept in our business processes and systems
- Routinely evaluate and leverage business systems technology to increase efficiency and effectiveness
- Engage employees in the planning of services to be provisioned, while ensuring they understand how these services support the vision and mission of the university
- Ensure all services are provided in a cost-effective manner
- Create a safe, supportive, and efficient work environment promoting creativity, productivity, and high-quality standards of work

Safety

As Network Infrastructure and Services has grown, it has become more efficient to handle the majority of important safety issues in-house. To enable this process, a full-time Safety Coordinator began work at NI&S in July 2005. Our partnerships with Facilities and Environmental, Health and Safety Services (EHSS) remain strong. However, environmental, safety, and health questions are now answered more rapidly and efficiently because managers and staff receive information regarding health issues and Occupational Safety & Health Administration (OSHA) compliance directly from the NI&S safety coordinator. Training is customized to specific NI&S workgroups, and environmental investigations are completed more rapidly. Overall, we believe we have created a safer, more supportive, and more efficient work environment for employees at NI&S and throughout the university through this initiative.

The coordinator is certified by the National Safety Council in first aid/CPR and by the Commonwealth of Virginia as a lead-based paint risk assessor and asbestos inspector. He is also certified by OSHA as an instructor of the ten-hour construction course and as a general industry outreach trainer. At the university, he is authorized as a confined space entrant/attendant/supervisor and a lockout/tagout authorized person. He provides environmental reviews for lead and asbestos in Virginia Tech buildings, safety compliance guidance at construction sites, and serves as the department's personal protective equipment coordinator.

Worker safety and training

OSHA training standards have been initiated and the tracking of employee training is being automated so managers can effectively plan employee time and activities in these important areas. Employee training requirements for work at construction sites have been re-evaluated to ensure employees receive adequate instruction as efficiently as possible. Field personnel attend the OSHA ten-hour construction course that covers a variety of safety topics and serves as a foundation of construction site safety knowledge. Additional training, where needed, is provided through EHSS and outside vendors.

NI&S has also partnered with EHSS to conduct comprehensive safety surveys for all NI&S workgroups so potential hazards can be eliminated before any workers are injured. These surveys were completed in June 2006, and we are currently working to correct the small number of hazards that were found.

Asbestos

Asbestos was used extensively in many building materials throughout the United States during almost all of the twentieth century. Virginia Tech's strategy is to manage asbestos in-place. Therefore, comprehensive employee training and worksite inspections are necessary to avoid disturbing asbestos and to maintain compliance with all state and federal regulations.

Asbestos training

Employees receive comprehensive training so they can identify and avoid materials containing asbestos. Approximately 30 NI&S employees have completed asbestos operations and maintenance training. Another five employees have been re-certified as asbestos inspectors.

Asbestos inspections

Asbestos inspections were previously completed by the university’s Facilities Department. Having moved this function in-house, the reviews are completed more quickly, and just-in-time information is provided when on-site decisions need to be made. An asbestos review is a requirement for all projects in buildings constructed before 1990. If asbestos is found, recommendations are made to avoid disturbing such material.

Confined Space Program

The Virginia Tech campus has many potentially hazardous, confined spaces that could expose employees working in those areas to unsafe conditions. Conditions can change rapidly so all field personnel are trained to recognize confined spaces and contact the safety coordinator for further information. Additionally, some NI&S personnel receive additional training to work in these areas. This training includes assessing hazards and monitoring air. This training has become increasingly critical since late 2006 when the campus steam tunnel upgrade project began. NI&S has worked extensively with EHSS to develop a flexible, state-of-the-art, confined space program to meet the requirements associated with such a complex project.

Continuity of operations planning

In the spring of 2006, Virginia Tech's Environmental Health and Safety Services (EHSS) charged Information Technology and other groups providing essential university services to begin developing a Continuity of Operations (COOP) plan. The initial focus of the plan concerned the possibility of a pandemic flu outbreak.

An Information Technology workgroup was assembled to discuss and evaluate existing departmental disaster recovery plans (DRPs) and emergency response plans (ERPs) and to consider the differences between a COOP plan and existing DRPs and ERPs and how to best prepare for a pandemic flu outbreak and its impact on the university community. The initial workgroup was NI&S-centric, but it was quickly expanded to include representatives from all areas of Information Technology.

Information Technology has extensive, detailed DRPs and ERPs in place for various areas, and it was unclear what should be incorporated into a COOP plan. EHSS and the other university departments tasked with this project were struggling to understand the differences between a COOP, DRP, and ERP. The Information Technology workgroup decided to concentrate on the ability to perform essential information technology functions and expand the university's capacity to conduct classes in a non-traditional manner in the event a pandemic flu disabled a significant number of employees. The group also considered the possibility the government would order *social distancing*, an order that persons would not be allowed to assemble, whether in classes or elsewhere.

Group discussions were lively and valuable for raising awareness about this possibility; thinking through the steps required to respond to a pandemic; and, at least partially, preparing for this particular scenario. However, given the lack of understanding about what should be included, the meetings did not result in the production of a written COOP plan.

Work with EHSS continued throughout this challenging process. EHSS informed us that Information Technology was well prepared compared to other groups on campus, even though the requirements of what constituted a COOP plan remained unclear.

In late 2006, EHSS asked us to shift our focus from pandemic flu planning to a more generic COOP plan. A consultant was hired to guide the various university groups involved in this effort. The Information Technology workgroup expanded its deliberations to include additional scenarios. Group members quickly realized that, while there were some commonalities, every scenario would require a unique response depending on the details of the crisis or disaster at hand. This ongoing discussion and planning process continued to raise the general level of awareness and preparedness.

Information Technology was invited to meet with the university's COOP consultant to review our DRPs and ERPs in March 2007. At that meeting, the consultant was asked to provide a COOP template to assist the workgroup in documenting its plans. The template was provided to the university later that month. The consultant recommended that COOP plans address the restoration of an organization's essential, internal functions in the event relocation was required as a result of an emergency situation. Once an organization had been relocated and its essential functions restored, the consultant explained that the group could then concentrate on its mission to provide services to the university. The templates are designed around such a scenario.

The Information Technology workgroup expanded its focus in an attempt to use the consultant-provided template. The team is developing plans to re-establish essential services to the university *and* restore critical internal functions. The templates are helpful, but imperfect. Information Technology is still struggling with how to best use them to document COOP plans.

The governor has directed all agencies to complete agency-level COOP plans by October 2007. Information Technology is supporting Virginia Tech in meeting this deadline. The deadline to complete all internal university COOP plans is April 2008. Information Technology will have completed COOP plans, using the templates provided by the consultant, for all Information Technology groups by November 2007 and will work with the university to review and improve our draft plans, if required, before the April deadline. Initial reaction from the university's interim director of Emergency Management, appointed in early summer 2007, is that our draft plans are on target. Feedback on the draft is expected from the COOP consultant in time to incorporate that information into our plans before the internally imposed November deadline.

Given our current understanding and documentation, there is overlap among and between continuity of operations, emergency response, and disaster recovery planning and plans. However, there is no doubt that Information Technology is better prepared to respond to any emergency as a result of these regular and ongoing internal discussions. The plans will be "living documents" as a result of the dynamic nature of information technology and campus systems and our evolving understanding of what documentation is appropriate for inclusion in each plan. The first COOP proposals will be imperfect. However, they can be updated on an ongoing basis as we continue to meet internally and with representatives from other areas of the university, to revisit and revise these important plans.

The university intends to hire a permanent Director of Emergency Management who will be responsible for coordinating the development of COOP programs for the entire university. Information Technology is represented on the search committee for this new position and will work closely with the new director over time to ensure our COOP plans are robust, coordinated with other university COOP plans, and are supportive of important university information technology needs.

Space Management Committee

There is a critical need for a comprehensive space management strategy at Virginia Tech. The preferred approach would involve more effective utilization of space and facility data related to university infrastructure, including tracking space and land usage, facilities inventory and condition assessment, and geographic information system (GIS) data. This approach would allow the university to manage space and land as the campus continues to grow. Computer-aided design (CAD), GIS, relational database, and Web access systems are generally components of a space management system.

James Hyatt, Executive Vice President and Chief Operating Officer, established a Space Management Committee on March 6, 2006, to research solutions. The panel is composed of individuals who can provide expertise in the programmatic, financial, and administrative evaluation of space management systems. John Nichols, Senior Information Technology Manager of Network Infrastructure and Services, is representing Information Technology on the committee.

The primary goal of the group is to identify, evaluate, and recommend an appropriate space management system or systems to meet university needs. The committee has researched systems in use at other universities. At the end of summer 2006, upon completion of a thorough review of viable options, the committee presented a set of recommendations to be considered. Recommendations included hiring a consultant to help prepare RFPs for firms to develop a space management system and for performing a campus space inventory.

In March 2007, a preliminary meeting was held with a consultant. The meeting included Virginia Tech advisory groups representing finance, information systems, infrastructure, and GIS. One conclusion drawn from the meeting was that Virginia Tech already had substantial infrastructure in place to support a space management system. It was later determined that Network Infrastructure and Services maintains the most up-to-date floor drawings derived from the master drawings provided by Capital Design and Construction. The NI&S AutoCAD drawings may be useful for performance of the space inventory along with those from Site and Infrastructure Development and Renovations. In addition, NI&S and eCorridors have implemented a networked-based enterprise GIS system that provides a model for the space inventory system.

Dr. Sherwood Wilson has recently been named Virginia Tech’s Vice President for Administrative Services. In this role, Dr. Wilson will be responsible for many of the university areas critical to space management including capital design and construction, physical plant and utilities, transportation services and parking, the university architect, real estate management, and environmental health and safety. Dr. Wilson has been asked to involve the University Space Management Committee as his planning moves forward.

Blacksburg Electronic Village and Woodrow Wilson Rehabilitation Center partnership

The Woodrow Wilson Rehabilitation Center (WWRC), a division of the Virginia Department of Rehabilitative Services (DRS), provides in-residence, "wrap-around" care including medical, technological, and vocational rehabilitative services. The facility, located in Fishersville, serves Virginians with disabilities who cannot be adequately supported by DRS resources available locally across the commonwealth.

Beginning in 2003, Virginia Tech Information Technology partnered with WWRC on its federally funded, Project Train-IT. Project Train-IT was unique as a job training and placement program in that it prescreened candidates for technical ability, workplace affinity, and the ability to learn by computer at a distance. Students accepted into the program trained online from home—as opposed to in-residence at Fishersville—and acquired skills and industry certifications. As a Train-IT partner, Virginia Tech provided both internships and research collaboration related to assistive technologies in the information technology workplace.

Also in 2003, Dr. William Sanders accepted an invitation to join the WWRC Business and Information Technology Program Curriculum Advisory Committee. This group of external information technology managers and professionals advises the WWRC on the content of the in-residence, technology-training curriculum.

Shortly thereafter, in 2004, the Blacksburg Electronic Village (BEV) and WWRC piloted a virtual internship program. WWRC resident students, pending an interview and acceptance into the program, worked on BEV projects remotely from Fishersville using NetworkVirginia. The first virtual intern in Fishersville worked on the BEV's Department of Commerce TOP grant project consulting by telephone and e-mail with BEV customers (micro-businesses, nonprofits, and civic organizations) located in any of six, disadvantaged, rural Virginia communities covered under the grant. After the consultation was complete, the intern developed web pages to be hosted on the BEV's servers at Blacksburg.

Both Project Train-IT and the virtual internship pilots proved successful. Over the past year, WWRC has integrated Project Train-IT and its residency program so the center now has a single curriculum with two delivery methods: in-residence and at-a-distance. Over that same period, the BEV has created its Web Support Service, staffed primarily with Virginia Tech students. This project will continue the partnership with WWRC, offering internship opportunities on web development projects to qualified individuals whether they are in Blacksburg or telecommuting from Fishersville or from other communities around the commonwealth.

Preliminary, informal discussions of additional workforce development ideas have received encouragement from several entities. BEV and WWRC plan to pursue them together through their respective parent organizations.

Regional fiber-optic network for the New River Valley

The origin of the New River Valley Fiber-optic Network project is described in the *2006 New River Valley Community Broadband Network Plan*:

> In early 2003, a group of leaders came together through the New River Planning District Commission (NRVPDC) to assess the telecommunications infrastructure in the region. These leaders—principally from education, local government, private business, and economic development--were concerned that the New River Valley is being "outflanked" by neighbors in far Southwest and Southside Virginia, where state and federal resources have accumulated to develop broadband telecommunications infrastructure. The NRV Telecommunications Committee of the NRVPDC was formed to assess this need and develop a plan of action. Funding was sought for the planning process. The Committee also called a Telecommunications Summit in October 2003, to draw attention to the work of surrounding areas and gauge interest and need.

Early in 2003, telecommunications committees from the Pulaski and the New River Valley (NRV) regions began collaborating with Virginia Tech's Office of Economic Development, eCorridors, and Network Infrastructure and Services. Later that year, the NRVPDC Telecommunications Committee asked the eCorridors and NI&S organizations to develop a preliminary system design scenario for a regional Fiber to the Premises (FTTP) community network. The region included Floyd, Montgomery, Pulaski, and Giles counties. The design was to deliver Gigabit Ethernet access over a fiber-optic backbone to 127 sites including local governments, education, healthcare, industrial parks, and major industries.

John Nichols, of NI&S, led the design team, which included Seth Peery of eCorridors, NRVPDC staff, and interested members of the New River Valley Telecommunications Committee. Cost information was provided by Corning Cable Systems for the fiber-optic infrastructure and by Cisco Systems for the network equipment. Seth Peery used geographic information system tools to plan fiber-optic routes and to estimate costs for materials and labor. The design was unveiled in June 2004. It included 283 miles of fiber-optic backbone cable routes. The plan is available at *www.nrvpdc.org/NRVTelecomPlan/NRVTelecomPlan.html*.

The NRV Telecommunications Committee envisioned the formation of a nonprofit entity to manage the provision of open-access transport to support broadband services and economic development. A milestone was reported in the *Roanoke Times* on August 1, 2006:

> On July 12, 2006, the Virginia's First Regional Industrial Authority authorized forming a participation committee to include its seven counties, three cities and five towns, as well as several private companies and nonprofit organizations.
>
> It will be set up along the lines of the authority's only other participation committee, in which 11 of its jurisdictions fund shares in Commerce Park, a large industrial site created in Pulaski County in a so-far-unsuccessful effort to land a large industry. The entities that take part in this second project would also buy shares and, as with the Commerce Park, be able to share in any profits down the road from a telecommunications network.

The NRVPDC FY 2005-2006 Annual Report states that the number of new construction cable-miles had been dropped to approximately 90 miles from the initial 283 with the remainder to be initially leased from local providers. The amount of new construction was later changed to 60 miles with a proposed route from the Wythe County line to the intersection of Rt. 11 and Rt. 114 in Christiansburg. In committee meeting notes for February 23, 2007, it was stated that the "total project included 60-miles of newly constructed fiber with a total construction cost of $4.9 million. Half of that expense would need to be covered by the local match. In addition, there is an estimated need of $540,000 annually for operations and maintenance."

In April 2007, the NRV Telecommunications Committee received word that Governor Tim Kaine had approved a $100,000 grant for engineering and design to be administered through the Appalachian Regional Commission's (ARC) Area Development Program. In a committee meeting on June 15, 2007, it was reported that a matching grant of $100,000 was also needed.

As of end of June 2007, the NRV Telecommunications Committee was pursuing a pre-application for a $2.48 million grant from the Economic Development Authority. Another $2.48 million in matching funds would be needed from regional entities.

One issue for entities in Montgomery County, including Virginia Tech, is that the proposed fiber termination point at the intersection of Rt. 11 and Rt. 114 does not connect to anyone in the county, so the immediate benefits are not apparent. This situation may make it less likely that Montgomery County entities will become members and contribute matching funds.

It is desirable for the new fiber construction to interconnect major government, education, and business sites within Montgomery County with similar entities in the City of Radford and Pulaski County. NI&S and eCorridors contacted major entities within Montgomery County, and there was interest in collaboration to define where fiber backbones and access points could meet local needs for potential inclusion in the NRV fiber-optic network. NI&S and eCorridors have requested fiber route information from Montgomery County entities. Seth Peery, of eCorridors, is developing a Web GIS application for viewing, sharing, and planning the fiber routes.

EDUCAUSE Net@EDU Wireless Networking Group/Integrated Communications Strategies

"EDUCAUSE is a nonprofit association whose mission is to advance higher education by promoting the intelligent use of information technology."[1] "Net@EDU is a member-driven program of EDUCAUSE whose mission is to promote thought leadership on advanced networking in higher education. Membership comprises information technology leaders from higher education, state networks, and industry. Members work together in advancing the evolution of a global networking environment to best support the transformation of education and research through information technology. The activities of Net@EDU members span the spectrum of academic networking, from administration of campus networks to local, state, regional, national, and international networking projects. Net@EDU provides individual members a forum for discussing issues they deem important to the higher education community and the opportunity to work with colleagues who share those same interests."[2] Seeking to develop winning strategies for networking in higher education, the working groups of Net@EDU offer collaboration opportunities by sharing resources, time, and energy.

Virginia Tech is a member of the Net@EDU Wireless Networking Group. For the last several years, John Nichols co-chaired the group and Richard Hach served on the steering committee. Over the past two years, the Net@EDU Wireless Networking Group and the Integrated Communications Strategies (ICS) Group have held joint meetings prior to the annual EDUCAUSE and Net@EDU forums. As planning for these events took place, it became increasingly clear that there was a high degree of commonality in the interests and initiatives of the two groups. Members of the groups' steering committees observed that wireless on campus must be integrated into overall infrastructure and services solutions, and any comprehensive discussion about convergence required the consideration of wireless technologies. As a result, the steering committees of the two groups merged into a single working group effective July 1, 2007. The title for the merged group is the Converged Communications Working Group (CCWG).

CCWG will explore the application of wireless networking across the full spectrum of wireless technologies. It will continue to focus on discussions with the vendor community before the EDUCAUSE conference each fall and on projects and strategic initiatives from within higher education before Net@EDU each spring. As before, the emphasis will be on wireless technology—including fixed, portable, and mobile applications—the spectrum, convergent services, financial planning, and best practices. The group direction will also emphasize the

[1] EDUCAUSE membership, *http://www.educause.edu/Membership*
[2] Mission of Net @ EDU, *http://www.educause.edu/Organization/54*

tracking of future technologies, strategic initiatives of vendors and universities, regulations, security, and deployment issues of importance to higher education.

The steering committee (*www.educause.edu/13525?code=ccsc*) for the new Converged Communications Working Group meets during bi-weekly conference calls. John Nichols and Richard Hach serve on the committee along with representatives from Arizona State University, the District of Columbia, Duke University, Indiana University, Macon State College, New York University, Northwestern University, Oklahoma State Regents of Higher Education, Pennsylvania State University, the University of Chicago, the University of Iowa, the University of North Carolina at Charlotte, and the University of Virginia.

Additional information about the CCWG and EDUCAUSE is available at the following URLs:

Net@EDU CCWG site: *www.educause.edu/ConvergedCommunicationsWorkingGroup/13524*
EDUCAUSE wiki site: *www.connect.educause.edu/*
EDUCAUSE main site: *www.educause.edu/*

HokieMart

Virginia Tech has entered into partnership with SciQuest, Inc. to provide an effective and efficient e-procurement (purchasing) system for the university, branded as "HokieMart." In an April 2006 memo to deans, directors, and department heads, Executive Vice President and Chief Operating Officer James A. Hyatt indicated that implementing such a system would better position the university to support future growth and greatly enhance Virginia Tech's ability to move toward more broad, distributed, electronic business practices.

HokieMart offers the ability to improve storeroom management and provides for electronic receiving and invoice processing. It also offers the ability to establish a paperless marketplace for business activities that are internal to the university. With this capability, the university will have the opportunity to create a common, paperless environment in which to process transactions, as compared to the current process where many service requests are paper-intensive and manually processed through several systems.

In support of the Information Technology strategic plan to implement enhancements to university enterprise systems to facilitate e-business (to include e-commerce and e-procurement), Network Infrastructure and Services began the migration to HokieMart. The first orders were entered into the new system in June 2007. As a result, for most orders,

- paper documents previously used to authorize purchases and payments are no longer needed. Instead, orders are placed using on-line forms in HokieMart.

- invoices are no longer received in NI&S. They are received in the Controller's Office for payment.
- packing slips (proof of delivery) are still required when goods are received, but they are no longer routed between NI&S departments as part of the payment process. Instead, receiving documentation is entered electronically into HokieMart.

Continued enhancements will be made to HokieMart and process adaptation will be necessary. Overall, though, the quantity and the routing of paper documents have been reduced. In addition, some NI&S suppliers have on-line catalogs (or storefronts) that are integrated with HokieMart. These catalogs are available to individuals who enter orders into HokieMart and facilitate the ordering process.

For more information, see *www.purch.vt.edu/HokieMart/hm.html*.

Continuity of operations presentation

Network Information and Services supported the office of the university's Vice President for Information Technology by giving a presentation on information technology continuity of operations (COOP) and disaster recovery (DR) at the spring 2006 meeting of the Atlantic Coast Conference (ACC) chief information officers (CIO) group. The meeting was held in Charlottesville, Virginia.

In support of an Information Technology strategic initiative to leverage collaboration with other higher education institutions, Virginia Tech actively participates in this group. The ACC CIOs and invited subject-matter experts from their universities meet periodically to discuss best practices in higher-education management and information technology issues common to all ACC schools. The forum on COOP and DR allowed the ACC schools to share lessons learned and future plans.

Virginia Tech's information technology groups have extensive DR plans and had been working on COOP planning for approximately one year prior to this meeting. The presentation included an overview of the organization, our DR plans, our COOP planning to date, and our intention to formalize our COOP plans by autumn 2007.

Based on the information presented, the other ACC schools attending the conference were in various stages of COOP and DR planning, ranging from early stages of planning to fully implemented hot sites. The group presentations and subsequent discussion were very informative, helpful, and/or appreciated by all in attendance.

Printing Services equipment strategy

Over the past few years, Printing Services has begun the process of modernizing aged, inefficient equipment. This effort has allowed Printing Services to better meet the evolving needs of the university by producing high quality jobs more efficiently, and in some cases, completing work that we were not previously capable of producing on campus.

To date, Printing Services has had no formal mechanism to save monies across multiple fiscal years as required to replace aged capital equipment. Operational monies have been used to purchase more modern equipment. Initial purchases were modest, as there was limited operational budget available to use to upgrade equipment, but such purchases over two or three years have resulted in reduced expenses and increased revenues.

This year, with the support of the Budget Office, we combined these operational savings with savings from other budgeted, but deferred, equipment purchases in order to purchase a used, but modern, 5-color printing press. The 5-color press will allow us to support the university's increasing demand for high quality multi-color work while becoming even more efficient.

For the coming year or two, we will continue to use this strategy to modernize and upgrade remaining aged and or inefficient systems. We will also work with the Budget Office to establish an equipment reserve fund to allow us to carry monies over fiscal year boundaries as required planning to replace aged capital equipment in the future.

After we complete the modernization of the print plant, we will work with the Controller's office to revisit rates. Our goal is to reduce rates, due to increased efficiencies, while also funding the equipment reserve fund. This should allow us to provide higher quality work at reduced rates with a planned, and funded, equipment upgrade and or replacement strategy for the foreseeable future.

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, 2006 through June 30, 2007.

Seminars and academic course support

Kevin Cook and Jeffrey Dalton taught Faculty Development Institute (FDI) classes on video production and use of video in presentations.

Taikara Peek, May 2007, taught a seminar at the Summer Track F for IDDL.

Bill Sanders, January 2007, gave two presentations on information technology risk analysis to sections of the “Information Systems Audit and Control” course taught by the Department of Accounting and Information Systems in the Pamplin College of Business.

VBS Multimedia Production staff and the IVC Classroom Support staff provided demonstration and instructional sessions for CS4624—Multimedia, Hypertext, and Information Access.

Degrees awarded/certifications achieved/classes and training

Eleven University Computing Support student consultants, December 2006 and May 2007, graduated from Virginia Tech.

Twenty-six NI&S staff members, June 2007, completed Commonwealth of Virginia Asbestos Operations and Maintenance (O&M) Refresher Training Course.

Five NI&S staff members, June 2007, completed Commonwealth of Virginia Asbestos Inspector Recertification Course.

Morgan Allen, Eric Brown, Jason Christian, Brian Early, Carl Harris, Joe Hutson, Andrew Olson, Richard Phipps, Robert Roberts, and Luke Ward, June 2007, Hibernate Training by Accelebrate

Jason Christian, Dan Cook, Eric Fischer, and Danny Wright, December 2006, Windows Vista Training

Jason Christian, Brian Early, Carl Harris, Joe Hutson, Mathew Mathai, Phil Norman, and Luke Ward, December 2006, AJAX Training by Accelebrate

Dan Cook, April 2007, MBA, Averett University

Dan Cook, Eric Fischer, Richard Phipps, Luke Ward, Danny Wright, and Laurie Zirkle, March 2007, SANS Security 508: System Forensics, Investigation and Response

Dan Cook and Laurie Zirkle, October 2006, Solaris 10 Deep Dive class

Ludwig Gantner, December 2006, graduated with a BS in Math from Virginia Tech.

Garry Goad, August 2006, Commonwealth of Virginia Lead-based Paint Risk Assessor Recertification

Steve Gordon

- August 2006, Commonwealth of Virginia Lead-based Paint Risk Assessor Recertification
- November 2006, Virginia Tech Confined Space Entrant/Attendant/Supervisor Recertification

Cindy Kelley, completed 20 hours of Continuing Professional Education classes for renewal and maintenance of her CPA license

Brian Maloney, SANS GIAC Certified Forensics Analyst

Carl Harris, Sun Certified Java Programmer (SCJP)

David Martin

- August 2006, certificate of completion, "ArcSDE Administration for Oracle"
- March 2007, certificate of completion, "Security 508: System Forensics, Investigation and Response"

Mike Moyer, May 2007, graduated with a BS in Mechanical Engineering from Virginia Tech.

John Nichols, Certified Master Telecommunications Engineer by iNARTE (The International Association for Radio, Telecommunications and Electromagnetics)

Robert Rankin, Virginia Department of Professional and Occupational Regulation, Journeyman Electrician license

Joe Schottman, July 2006, Crestron Controller Training

David Schuh

- July 2006, Crestron Controller Training
- Advanced to Second Lieutenant in the Montgomery County Squadron of the Civil Air Patrol, Search and Rescue aircraft crew member

Jerry Surface, May 2007, BS, Occupational & Technical Studies/Training Specialist, Old Dominion University

Andrew Tweedt, May 2007, graduated with a BS in Forestry from Virginia Tech.

Luke Ward

- July 2006, SANS GIAC Certified Incident Handler
- October 2006, Virginia Alliance for Security Computing and Networking (VA SCAN) Annual Conference

Warehouse Staff, Powered Industrial Trucks Certification

Myrtle Yopp, May 2007, appointed a Virginia Notary Public

Laurie Zirkle, July 2006, SANS GIAC Certified Incident Handler

Military service

Ron Keller, active member, Army National Guard

Robert Roberts, active member, United States Army Reserve

Presentations/papers/publications

Jeff Crowder and Judy Lilly, January 2007, co-authored a major Project Request Justification entitled “A New Information Environment for Research and Innovation” addressed to Virginia Department of Planning and Budget.

Jeff Crowder

- September 2006, panelist at COVITS 2006 session, “Rural Technologies: Broadband, Telemedicine, Distance Learning”
- Featured in a Verizon informational video describing NetworkVirginia and National LambdaRail programs. Video highlighted at COVITS 2006 *https://rdweb.cns.vt.edu/~crowder/talks/VT-VZ.rm*
- Prepared and/or delivered numerous presentations regarding National LambdaRail and Mid-Atlantic Terascale Partnership to multiple groups
- November 2006, invited presentation, “Guidelines for Networking in Schools” for Virginia Department of Education Technology Leadership Conference in Roanoke, Virginia
- March 2007, presented “Regional Optical Infrastructure for Competitiveness” at Mid-Atlantic Broadband Cooperative Board Retreat

William Dougherty, September 2006, presentation on thin client/managed desktop option at the Common Solutions Group Fall 2006 Conference, University of Delaware

Mark K. Gardner, Wu-chun Feng, Jeremy Archuleta, Heshan Lin, and Xiaosong Ma, November 2006, "Parallel Genomic Sequence-Searching on an Ad-Hoc Grid: Experiences, Lessons

Learned, and Implications," Proceedings of IEEE/ACM Intl Conference High Performance Computing Networking and Storage (Supercomputing), Tampa, Florida

Richard Hach, April 2007, invited presenter and panel member regarding Communications Assistance for Law Enforcement Act (CALEA) particularly with regard to higher education compliance, Charlottesville, Virginia (Proposal submitted and accepted by the Association of Collegiate Computing Services (ACCS) of Virginia Program Committee; unable to attend due to April events on Virginia Tech campus)

Raven Jennings and Rob Sprague, April 2007, co-presented “Innovative Uses for Collaborative Support Tools” at the Association of Collegiate Computing Services (ACCS) of Virginia conference, Charlottesville, Virginia.

Consultation and outreach activities

Morgan Allen, Dubby Charlton, William Dougherty, Richard Hach, John Pollard, and Roy Smith, March 2007, met with representatives from Radford University to discuss services and technologies provisioned by Virginia Tech and Radford, disaster recovery and business continuity planning, managing network bandwidth, network access control, network closets, campus notification systems, and other areas where synergies could be gained by participating in joint endeavors.

Bill Blevins, September 2006, participated in Hurricane Katrina relief efforts in support of the Habitat for Humanity’s Musician’s Village project

Jeff Crowder

- Served as National LambdaRail administrative point of contact for the mid-Atlantic region
- Served as MATP/Virginia Tech representative for the National LambdaRail TransitRail Project
- Participated in the National LambdaRail Valuation Workgroup
- Initiated and led creation of the “National LambdaRail and Internet2 Virginia K-20 SEGP” program
- Negotiated fiber-optic IRU agreement between Mid-Atlantic Broadband Cooperative and the Virginia Tech Foundation
- Negotiated a Settlement Free Peering Agreement between MATP and MAX to provide transit access to Internet2 and PacketNet
- Negotiated a master services agreement between Level3 and Virginia Tech coupled with a “Triple A” assignment agreement between National LambdaRail and Virginia Tech

- Negotiated major addendums to the NetworkVirginia agreements with Verizon and Sprint
- Served on two committees (financial and technical) of the SURA Southern Region Optical Networks (SRON) group
- May 2007, hosted technology demonstration booth representing National LambdaRail, Internet2, and NetworkVirginia at Innovate2007, Virginia Society for Technology in Education advanced technology conference

Dan Cook, Member, Business and Technology Advisory Committee, New River Community College

William Dougherty, April 2007, began assisting information technology staff from the University of Virginia in placing an optical library server and storage in Virginia Tech's Data Center as part of cooperative disaster recovery planning.

Richard Hach

- Member, Sprint Higher Education Advisory Board, a forum of key decision makers within higher education, in consultation with strategic sales and marketing leadership from Sprint, to discuss current and emerging business needs and provide industry-specific solutions
- 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 2006 in Dallas, Texas and Net@ Edu 2007 in Tempe, Arizona
- Consulted with peer institutions including Penn State, George Mason University, Northern Virginia Community College, Radford University, and William and Mary regarding service, policies, procedures, and regulatory issues

Joyce Landreth, March 2007, hosted "Birds of a Feather" discussion group, "How collaborative tools can be used to improve support in a University Help Desk environment—a roundtable discussion to include the use of new and innovative tools such as chat rooms and wikis. What new and innovative tools is your organization utilizing to improve communication and end-user support?" at the 34th annual Computer Services Management Symposium of Association for Computing Machinery's (ACM) Special Interest Group on University and College Computing Services, Savannah, Georgia

John Nichols

- Served as Co-Chair of the EDUCAUSE Net@ Edu Wireless Networking Group, developed conference programs for EDUCAUSE 2006 in Dallas, Texas and Net@ Edu 2007 in Tempe, Arizona
- Provided consulting support for BEV and eCorridors to begin documenting fiber-optic infrastructure and needs within Montgomery County

Bill Sanders

- Ex officio member, Blacksburg Telecommunications Advisory Committee
- Member, Town of Blacksburg Comprehensive Plan Review Task Force
- 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
- Member, Business and Information Technology Curriculum Advisory Committee, Woodrow Wilson Rehabilitation Center
- Multiple presentations to county Boards of Supervisors, business people, as well as economic development and human resource organizations, concerning the economic and social value of community networks and e-Villages

Anne Sheppard, April 2007, 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.

Doris Stock

- Consulted with peer institutions including Mississippi State, University of Georgia, University of Buffalo, University of Kansas, Washington State, Ohio State, and the University of Guelph regarding service, policies, procedures, and regulatory issues
- Member, Legislative and Regulatory Committee, Association for Communications Technology Professionals in Higher Education (ACUTA)

Laurie Zirkle

- Member, SANS Institute Advisory Board
- Team Member, GSEC Passing Point Project--a formal psychometrics and statistics approach to help validate the correct passing point for the GSEC exams. Volunteers reviewed a sample (around 100) of GSEC exam questions, providing feedback regarding what percentage of minimally qualified exam takers would be able to answer each question correctly.

Research Computing

Research Computing at Virginia Tech 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 Visualization and Research Computing 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.

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 $540,000required to purchase this storage. Although we had been successful in efforts to provide a research computing hardware budget through such request 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 $475,000t allows us to purchase 67TB of research computing storage. The installment of this additional research storage was delayed by the workload of Network Infrastructure and Services. We hope to be operational early in the Fall Semester 2008.

Research Computing support services. We have put together proposals for two new positions for Research Computing. One is a computational science specialist with expertise in message passing interface or MPI, parallel codes, third party software, domain expert, and related area, while the other is a visualization expert. These positions are to be administrative/professional faculty positions and will be initially funded by Information Technology, the College of Science, the Interdisciplinary Center for Applied Mathematics, and Jeff Borggaard's funded projects with Air Force Research Laboratory and the National Science Foundation (NSF). We are currently seeking all necessary approval so that both positions will start in mid August 2007. The successful candidates will be expected to seek external funding for both basic research and equipment grants.

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 in 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 and graduate students. The camp will consist of morning lectures and afternoon hands-on labs where attendees will learn about supercomputing architectures, code parallelization, performance benchmarking as well as analysis and communication of results through visualization. The 9-day course is to be held at the University of Virginia August 8-17, 2007. Plans are for the training course to 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; 64p Altix 4700. All of these systems are heavily used and get excellent reviews from the research computing faculty and graduate students. We continue to have a strong relationship with SGI. SGI has inquired of our interest to join them in a large petascale project. We will consider this over the next year.

Visualization. In December 2006 and in collaboration with the Provost's Office, the College of Engineering, and Information Technology, we put together a plan to continue the CAVE facility through Dec 2007, including CAVE staff member Pat Shinpaugh and a small budget. This effort was a result of the Institute for Critical Technologies and Applied Science (ICTAS) ending the

funding of the CAVE facility and staff. We were asked to prepare a report on the past and current efforts in visualization. The report is to include a plan for future visualization efforts.

Oak Ridge National Laboratory. During this period, we had had several opportunities to interact with Oak Ridge National Laboratory (ORNL). Terry Herdman and Mechanical Engineering faculty members Ken Ball and Mark Pierson, attended meetings concerning proposed energy education and research programs, primarily nuclear programs. One outcome is Virginia Tech joining the Southeastern Universities Nuclear Reactor Institute for Science and Education (SUNRISE) group. We have worked with Dr. T. Zacharia on joint research computing efforts, and we joined ORNL in submitting both a Track 1 and a Track 2, Petascale NSF proposal. Research Computing personnel interacted with Dr. Paul Gilman, Oak Ridge Center for Advanced Studies (ORCAS), on his efforts to put together a research team to submit a proposal for the Defense Advance Research Projects Agency (DARPA) entitled, "Actionable Capability for Economic Systems." Research Computing participated in the ORNL graduate fair, attended liaison meetings, and represented Virginia Tech at the ORCAS board meeting. Nicholas Polys visited ORNL and met with Dr. T. Zacharia and other computational/visualization researchers. We hope to build on the foundation Nicholas established with this group over the next year.

National Capital Region. Research Computing contributed to planning for the proposed new Virginia Tech building for the National Capital Region. Efforts centered on creating a state of the art technology environment that would be a showcase for research computing. We have worked with Dave Sebring and Dr. Joseph Guerci to identify research opportunities for Virginia Tech research teams. In particular, we have met with Bruno Sobral and Chris Barrett, Virginia Bioinformatics Institute, and Dennis Dean, Fralin Biotechnology Center, to discuss possible collaborating in a targeted DARPA proposal.

High Performance Computing Cost Center. In order to be able to charge for external use of System X, we established a charging structure. "External use" is defined as those not having joint projects with Virginia Tech researchers. The number of such external users may be small; however, we did have requests and we did want to develop a structure that would allow charging for CPUs. We are working with four companies that have requested time on System X.

Virginia Bioinformatics Institute review. Research Computing leadership participated in the cyclical review of the Virginia Bioinformatics Institute (VBI). Research Computing staff members met with the external review committee. The external review committee was interested in the relationship between VBI and Research Computing. We have met with Dr. Sobral and started discussions on how we can work together on research computing.

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 2006. The Supercomputing Conference 2006 was held November 11-17 in Tampa, Florida. 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. Presentation were given by Wu Feng (Computer Science), Nicholas Polys (Information Technology), Kirk Cameron (Computer Science), Keith Bisset (Virginia Bio-Informatics), Madhav Marthe (VBI), Naren Ramakrishnan (Computer Science), and Dimitrios Nikolopoulos (Computer Science) on research conducted on Virginia Tech's computational resources. Also this year, we had non-disclosure meetings with IBM, Sun Microsystems, SGI, DataDirect, and BlueArc Corporation.

HPC User Forum. The Denver meeting was held September 18-20. Research Computing's principal tasks were to:

- continue showcasing examples of high performance computing (HPC) "Leadership and Partnerships" in government, industry, and academia;
- continue an in-depth exploration of HPC storage and data management systems;
- provide an overview of petascale computing initiatives around the world;
- explore the growing array of processor options and the related trends toward heterogeneous HPC systems that couple multiple processor types.

Attending were Kevin Shinpaugh and Mark Gardner.

At the April 9-11 meeting in Coeur d'Alene, Idaho, high performance computing professionals undertook the following tasks:

- Share information among HPC users and vendors for improving the health of the HPC industry
- Continue showcasing examples of HPC "Leadership and Partnerships" in government, industry, and academia
- Further explore the challenges associated with rampant parallelism
- Discuss current practices and goals in numerical weather prediction and climate modeling
- Learn more about Phase 3 of the DARPA High Productivity Computing Systems (HPCS) program
- Discuss entry-level HPC issues, requirements, and future directions

- Continue examining the strengths and weaknesses of various processor types

Attending the workshop from Virginia Tech were Terry Herdman and Kevin Shinpaugh.

SGI meeting. Research Computing was invited to attend the launch of SGI's Altix ICE in Washington DC. We were also invited to meet privately with the new CEO of SGI, Bo Ewald. Topics discussed include:

- Virginia Tech's plans for the future in high performance computing
- Possible collaborations between Virginia Tech and SGI
- An open invitation for them to visit Virginia Tech

Collaborations

NSF urgent computing. Virginia Tech was invited to participate in Argonne National Laboratory proposal to NSF on urgent computing. Kevin Shinpaugh is co-principal investigator from Information Technology with Keith Bisset of VBI. Urgent computing (also known as SPRUCE) is a system to support urgent or event-driven computing on both traditional supercomputers and distributed grids. Scientists are provided with transferable right-of-way tokens with varying urgency levels. During an emergency, a token has to be activated at the SPRUCE portal, and jobs can then request urgent access. Local policies dictate the response, which may include providing "next-to-run" status or immediately preempting other jobs.

Research Computing would provide 200,000 CPU-hours per year and would receive $50,000 per year for three years in funding from NSF if the project is awarded.

Laboratory for Advanced Scientific Computing and Applications. Information Technology has continued to work with 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.

Rendering Project with Hayes, Seay, Mattern & Mattern. Hayes, Seay, Mattern & Mattern, Inc. approached Research Computing to provide computational resources for an architectural rendering project. This project was related to the upgrade of the White House Press Room. This sponsored project's award is $16,569.

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 would allow Research Computing to offer 10% of the system and unused cycles to other researchers.

The cluster is being purchased from Dell. and should be installed in August 2007. This cluster will have more than one-third of 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 only available 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 rather than only when the computer lab is open.

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.

Investigate collaboration with Analytical Mechanics and Associates. Research Computing was contacted by Analytical Mechanics and Associates (AMA) from Hampton Virginia, to provide computing cycles for their projects associated with NASA. The initial need was for compute cycles for running CFD code in support of the upcoming flight test of the launch abort system for the new crew excursion vehicle. This effort was to be a subcontract from Orbital Sciences, Inc. AMA did not win the contract but are still interested in pursuing a relationship with Virginia Tech.

We were able to run and test the application (NASA Fun3D code) on System X.

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

Student employee: Jeffrey Nelson. Jeffrey Nelson has been working with Research Computing as a wage student for the past three years. He is a senior this year, majoring in computer science. The projects he has been working on this year are Linux for System X and a rapid imaging system for System X.

When we first installed Yellow Dog Linux 4.1, we found out that it did not support error correcting code (ECC) error detection or the lights and buttons of the Xserves font panel. In a machine with 8800 sticks of RAM, it is critical for us to have the ability to detect and replace these error-spawing chips to ensure data yielded by the supercomputer is accurate. While exploring more recent code in the mainstream Linux kernel, Jeffrey found Benjamin Herrenschmidt had written some code to control the CPU lights on the Xserves. After getting in contact with him to ask him about this code, he offered to and then wrote an ECC driver for us. In addition, they also helped us write a driver for the rest of the lights and buttons of the front panel display. In both instances, the drivers provide more information and control than what was possible under OS X.

Automated imaging is done by a process that requires the following elements:

- Imaging partitions with imaging scripts
  These partitions cannot be moved, resized, or otherwise altered once they have been written to disk in order for the procedure to work. They also must be present and writeable to while the current node OS is being used.
- A means to run commands on each of the machines to be imaged
- A method to distribute large files over the network quickly

In addition, if you need to repartition your disk and cannot do so while booted under the current operating system (e.g. with OS X), you will need to setup a netboot server and a small netboot image that can be used to do this partitioning. This action should be avoided, as it will quickly turn this parallel process into a serial one.

The general process for this setup involves initially setting up all the nodes to have the exact same disk layout and also have some partitions which can be used for booting off of when imaging the system. Once this is setup in the cluster, when an operating system (OS) change is required, a "Golden Client" consisting of the new install is created and its new OS partitions copied and compressed as partition image files. These files are then copied onto the file system of the OS that reside on the imaging partitions along with scripts that automatically write these partitions to the correct locations on disk. Once this has been done, the imaging partitions themselves are copied and compressed then sent over the network in parallel to the nodes where they are written back to the imaging partitions of the nodes. After setting some firmware commands to have the machines boot off the imaging partitions, the machines are rebooted and

run the scripts at boot in order to copy the compressed image partition files back over to the main OS partitions. Once this is done, the machine resets its firmware and then reboots into the main boot OS again.

Outreach

Hollins University. Dr. Patricia Hammer at Hollins University contacted Research Computing about using System X for a special student project. Kate Stanley has been doing research with Dr. Hammer in the math department for the past few years. She has been working on creating Julia set images corresponding to the function f(x)=csin(x).

Stanley worked with the Research Computing staff over one week in Spring 2007. Her initial project was using Mathematica. We introduced her to MATLAB, which she found easier to use and gave her results quickly. She used MATLAB to set the parameters of interest to her, which would then be run on System X. Her MATLAB code was then ported into C for use on System X.

She was able to get all the data she needed to produce her image files to be used in her animation.

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, Richmond Virginia, with state Equipment Trust Funds and was 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
- Available to faculty members and researchers

New 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 web site to consolidate this information. Several names were examined as possibilities for the site, including Advanced Computing Center. After much deliberation and discussion with individuals outside the group, the committee selected the name "ARC," for "Advanced Research Computing."

Brandon Morrison was employed to design a new layout to be used for the ARC web site. Following preliminary discussions with the committee, he prepared an initial prototype (*www.arc.vt.edu/arc0/images/arc.jpg*). Following additional feedback, the prototype developed into the next iteration (*www.arc.vt.edu/arc0/images/arc6.jpg*). In November, Brandon further refined the prototype and completed his work on the project by converting the prototype to a web site using the Web Hosting service (*www.arc.vt.edu/arc0*). He also provided examples for three sub-levels of pages linked from the main web page:

- Computing systems and resources
- Dante
- Dante software

After Brandon completed work on the design, Bill Sydor reworked the design code to simplify the addition of future web pages. As initially implemented, the design would typically require five files per page: a PHP file which designated which files were to be included to create the page, an html file containing the main body content, a Cascading Style Sheet file defining page element definitions, a top title file defining the image to be used at the top of each page, and a jpg image file which would be called by the top title file. The design construction was simplified by creating master page and style sheet definition files common to all pages. Thus, creation of a new page now only requires a PHP file that contains the page specific variable definitions, PHP include commands specifying the master files used for page formatting, and the page content. An optional second file, a jpg image, can be used when a page specific image is desired.

For example, the following lines are all that are required to define the initial formatting for the "Research" page of the Virginia Tech ARC web site:

```
<?php
// Modify the value on the next line to match the current date
$lupdate        = "July 16th, 2007";
// Title Text to appear with "VT-ARC:" in the title bar of the page.
$title          = "Research" ;
include("templates/top.php") ;
?>
```

Note that the lines beginning with // are PHP comments; thus only two variables and an include of the file "top.php" in the templates directory are all that are now required prior to the html commands and text which would make up the body of the web page.

Similarly, only one line of PHP is required to complete the page:

```
<?php include("templates/bot.php") ; ?>
```

Once the revised PHP code structure was developed, Sydor began the incorporation of existing web information into the new design. An initial implementation of the new design went into production at the beginning of Spring Semester 2007. In February, information about the new web site was forwarded to the Knowledgebase, TechSupport listserv, Erv Blythe, Susan Trulove (Public Relations Manager, Office of the Vice President for Research), Lynn Nystrom (Director of News and External Relations), and Michael Dame (Director of Web Communications).

Since then, Sydor has been working on developing the site by adding additional content and refining the design using feedback from the design committee and the campus community. A major shortcoming in the initial implementation had been general lack of information about ARC; e.g., information about staff, mission and objectives. Information was solicited from individuals within the group and the "About ARC" page was developed and then supplemented with a page of staff photos and biographies. Additional pages were also written to provide content for all remaining links that were included in the web site design.

New photographs have been taken of the systems in the machine room and added to the site to enhance the appearance of the content pages. The original background image on the main page was replaced by a new one showing the current Silver Storm hardware. The orientation of the hardware display was also modified to lead inward towards the content of the web page rather than leading outward, i.e., compare:

www.arc.vt.edu/arc0
www.arc.vt.edu/arc/index.php

At the suggestion of Michael Dame, the color of the bullet points was modified from the original blue light color from System X to maroon to better match university style guidelines. This change can also be observed by comparing the two web pages above.

Initially there was a problem printing pages from the web site, as the right margin of all pages would be truncated. This problem was resolved by preparing a printer template for the site.

Significant effort has been devoted to migrating the individual pages and forms from the TeraScale Computing Facility web site so that the tcf.vt.edu domain could be returned. A major challenge in this migration was creating a forms processing script on web hosting with the capability of forwarding attachments with the submitted forms. The web site now directly processes forms for contacting the ARC staff, requesting help, scheduling a tour, and obtaining an account on the SGI and Sun systems; account requests and database management for System X accounts are still processed by 128.173.49.4. The tour request form accesses a MySQL Database to store the submitted request that can be reviewed later by ARC staff members. Thus, the web site no longer needs the tcf.vt.edu domain for any of its functions.

To minimize the amount of e-mail spam being sent to the ARC staff, all e-mail contacts are processed via PHP forms; however, even this action does not eliminate all spam as some spammers have developed techniques to mimic forms processing requests and send their spam via these methods. Messages sent to the ARC list are monitored and a filter, maintained by manual intervention, in the PHP forms processing scripts inspects forms requests to reduce the amount of spam messages that might otherwise be sent out to the list.

A new link for visualization has been added to the ARC menu on the left margin of all pages and connects to a new page which displays information on visual computing.

A page has been prepared which describes how to use the parallel computing capabilities of the SGI systems (*www.arc.vt.edu/arc/sgi/sgi-parallel.php*\).

A master PHP file was developed to output most of the site content (with the exception of the main page, forms, links page, and site map) as a single document which can then be converted to a PDF document, as a draft example, see: *www.arc.vt.edu/pdf/VT-ARC.pdf*

Areas currently under development—

1. Conversion of the "AIX Users Guide" into a generic "Unix Users Guide," applicable to all of the ARC systems
2. Updating the research pages with information to describe current research being performed using ARC resources
3. The ARC web pages continue to be updated as new information and corrective feedback are received

Loaner/gift hardware from IBM. Based on last year's discussion with IBM on submitting an National Science Foundation petascale proposal, Research Computing was able to secure a long-term loan of an IBM BladeCenter-H system. The system was configured with five (5) JS-21 blades (power pc based). We took delivery of the system in August 2006; unfortunately, it arrived in a non-usable condition. The system was finally in usable condition in February 2007. IBM also donated a HS-21XM blade (Intel-based) to Virginia Tech in April 2007.

The system has been used for some performance testing and is currently being used for the virtual computing laboratory.

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 128 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 of this year, 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 Computer Science Department 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.

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.

Queuing software for research computing platforms. Research Computing negotiated a 94% discount with Cluster Resources, Inc. for queuing and cluster management software to be used on our computational platforms. The Torque and Moab software is 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 for the past two years seeking an affordable 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 delivery 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 should be in production in September 2007.

MATLAB Distributed Computing Toolbox. We have received several requests from researchers to provide the MATLAB Distributed Computing Toolbox. Efforts are currently underway using a demo license to setup this environment on System X with integration in to our queuing system. We have obtained initial quotes for 64 nodes at $9,500.

Some of the key benefits include the following:

1. Distributed applications, or embarrassingly parallel applications, contain independent tasks that can be executed without the need for communication between the tasks.
   For distributed applications, use the functions in Distributed Computing Toolbox to define independent computation tasks for an application, which can then be collected into a distributed job and submitted for execution on a cluster.
2. Parallel applications contain interdependent tasks that exchange data during the execution of the application.
   The toolbox and engine include functions based on the message passing interface (MPI) standard that supports explicit communication for developing parallel applications in MATLAB. However, using these MPI-based functions involves keeping track of message-passing details such as synchronizing data between processors and managing interprocessor communications.

Distributed Computing Toolbox simplifies the development of parallel applications in two significant ways. First, the toolbox supports distributed arrays, which treat related data distributed across processors as a single array rather than as independent arrays on different processors. Through distributed arrays, researchers can perform operations directly on arrays without having to manage the tedious details of message passing. The toolbox provides more than 150 MATLAB functions for distributed arrays, including linear algebra routines based on ScaLAPACK. Second, the toolbox includes a new interactive parallel mode (pmode) of execution so that researchers can work interactively with a parallel job running simultaneously on several processors or cores. This mode facilitates iterative exploration, design development, and problem solving.

Using MATLAB on System X should increase the number of users that can take advantage of this resource due to the ease and familiarity of MATLAB programming. Once a researcher has working MATLAB code that meets their needs, these can also be ported into C.

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.). This usually constitutes 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.

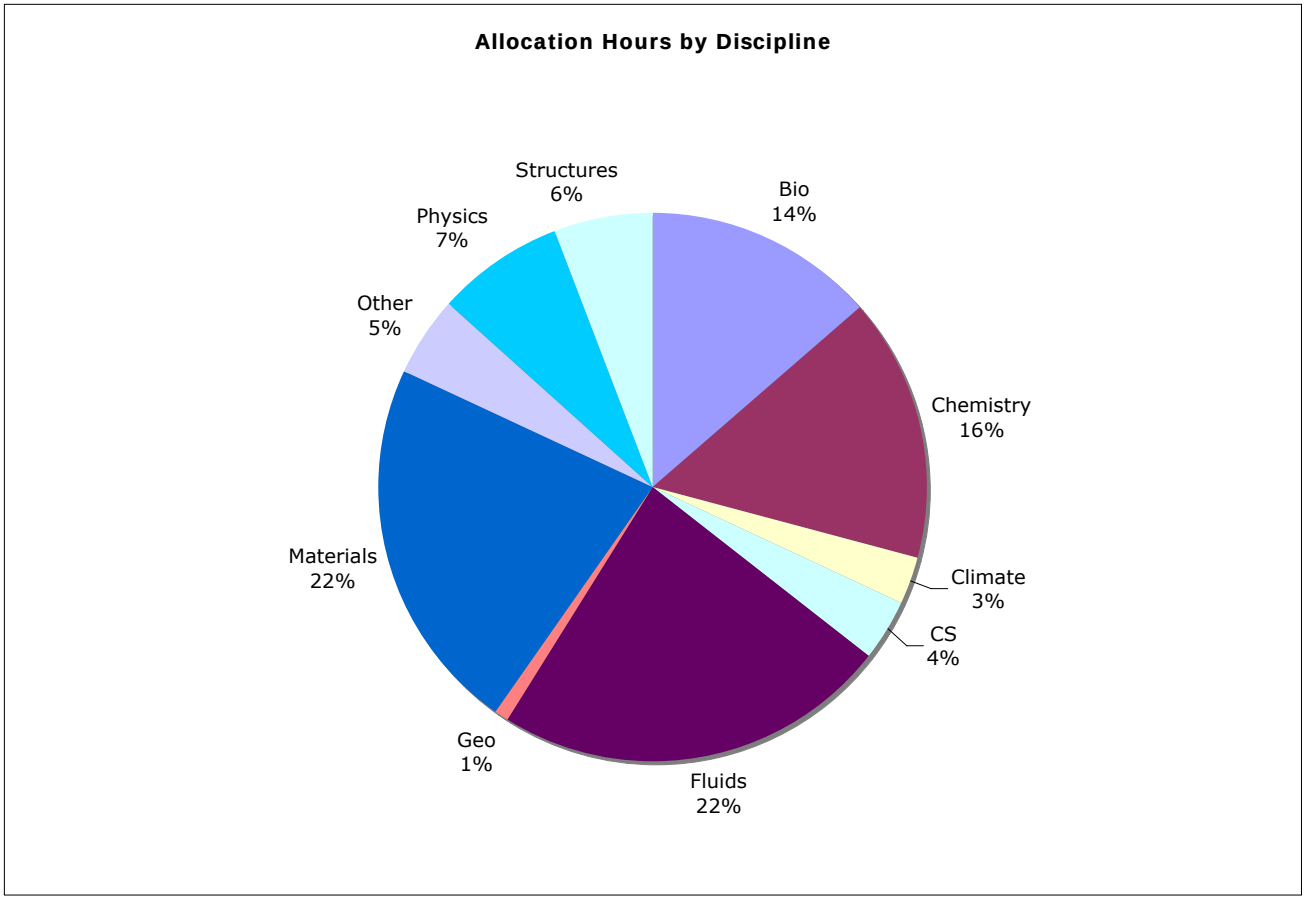
Cumulative allocations by principal investigator for System X

PI	College	Department	Hours
Adrian Sandu	COE	CS	305000
Alexey Onufriev	COE	CS	755000
Ali Neyfeh	COE	ESM	100000
Amadeu Sum	COE	CHE	2864615
Andrew Duggleby	COE	ME	10000
Andrew Kurdila	COE	ME	9000
Beate Schmittmann	COS	PHYS	320000
Cal Ribbens	COE	CS	145000
Chris Wyatt	COE	CEE	10000
Clark Gaylord	VBI	VBI	10000
Craig Mattocks	UNC	GEOS	5000
Danesh Tafti	COE	ME	3633000
T. Daniel Crawford	COS	CHEM	15000
David Bevan	COS	BIOCHEM	504999
David Cox	COE	CHE	50000

Diana Farkas	COE	MSE	4345000
Diego Troya	COS	CHEM	100000
Donald Leo	COE	ME	20000
Elisa Sotelino	COE	CEE	384615
Gary Brown	COE	CEE	300000
Ina Hoeschele	VBI	VBI	14000
Ishwar Puri	COE	ESM	90000
Jacob Sewall	COS	GEO	8000
James McGrath	COS	CHEM	10000
Jaroslaw Sobieski	NIA	NIA	10000
Jean Peccoud	VBI	VBI	333333
Jeff Borggaard	COS	MATH	370000
Joe Schetz	COE	AOE	50000
Joe Wang	COE	AOE	5000
John Hole	COS	GEO	200000
John Jelesko	CALS	PPWS	100000
John Tyson	COS	BIOL	10000
Kenneth Ball	COE	ME	410000
Kirk Cameron	COE	CS	100000
Kyungwha Park	COS	PHYS	340000
Layne Watson	COE	CS	505000
Levon Asryan	COE	MSE	246154
Linsey Marr	COE	CEE	75000
Liqing Zhang	COE	CS	15385
Madhav Marathe	VBI	VBI	100000
Mark Paul	COE	ME	984615
Mark Stremler	COE	ESM	50000
Matthias Imhof	COS	GEOS	120000
Michael von Spakovsky	COE	ME	20000
Michel Pleimling	COS	PHYS	1000000
Mike Cliff	BUS	FIN	10000
Naren Ramakrishnan	COE	CS	1200000
Patrick Koelling	COE	ISE	2500
Bob Walters	COE	AOE	100000
Ron Kriz	COE	ESM	750000
Sarah-Jane Frankland	NIA	NIA	25000
Scott King	COS	GEOS	500000
Sean Corcoran	COE	MSE	212000
Srinidhi Varadarajan	COE	CS	200000
Sucheta Tripathy	VBI	VBI	10000
Suqin Ge	COS	ECON	35000
Terry Herdman	COS	MATH/ICAM	300000
Traian Iliescu	COS	MATH	200000
Uwe Tauber	COS	PHYS	200000
Wu Feng	COE	CS	750000
Yilu Liu	COE	CEE	76000

Ying Zhou	COS	GEOS	1000000
Yu Wang	COE	MSE	246154

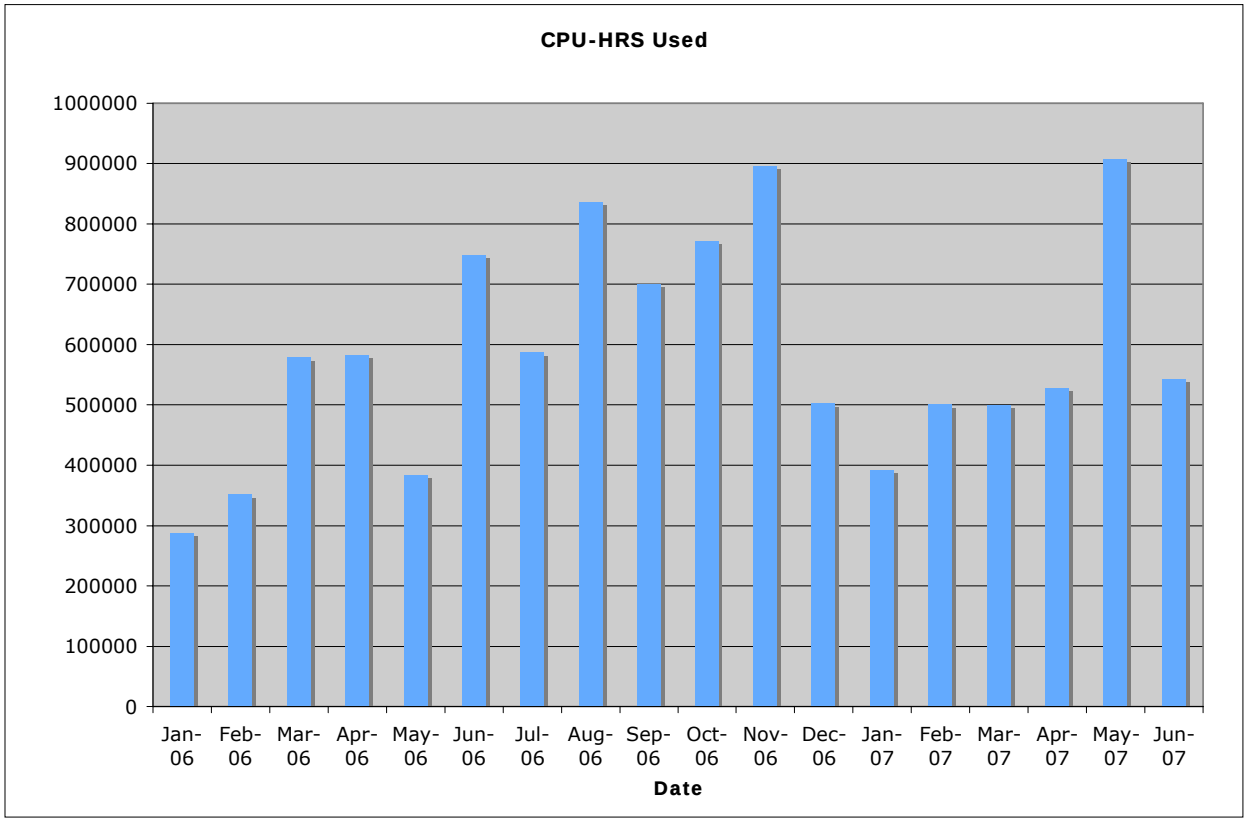
Total Awarded: 25,331,370



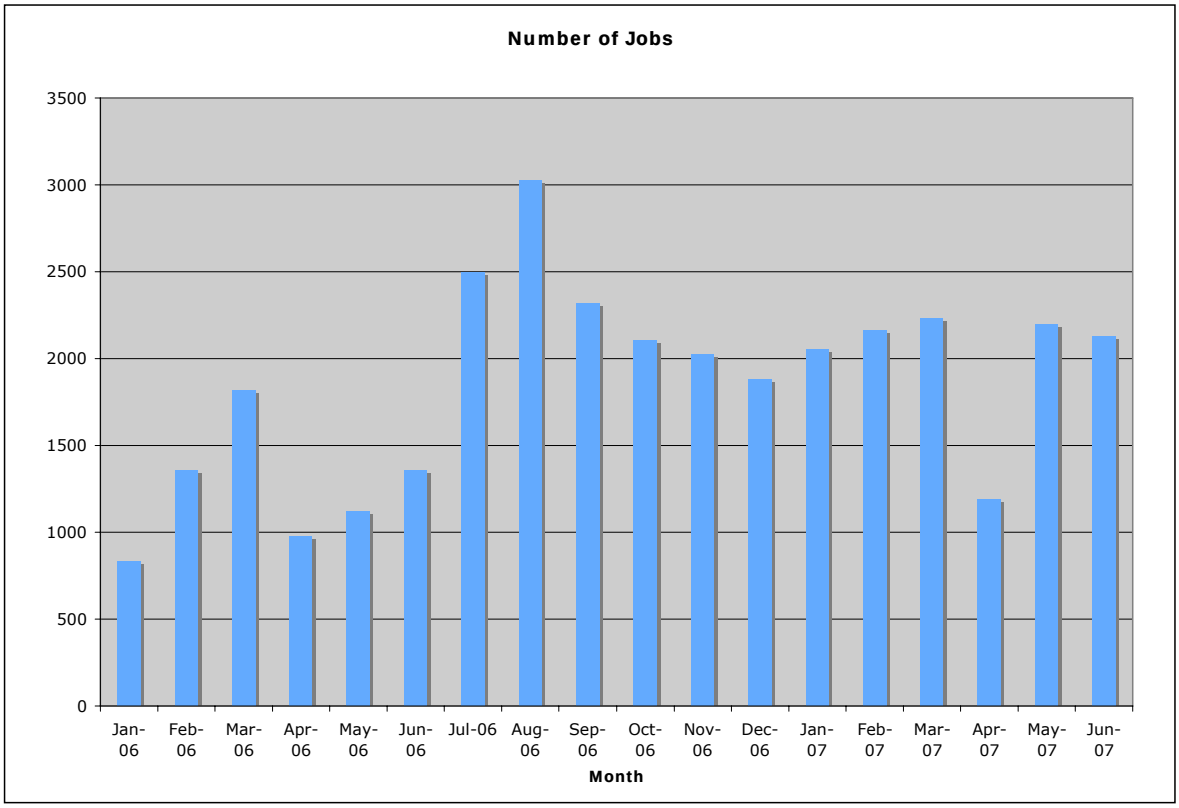
Allocation by research area for System X

System utilization

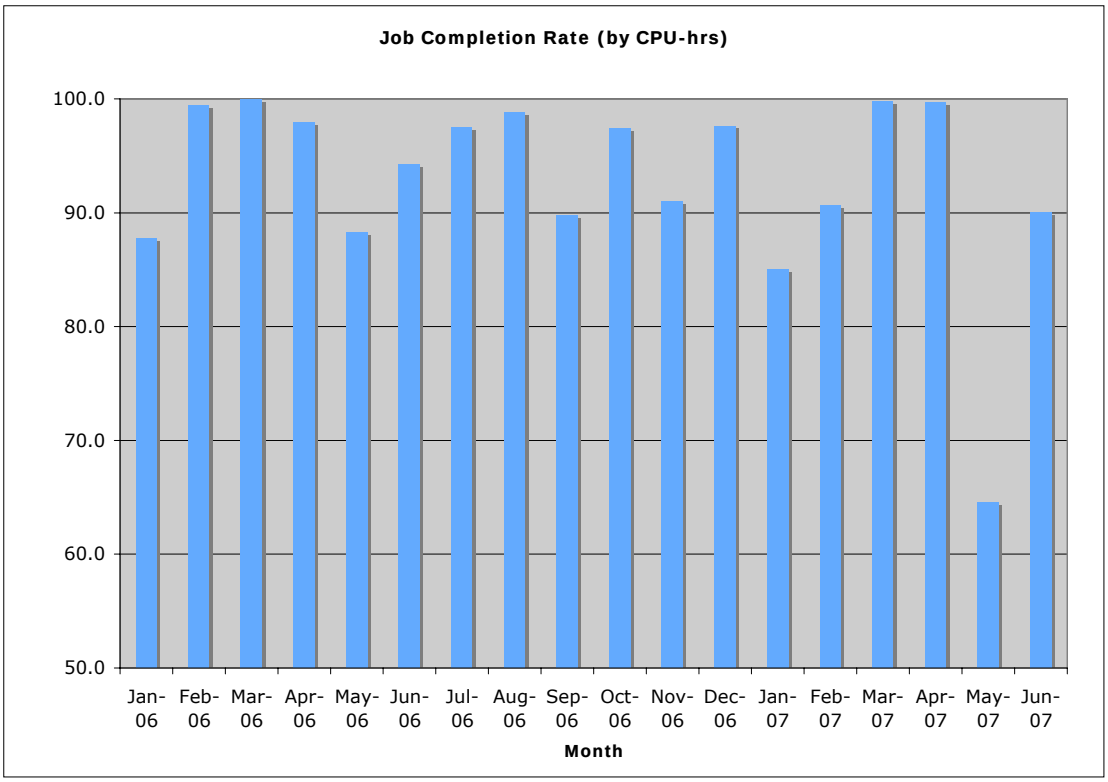
The following graphs and tables show how System X was being used during the production period from January 1, 2006, to June 30, 2007. Utilization is generally highest in mid-semester and summer time periods. In May 2007, we had serious issues with our NFS storage system that lead to the loss of a significant number of running jobs. The NFS issues appear to be related to the high I/O demands some of the running jobs required. Our new SGI NAS storage system should mitigate this I/O performance issue.



Monthly CPU-hours used on System X



Monthly number of jobs submitted on System X



Percent of CPU-Hours that resulted in successful jobs

Research impact

There are several ways to measure the impact of System X on Virginia Tech research. The most direct measure is grants funded and submitted, and publications. A survey of current principal investigators produced the data in the table below. About one-third responded. Investigators were asked to list research proposals funded or submitted during 2006-2007 fiscal year.

System X is generating significant returns on the cumulative investment for its creation, upgrades, and continued maintenance and support.

Survey responses of the principal investigator
research grants and publications related to HPC

PI	College	Dept	06-07 Funded	06-07 Pending	06-07 Pubs
Alexey Onufriev	COE	CS	$250,000		1
Amadeu Sum	COE	CHE		$500,000	5
Beate Schmittmann	COS	PHYS	$92,500	$783,651	4
Chris Wyatt	COE	ECE	$180,000	$560,000	
T. Daniel Crawford	COS	CHEM	$15,000	$240,000	7
David Notter	CALS	APS	$30,000	$53,000	
Danesh Tafti	COE	ME	$768,385	$608,286	31
Diego Troya	COS	CHEM	$180,000	$200,000	0
Elisa Sotelino	COE	CEE	$18,000		2
Gary Brown	COE	ECE	$45,000	$30,000	
Ishwar Puri	COE	ESM		$500,000	6
Jeff Borggaard	COS	ICAM	$81,180		4
Naren Ramakrishnan	COE	CS	$220,262		4
Paul Carlier	COS	CHEM	$250,000		4
Bob Walters	COE	AOE	$70,000	$750,000	2
Sarah-Jane Frankland	NIA	NIA	N/A	N/A	2
Traian Iliescu	COS	MATH	$75,000	$600,000	0
Yuriko Renardy	COS	MATH	$67,000		5
Total			$2,342,327	$4,824,937	77

In addition to grants and publications, we believe another significant benefit of System X has been its role in helping to recruit several new faculty members to the university. Over the last two years, several departments have recruited highly qualified researchers who work in high-performance computing and computational science and engineering. These departments include Chemical Engineering, Chemistry, Civil and Environmental Engineering, Computer Science, Engineering Science and Mechanics, Geosciences, Materials Science and Engineering, Mechanical Engineering, and Physics. Computer Science, in particular, has rapidly assembled a

world-class research group in high-performance computing systems and cluster computing, due in no small part to the commitment demonstrated by the university in System X.

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*).

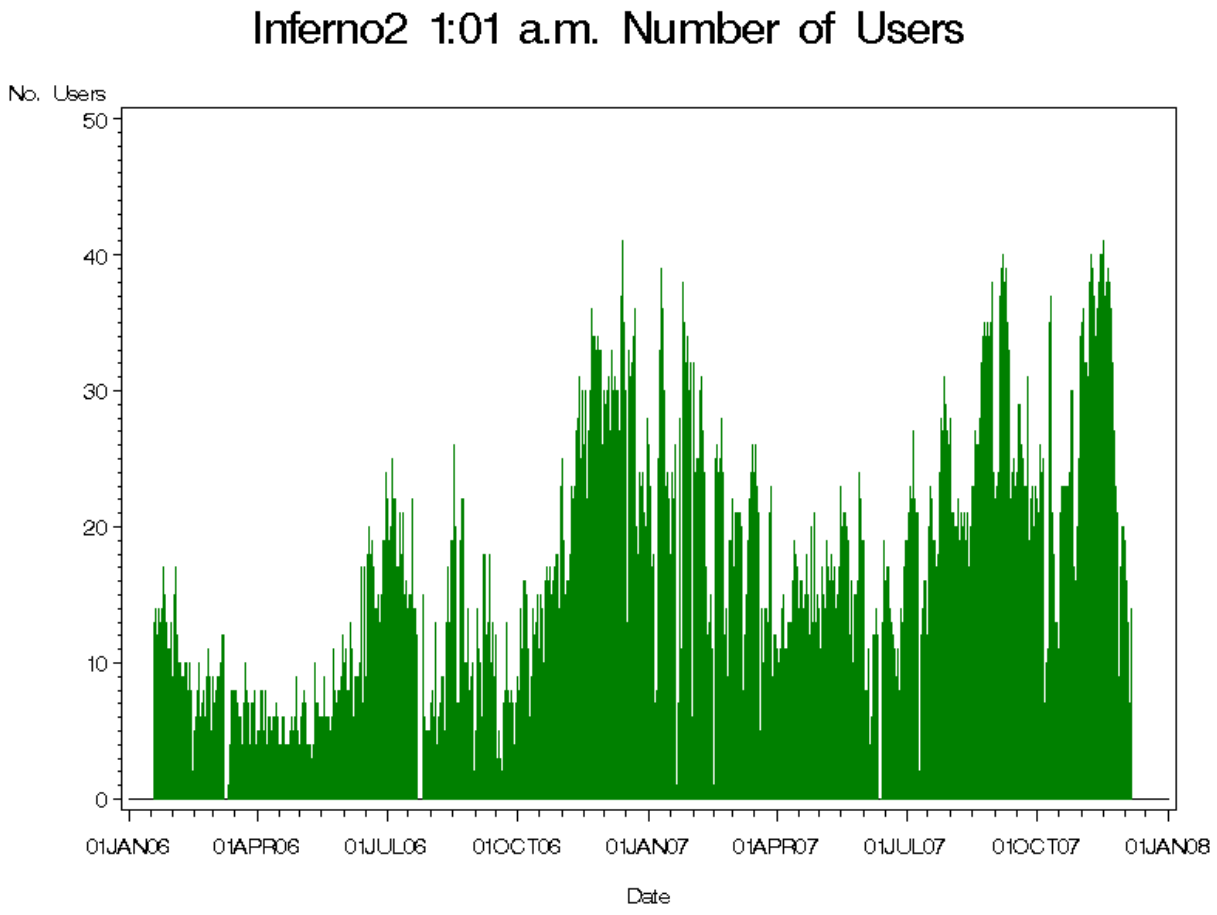
Mathematica provides an environment and collection of tools for visualization, computation, and mathematical analysis (*www.arc.vt.edu/arc/sgi/mathematica.php*).

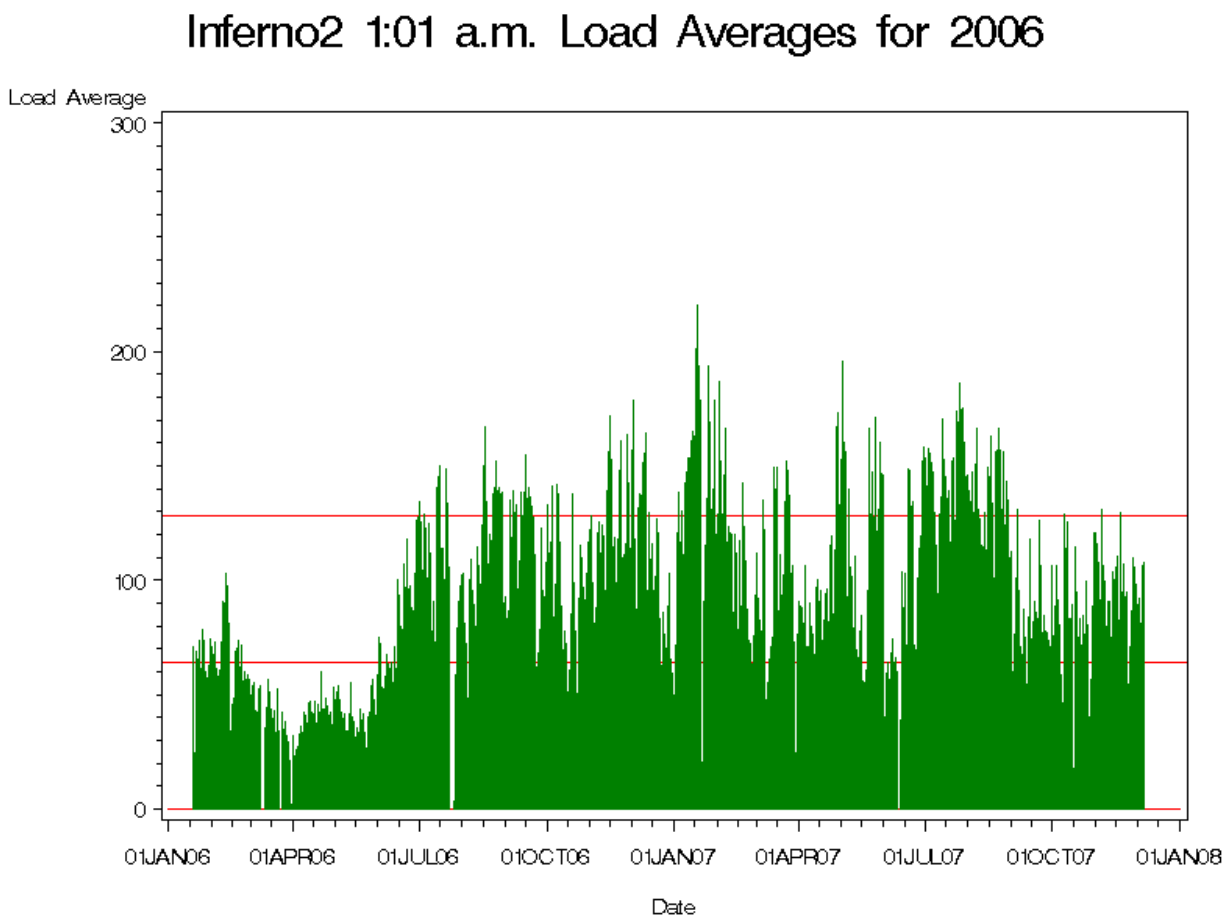
Gaussian is an interconnected system of programs used for performing molecular orbital calculations. Gaussian 03 is now available for your use on Inferno (*www.arc.vt.edu/arc/sgi/Gaussian.php*).

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.





Inferno2 daily load average, reflecting the number of processors (128 CPUs) actively in use

Sun systems

Dante is a Sun Fire v480 system running Solaris 9 which 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 Virginia Tech NAS.

Styx is a Sun Fire v490 system running Solaris 10 which provides researchers with access to high performance computing on a Sun Microsystems hardware platform and supports SAS, MATLAB, and R which 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, NC. (*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

Administrative changes

In Spring 2007, we worked with the Office of the Controller to put a cost center in place. The purpose of this cost center is to facilitate collaboration with external customers who are interested in using Virginia Tech's computational resources. All costs related to Virginia Tech's internal use will be covered by the Information Technology, and Virginia Tech researchers will not be billed.

The rates that have been agreed upon are $0.05 per CPU-hour for federal customers and $0.20 for the market rate. We have had inquires from Harvard University, several NASA-related contractors, and a biotech company in Virginia interested in using our computational resources.

Selected project summaries

System X

Hat: engr1001
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 which influence air quality over thousands of square miles

Hat: engr1002
PI: Diana Farkas, Engineering Science and Mechanics
Allocation history: 5,000 (1/10/05), 240,000 (2/11/05), 500,000 (10/18/05), 800,000 (2/16/06)
Project title: Mechanical Behavior of Nanocrystalline Materials
Project description: studying mechanical properties and deformation behavior of metals and alloys using atomistic simulations involving many millions of atoms

Hat: engr1003
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)
Project title(s): 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.

Hat: engr1004
PI: Alexey Onufriev, Computer Science
Allocation history: 5,000 (1/10/05), 250,000 (6/7/05)

Project title: Insights into the Primary Level of DNA Packing from Novel Computational Methods
Project description: molecular dynamics simulations to study the details of DNA packing within the nucleosome

Hat: engr1006
PI: David Cox, Chemical Engineering
Allocation history: 50,000 (2/3/05)
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

Hat: engr1007
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.

Hat: engr1008
PI: Ken Ball, Mechanical Engineering
Allocation history: 10,000 (3/28/05), 200,000 (6/10/05), 200,000 (10/26/05)
Project title: 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
Project description: using spectral-element code to study complex flows in pipes

Hat: engr1009
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

Hat: engr1010
PI: Ishwar Puri, Engineering Science and Mechanics
Allocation history: 50,000 (7/14/05)
Project title: Multiscale Simulations of Complex Fluids Flowing in the Presence of Electric and Magnetic Fields
Project description: using the lattice Bolzmann 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.

Hat: engr1011
PI: Ron Kriz, Engineering Science and Mechanics
Allocation history: 100,000 (9/6/05), 250,000 (5/24/06)
Project title(s): Deformation Behavior of Gold Nano-Pyramids; and Deformation Behavior of Nickel
Project description: using atomistic simulations to study the response of gold and nickel nanoscale structures to compression

Hat: engr1012
PI: Naren Ramakrishnan, Computer Science
Allocation history: 100,000 (12/24/05), 500,000 (3/7/06)
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.

Hat: engr1013
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

Hat: engr1014
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

Hat: engr1015
PI: Christopher Wyatt, Electrical and Computer Engineering
Allocation history: 10,000 (5/24/06)
Project title: Deformation Based Morphometry of Human and Non-Human Primate Brains
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

Hat: engr1016
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.

Hat: engr2001
PI: Amadeu Sum, Chemical Engineering
Allocation history: 384,615 (1/10/05), 800,000 (3/28/06)
Project title(s): 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.

Hat: engr2002
PI: Yu Wang, Materials Science and Engineering
Allocation history: 246,154 (1/10/05)
Project title: Computational Studies of Microstructure Evolution
Project description: Meso-scale and nano-scale simulations of piezoelectric materials

Hat: engr2003
PI: Mark Paul, Mechanical Engineering
Allocation history: 384,615 (1/10/05)
Project title: Spatiotemporal Chaos and Nonlinear Dynamics of Fluids
Project description: using partial differential equations and spectral solution methods to model the complex spatiotemporal dynamics of fluids at macroscopic and microscopic scales

Hat: engr2005
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

Hat: engr2006
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

Hat: icts1001
PI: Layne Watson, Computer Science
Allocation history: 5,000 (1/10/05), 200,000 (4/12/05), 300,000 (6/10/05)

Project title(s): 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.

Hat: icts1002
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

Hat: rdiv1001
PI: David Bevan, Biochemistry
Allocation history: 5,000 (1/10/05), 99,999 (3/23/05)
Project title: Computational Studies of Protein Structure and Function
http://128.173.49.4/tcfalloc/downloadfile.php?resID=12
Project description: molecular dynamics simulations to allow atomic-level analysis of protein structural features

Hat: rdiv1003
PI: John Tyson, Biology
Allocation history: 10,000 (6/10/05)
Project title: Benchmarking of Electrostatic Interactions in Biomolecular Systems
Project description: testing the performance of molecular dynamics codes used to simulate the properties of cellular membranes.

Hat: rdiv1004
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

Hat: rdiv1005
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.

Hat: rdiv1006
PI: Ina Hoeschele, Virginia Bioinformatics Institute
Allocation history: 9,000 (2/23/06)
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
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.

Hat: vpit1001
PI: Matthias Imhof, Geosciences
Allocation history: 5,000 (1/10/05), 100,000 (11/3/05)
Project title: Preparing the Next Generation Synthetic Seismic Research Dataset
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

Hat: vpit1003
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.

Hat: vpit1004
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.

Hat: vpit1005
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

Hat: vpit1006
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.

Hat: vpit1007
PI: Madhav Marathe, VBI
Allocation history: 100,000 (10/17/05)
Project title: Epidemialogical Modeling
Project description: developing models and software to simulate information diffusion in large populations, with current application to modeling the spread of infectious diseases

Hat: vpit1008
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

Inferno

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 main 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 congential 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

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 of Virginia Tech 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, Virginia Tech will enable more productive scientists and more competitive researchers. In addition, the proposed plan will proliferate visual computing solutions around colleges and classrooms. The Visual Computing Group anchors university efforts to establish visual computing as a core competency and world-class resource.

National Capital Region

A crucial component in the success of Virginia Tech's presence in the National Capital Region (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 NRC. 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.

Complex systems

In many systems, dynamic properties are best modeled with their spatial and structural aspects—spatial relationships are important when structure, location, and function are related. Indeed, such is the case in many domains where complex systems are designed, simulated, or analyzed. Visual computing seeks to reduce the cognitive distance between the user and the system and increase the information throughput between the user and the system.

Through interactive graphical representations, visual computing tools can provide user control of overview and detail views, heterogeneous datasets, and simulation parameters. There are a number of current research projects at Virginia Tech using visualization in this way and these are shown in the following pages. While each of these projects demonstrates the value of visual tools to complex systems research, there are many aspects that must be improved and expanded.

Strategic plan

The 21st 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. Virginia Tech is consistently a leader in innovation and

nationally ranked as a research institution; but there is always room for improvement. This document outlines a proposal to unify our fragmented resources and position the university at the forefront of the modern research enterprise.

Through the Offices of Research Computing and Information Technology, the Visual Computing Group will provide the dedicated staff and infrastructure support required to realize the potential of visual tools for computational science and education at Virginia Tech. This group will expand the existing federally and university-funded infrastructures and allocate resources as follows:

- 60 % research application support
- 30 % education application support
- 10 % outreach support

The director of Visual Computing will sit on two boards related to the management of visualization resources:

- The Advisory Board, which meets monthly to review data, policies, and procedures
  This group will be composed of university personnel, and will recommend hardware and software upgrades, as well as publicity activities.
- The Stakeholders Group comprised of representatives from Research Computing, the Research Division, and each active college, center, institute, or department
  This board will meet semi-annually for review of data, procedures, and policies.

The mission of the Visual Computing Group is to undertake the following activities:

- 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

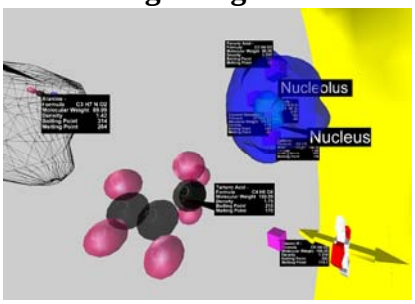
Initially, the group will work with the university’s user base of computational scientists to devise and deliver solutions for scientific visual analysis. This effort will lead to a number of grant proposals to fund post-docs who will continue to develop domain-specific applications. The CAVE will continue 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.

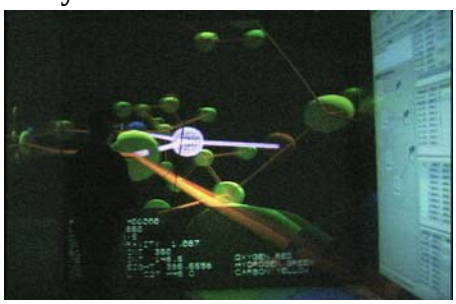
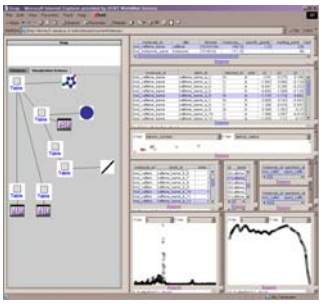
In the interest of connecting desktops, the CAVE, satellite sites, and HPC resources, the group will continue to the development of open-source solutions for information management, delivery, and visualization. This development includes informatics gateways and lab management software as well as visualization components and web services for individual or

collaborative use. The group will actively participate in international standards (e.g. ISO, Web3D, W3C) development for networked 3D graphics and visualization systems, further establishing Virginia Tech as a leader in visual computing technology. As the hardware and software technology infrastructure is established, the staff will be expanded to serve more researchers, departments, and projects.

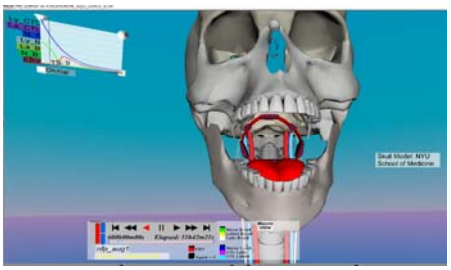
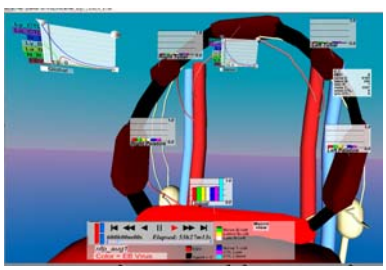
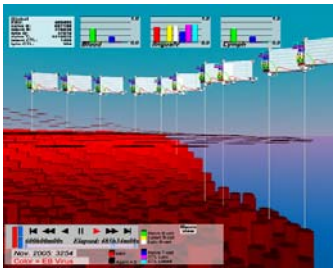
Examples of visual computing in complex systems research

Cellular signaling and molecular dynamics



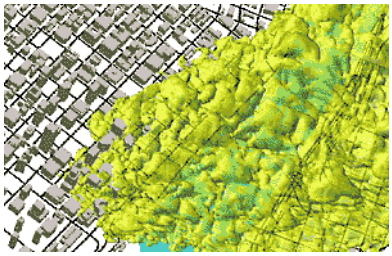
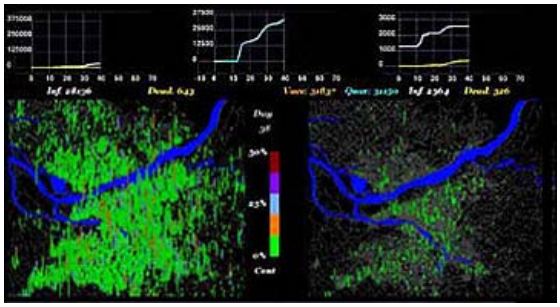
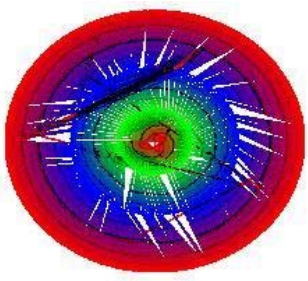
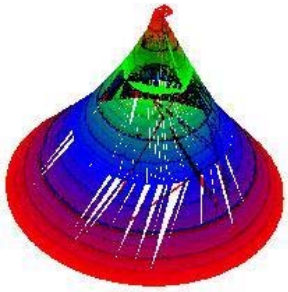



Immunology/virology (PathSim)

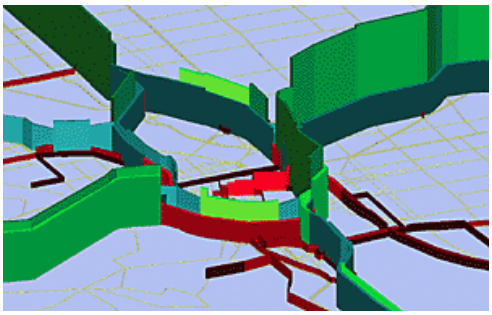




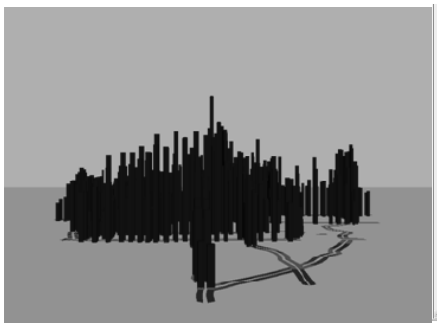
Epidemiology, disaster mitigation, and social networks (episims)

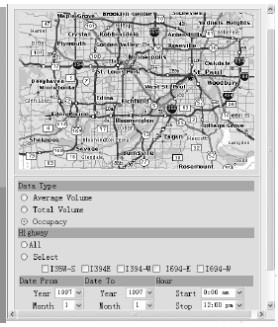


Transportation (Transims)







Inventory, middleware, and services

Hardware inventory

Display venues for visual computing include the VT-CAVE as well as several stereo walls.

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 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.

The hardware inventory includes associated workstations:

- Visualization walls
    - aisb-119-6.cc.vt.edu (AISB 119)
    - yakko.sv.vt.edu (Torgesen 3050D)
- CAVE (Torgersen 3090)
    - cave.sv.vt.edu (SGI Onyx IR2, soon to be replaced by SGI Onyx IR3- IRIX)

- DADS (Torgersen 3090)
    - console.sv.vt.edu (DADS console)
    - dads1.sv.vt.edu (front wall)
    - dads2.sv.vt.edu (floor wall)
    - dads3.sv.vt.edu (right wall)
    - dads4.sv.vt.edu (left wall)
    - io.sv.vt.edu (tracker server)
    - hammer.sv.vt.edu (file server for DADS system)
- Workstations (dual boot Linux / Win)
    - pitr.sv.vt.edu
    - leo.smvc.vt.edu
    - libra.smvc.vt.edu
    - taurus.smvc.vt.edu
    - gemini.smvc.vt.edu
    - wakko.sv.vt.edu
- Servers
    - Apache Viz server, gateway to SysX filesystem (AISB)
        - spectra.cc.vt.edu
    - LDAP/Samba server with Apache (Torgersen 3090)
        - snoid.sv.vt.edu

The Visual Computing Software Stack is installed on all machines and actively developed.

Operational costs for the Torgersen facility (estimated annual expenditures)

Item	Dollars
Power	5,000
Connectivity	1500
Data backup	750
Software licenses	5,000
Travel	8,000
Maintenance	2,000
Office supplies	800
Total	23,050

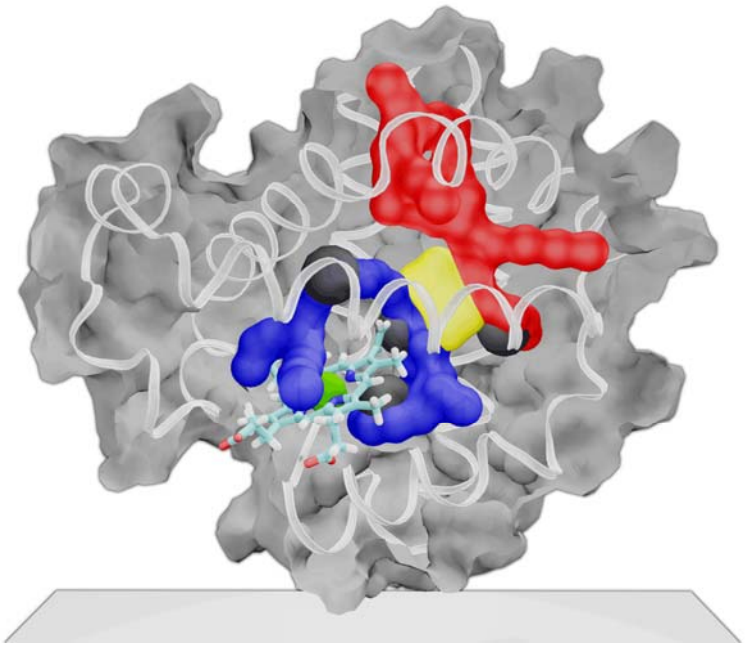
Support Services

The mission of Visual Computing Support Services is to

- consult with researchers about applications of visualization technology;
- develop visualization solutions for domain experts/HPC users;
- train faculty members and students on how to use and demo visualization equipment;
- develop additional grants and funding streams with domain experts to include visualization tools and HPC;
- provide education, outreach, and consulting support to faculty members and researchers regarding the value and application of visual computing and HPC for their productivity, using
    - FDI tracks (e.g. Track R);
    - GEDI courses;
    - office hours and consulting by appointment;
    - an open-house every semester;
- provide world-class visualization facilities for university researchers, faculty members, and students;
- build cutting-edge software stack for domains, emphasizing content portability and ease-of-use;
- deploy visualization web services middleware to HPC systems;
- build and maintain online multi-user collaborative spaces;
- upgrade and proliferate display hardware for speed, resolution, and brightness.

The staffing of the unit includes Nicholas Polys, Patrick Shinpaugh, and Nikita Sharikhov.

Activities



Data from System X molecular dynamics simulation as a 3D virtual environment

In its first eight months, the post-doctoral position created in Virginia Tech Information Technology for 2006-2007 has enabled significant progress and opportunities. The position has served several important functions in advancing the university's visual computing capabilities and paving the way for further progress. Through personnel reorganization and improvements to hardware and software infrastructure, the activity and tenor of activities surrounding visualization have become quite positive.

The goals of adoption and access for the university community have been pursued through a number of avenues such as spring and summer FDI courses ("Deep Media for Research and Education") as well as a credit GEDI course ("Introduction to Computational Science"). 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.

We have continued to further the university's leadership and recognition in enabling visualization tools and technologies. 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/content/examples/development/_pages/page46.html*) as well as 3D medical imaging (DICOM *http://medical.nema.org/*). During this time, we have also notably contributed to numerous well-regarded international conferences as program co-chair, workshops chair, workshop organizer, paper presenter, panelist, and exhibiters.

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 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.

Capabilities

One of the main goals of year one was to improve the visual computing infrastructure, including restructuring personnel and expanding hardware and software to reliably serve more members of the university community.

Personnel

Department of Engineering Education and 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 Terpenny and her NSF Center for eDesign (*www.e-design.iems.ucf.edu/area.html*) to the CAVE lab in Torgersen hall. Dr. Terpenny'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.

Virtual reality systems engineer. A virtual reality (VR) systems engineer is crucial for the maintenance and development of Virginia Tech's cutting-edge visualization and immersive systems. Information Technology and the Research Division have secured one year of continued support for Patrick Shinpaugh, an experienced developer and administrator, whose presence facilitates operations and maintains access to software, hardware, and files for HPC, stereo wall, and CAVE systems across campus and the Corporate Research Center.

Post-doctoral associate. The pilot position as facilitator and enabler of visualization applications for Research Computing has proven to meet an important need of the community by connecting researchers and their data through best-of-breed technology and tools. In addition, consulting, development, and grant proposals have resulted in a number of successful and high-profile projects and publications. The flexibility to meet new opportunities and liaison with multiple stakeholders is important for this role.

Significant progress has been made in supporting faculty research and education through this position. In addition, significant progress has been made in advancing Virginia Tech's international leadership in cutting-edge technologies. However, the nature of a post-doctoral position has some limitations in fully meeting the needs of all the visual computing activities on campus. For example, faculty members and students from many colleges use the CAVE and stereo wall facilities for research, classes, and outreach to great benefit. However, there is no funding stream in place to support educational and outreach activities involving these resources. The CAVE is an essential research and pedagogical tool as well as a flagship publicity venue. We recommend that a director position be created to take over management and administrative duties related to visual computing facilities around campus, including the CAVE. This position should have a base funding stream for salaries, overhead, and maintenance in serving the university for three to five years. More staff may be added in coming years, but in the short term, a set of students internships and graduate research assistants should also be created that would assist in developing web-based interactive 3D environments for class and public communication. Graduate and undergraduate students can scale the impact of visualization technologies across domains.

In all aspects of visual computing and communication, 'content is king.' With more groups on campus producing interactive 3D data and environments, providing multiple avenues to build authors' skill sets will be valuable. Student wage staff could assist in running scheduled and special-case tours of the facilities. With additional consensus toward a positive broad-based plan and with financial support from the university, we believe Virginia Tech can make quantum progress in visualization, in line with other top-tier schools and national labs.

Hardware

CAVE. Virginia Tech's flagship immersive venue, the CAVE, has provided an environment for world-class innovation since its founding in 1997. The successful philosophy of open access should continue. However, the hardware technology at the VT CAVE is aging and in need of replacement or upgrade.

We have proposed hardware upgrades to ICTAS, ETF, and governor's funds that will bring this valuable resource back into its place as a regional and national center for immersive media development. These upgrades include a high-resolution projection system, a new low-latency tracking system, and the latest 3D acceleration cards in commodity PC workstations. As equipment is upgraded in the CAVE, it will be distributed around campus to provide additional research and instructional venues such as stereo walls and natural tracked interfaces.

Stereo walls. The cost of stereo projection systems has dropped dramatically in recent years and now with commodity hardware, large-format projection systems such as interactive 3D walls are more affordable and feasible for moderately sized labs. For visualization applications where structure, scale, or spatial patterns are important, these venues provide significant productivity and insight benefits.

Passive stereo solutions provide the important perceptual cue of depth by way of 'binocular disparity' using lightweight polarized glasses. A wide range of desktop visual analytic software can be rendered from one machine in stereo with these systems. Modern projection displays provide high-resolution, large format wall-size) views for these applications.

In late winter 2007, we purchased a Viz3D system for the conference room and lab in Andrews Information Systems building. The resolution of this wall-size stereo display is 1440x1050, which provides excellent brightness and image quality for presentations and research. The system is dual-boot Linux and Windows machine with the full visual computing software stack installed.

A number of similar stereo wall screens and projection harnesses are or will be in operation at labs and departments this year in the departments of biology, art and architecture, and civil engineering. Most recently, an active stereo wall with ultrasonic tracking (the Fakespace ROVR) was setup in Torgersen 3050. These additions provide faculty members and students multiple opportunities to take advantage of immersive displays for large or complex digital environments

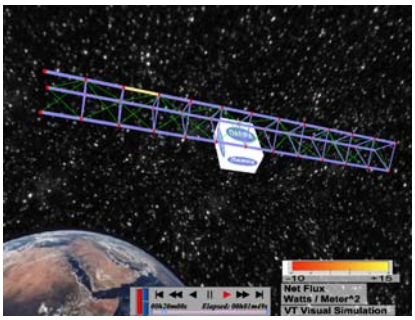
Spectra server. Spectra is the visualization gateway to System X installed in Spring 2007. This machine can serve supercomputer data and visualizations over the web and has a number of advantages over traditional architectures. Like standard web servers, the machine employs programs to transform data into alternative formats for publication and distribution. Unlike standard web servers, Spectra is also a real-time rendering server, able to generate visualizations for distributed and thin clients. This approach, in use by major national labs, is especially advantageous when the data set is prohibitively large to move or process in bulk.

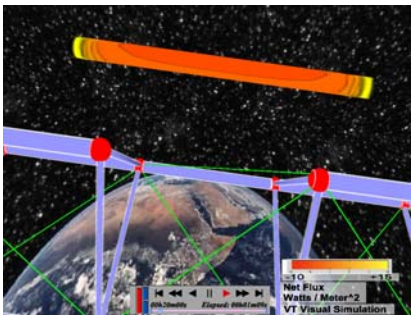
NCR planning. We have provided specifications for a large-format, high-resolution visualization venue in the National Capitol Region in the new building in Ballston. This venue would provide an arena for public, officials, and sponsor demonstrations. It will also serve as an immersive, interactive visual interface to any HPC systems resident there or on the high-speed network. Plans for budget, space, and support are pending approval.

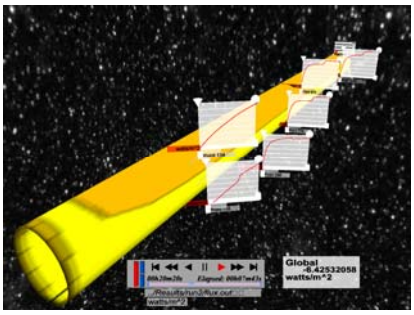
Software infrastructure

In the last eight months, we have surveyed, collected, formalized, and installed a core base of software that serves a majority of users across campus. Across departments, we identified the top tools and data formats in use for domains as varied as physical and biochemistry, computer-aided design, fluid dynamics, and geographic information systems. These tools include web and back-end services for visualization middleware (such as file format conversion and composition of interactive 3D environments) and front-end interfaces for visualization clients for the desktop, stereo wall, and CAVE platforms.

Due to the variety or user requirements for visualization, one size does not fit all. We have therefore focused on developing interchangeable capabilities such as support for international standards such as VRML and X3D. In addition, we have participated with the Naval Postgraduate School and the National Institute of Standards and Technology (NIST) in the development of open source solutions. Support for some commercial packages that require licensing (e.g. Amira) are desired by the HPC faculty, currently un-budgeted. Future work includes expanding capabilities and compliance of the software stack.







Education

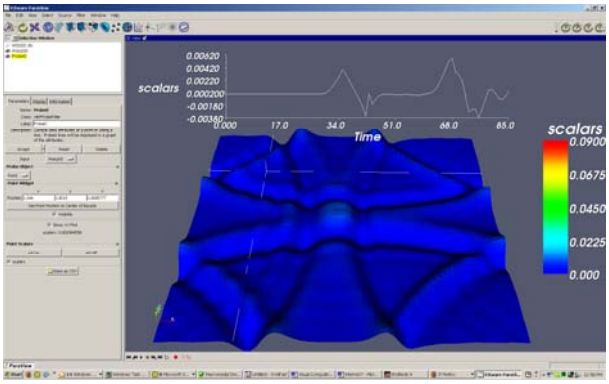
The principal approach to driving adoption of best-of-breed visualization technology relies on the education of faculty members and student users. We have made significant progress in disseminating tools and methods to VT users through formal classes and consultation with various research groups.

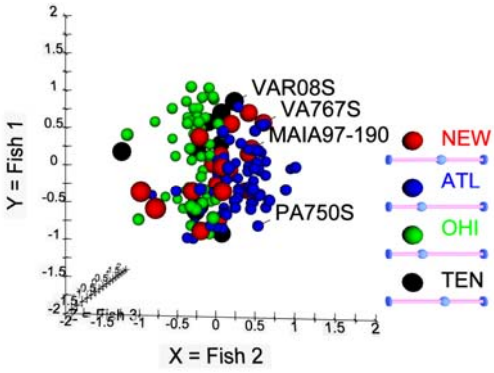
Faculty Development Institute. In the spring and summer terms of 2007, the Visual Computing post-doctoral fellow ran an FDI track called **"**Deep Media for Research and Education**."** Beginning with an introduction and overview to deep media, participants in this track learn the various ways deep media content can be delivered through the presentation of examples from a variety of disciplines. The pros and cons of deep media in research and education are outlined early in this track. From this introduction, participants learn to use various tools that assist with 3D graphics publishing, modeling, and animation. Visualization design techniques are explored and include an overview of recent research into human perception and cognition that informs design choices. An overview of the creation process of dynamic, scripted 3D environments, and immersive environments (e.g., stereoscopy, large screens, and CAVE technology) concludes this track.

Any media/computer-savvy faculty member will be able to be productive in this track; however, as it progresses, a knowledge of client-side (e.g., Java, ecmascript, etc.) and server-side (e.g., Perl and PHP) technologies will aid in understanding but are not required of all participants. Upon completing this track, participants will be able to plan and execute basic interactive visualization and 3D content production. Between the two offerings of this class, over a dozen faculty members from multiple colleges have successfully completed this training.

Graduate Education Development Institute. We participated in the planning and execution of a pilot program through the Graduate School focusing on skill sets for the "Workshop in

Computational Science.” With a team-taught format, Dr. James Turner, Dr. Nicholas Polys, and Dr. Cal Ribbens ran a two credit evening class that gave students basic applied understanding of simulation tools, visualization tools, and workflow.





Support

Visual Computing facilities and the CAVE provided research infrastructure for four master's students and four Ph.D. students, as well as two outstanding undergraduates in Computer Science alone. This research into computer science and human-computer interaction topics using the CAVE resulted in at least six peer-reviewed publications as well as successful theses and dissertations. In addition, the CAVE featured prominently in a number of publications and grants in other departments (Aerospace and Ocean Engineering, Biochemistry, the Virginia Bioinformatics Institute, Civil and Environmental Engineering, and Industrial and Systems Engineering).

Faculty projects. Through consultation and project development, we have provided expertise and solutions for projects in the following departments: Computer Science, Mathematics, Biochemistry, Physics, Plant Pathology, Building Construction, Architecture, and Art and Art History.

Student projects. Through consultation and project development, we have provided expertise to graduate students and their projects from Computer Science, Civil Engineering, Mechanical Engineering, and Fisheries and Wildlife Science.

Leadership

Through the post-doctoral position and Virginia Tech’s continued membership in the Web3D Consortium, Dr. Nicholas Polys has continued to lead and advance international standards for

networked, interactive 3D environments. As an elected member of the board of directors, Dr. Polys has helped guide the organization in recent successes including new members and effective liaison relationships with medical imaging standards groups (DICOM), game physics standards groups (COLLADA), and geospatial standards groups (OGC).

Dr. Polys is an active contributor to these industry-standard specifications. In the X3D Specification Working Group, he has provided key contributions in the area of text rendering and programming interfaces. As co-chair of the User Interface Working Group, Dr. Polys is applying his experience in 3D user interfaces and human computer interaction to open up the scene graph to multiple input devices and output displays. Finally, as Web3D representative to DICOM, he has contributed to the next-generation 3D mesh description for medical imaging devices. By participating in industry efforts such as Web3D standardization, we have continued to advance Virginia Tech's leadership in cutting-edge technologies.

Recognition

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 some tours including current and prospective faculty members and students. In March 2007, we assisted in hosting the Structural Biology Symposium at Virginia Tech and included CAVE tours for attendees.

Conferences and publications. In November 2006, we attended SC06 in Tampa, Florida. Virginia Tech had a strong presence at the conference with a booth and multiple papers being presented. Dr. Polys of Research Computing assisted with the booth planning as well as video examples and a presentation on visualization at Virginia Tech. This trip was productive for Virginia Tech recognition, but also for education of our team. For example, the "Workshop on Ultra-Scale Visualization" was an excellent venue to discover and discuss how next-generation tools will meet the challenges of tera-scale and peta-scale computing.

Dr. Polys was an important member of the IEEE VR 2007 Program Committee, serving as workshops co-chair. He also organized a workshop with other leading international experts entitled "Future Standards for Immersive VR." His contribution to this workshop included the position paper, **Polys, Nicholas F**., "Parallel Realities? The Requirements of Web3D and Immersive VR", for the Workshop on Future Standards for Immersive VR, *Proceedings of IEEE Virtual Reality*, IEEE Press. 2007. Dr. Polys was also a panelist on the NSF-sponsored student panel, ""Building the Future of and a Career in VR," which received outstanding ratings from attendees.

For the twelfth annual ACM/Eurographics Web3D 2007 Symposium, Dr. Polys served as program co-chair. The conference this year has an exciting variety and depth of topics. In addition, he is an invited participant for a panel on scientific visualization and a paper presenter. The paper describes our work done on the software middleware for simulation visualization.

Citation: Polys, Nicholas F., Shapiro, Michael., Duca, Karen, "IRVE-Serve: A Visualization Framework for Spatially-Registered Time Series Data," Web3D 2007 Symposium, ACM SIGGRAPH, 2007.

Journals. Dr. Polys' research on perceptual cues and display size in information-rich virtual environments is beginning to be published in computer science and graphics journals:

> Polys, Nicholas F., Kim, S., Bowman, D.A. "Effects of Information Layout, Screen Size, and Field of View on User Performance in Information-Rich Virtual Environments," *Computer Animation and Virtual Worlds* 18:1, 2007.
>
> Bowman, D., Chen, J., Wingrave, C., Lucas, J., Ray, A., Polys, N., Li, Q., Haciahmetoglu, Y., Kim, J., Kim, S., Boehringer, R., and Ni, T. (2006), "New Directions in 3D User Interfaces" *International Journal of Virtual Reality 5*, 3-14.
>
> Duca, Karen A., Shapiro, Michael, Delgado-Eckert, Edgar, Hadinoto, Vey, Jarrah, Abdul S., Laubenbacher, Reinhard, Lee, Kichol, Luzuriaga, Katherine, Polys, Nicholas F., Thorley-Lawson, David A., "A Virtual Look at Epstein–Barr Virus Infection: Biological Interpretations," *PLoS Pathogens* Vol. 3, No. 10, e137 doi:10.1371/journal.ppat.0030137.

Dr. Polys was also lead or co-author on a number of journal papers submitted this year:

> Polys, Nicholas F., Bowman, D.A., and North, C., "The Role of Depth and Gestalt Cues in Information-Rich Virtual Environments" *International Journal of Human-Computer Studies*, Elsevier (submitted 3/2007)
>
> 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," *PLOS Pathogens*. (submitted 2006).
>
> Yost, Beth, Saraiya, P., Polys, N.F., and North, C. "A Hierarchical Design Space for Visually Integrating Spatial and Multidimensional Data," *International Journal of Human-Computer Studies*, Elsevier (submitted 3/2007).

Funding efforts

We have worked diligently to alert and educate stakeholders in our new activities behind visualization. We have had communication with a number of department heads, deans, the Research Division, and ICTAS. While we were unable to garner significant internal financial support, we received positive verbal encouragement. We hope to translate these good intentions into real action and support for a comprehensive plan.

Grant funding. We completed an early phase software project for the Naval Postgraduate School. A number of proposals have been generated. One SBIR and two NSF proposals were not funded. Two additional NSF proposals are still pending with Dr. Polys as co-principal investigator:

- One add-on to the NSF MILES-IGERT ISE grant, “Thrive! A Radical Approach to Living Well”
- One NSF CCLI Phase 2 “Integration of Visualization with Structural Systems Understanding to Improve Technical Education of Architects”

We are planning and positioning for a large-scale NIH submission this year concerning the integration of visual informatics, protein structure, and molecular dynamics.

Researcher comments

“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 VT community will benefit from these modern technologies.

“For example, our recent $0.5M grant from DTO/NGA is a direct result of NSF and VT 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, VT 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, VT 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 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 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 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 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 Terpenny, 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 VT-UVA-Carilion Biomedical Institute initiative, university 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/Director, 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, Asst 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/Assc.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

Future goals

In this first year, we have demonstrated the value of visualization development and operations for Virginia Tech to be a world-renown innovator in visual computing. To be truly successful and compete with top-tier institutions, we believe is essential to have sustained commitment from the university administration and community as well as federal funding agencies. The organizational structure of Virginia Tech has been a challenge for our goals of open access. For example, visualization capabilities cut across research, education, and outreach activities. While we have proven that our approach meets a broad-based need and we have engaged stakeholders, obtaining consensus and investment from multiple parties has proven a difficult task. Indeed, at the current level of support, we are at a bare-bones survival budget: if equipment breaks, that functionality goes off line.

The most positive outcome would be administrative support for a comprehensive visualization plan that leverages the university's expertise and resources. By funding staff, overhead, and maintenance costs, we can provide the community with demonstrated solutions that are on par with other nationally-ranked institutions. For example, strategic investments will allow reliable access to facilities and a scaling of visualization consulting and development services.

The Visual Computing Group is actively seeking internal and external funding support for upgrades to bring Virginia Tech to a world-class stature for visual analytics. These upgrades include improvements to hardware and software, and adding time and talents.

Hardware

- Visualization servers (gateway to HPC filesystems, replacing Spectra)
  - Sun X4600 and 2 Quadro Plex Model 1 (NSF CRI proposal in, est $336k)
- CAVE upgrade
  - New high-res, super-bright projectors (est. $250k)
  - New tracking system (est. $30k)
  - 'New' SGI IR3 to replace IR2 (donated by BP)
  - New DADs Cluster nodes (est. $24k)
- Gigapixel system(s) (est. $25k ea.)
  - TORG electricity (est. $38k)
  - Bandwidth upgrade to Torgersen Hall
  - Additional workstations for content development seats (est. $4.5k ea.)

Software

Additional seats for commercial tools are requested by faculty members including Amira, Nugraf, 3DstudioMax, and Maya. A proposal is in consideration by ICTAS for Amira licenses for the CAVE.

Personnel

Building out application solutions and services to scale with demand will require additional staff. We are actively pursuing internal and external funding support for post doctoral fellows and new hires:

- Web services programmer ($45k)
- Visualization programmer ($55k)

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 (CS), 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 (CS), Wage student
Jeffrey Nelson is a Computer Science undergraduate who does hardware repairs and administrative work for System X. He has worked with System X since his freshman year. His work involves diagnosing/repairing hardware, administration, system programming, and other tasks as assigned.

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 Advanced Research Computing group in October of 2005. He provides consulting support for research applications, subroutine libraries, and programming languages. He is also responsible for ARC documentation and manages the web site.

Vivek Venugopal (ECE), Graduate research assistant
Vivek Venugopal is a PhD candidate with the ECE Department at Virginia Tech. He is working on reconfigurable communication and computation aspects of FPGA enabled high-performance

reconfigurable computing (HPReC) systems at ARC. His research interests include reconfigurable communication synthesis and cluster FPGAs.

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:

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
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

Invited lectures and participation:

- Invited presentation at SIAM Conference on Computational Science and Engineering, Costa Mesa California, February 2007
- HPC User Forum, Coeur d'Alene, Idaho, April 2007
- BM's CIO Conference, Hawthorne, NY, March 2007
- Dell Executive Brief, Washington, D C, March 2007
- Sun Worldwide Education and Research Conference, San Francisco, California, February 2007
- Invited presentation at DARPA, Large Space Systems Workshop, Mandalay Beach, California, September 2007
- Super Computing Conference, SC2006, Tampa, Florida, November 2006.
    - Organized Virginia Tech Booth

Presentations on Virginia Tech Research Programs

Professional Service:

- Member Education Committee, Society for Industrial and Applied Mathematics (SIAM).
- SIAM Representative to Mu Alpha Theta
- Co-Chair SIAM Visiting Lecturer Program.
- Editorial Board, Journal of Integral Equations and Applications.
- Refereed for Journal of Integral Equations and Applications, Journal of Applied Numerical Mathematics, Journal of Mathematical Analysis and Applications, Journal of Computers and Mathematics with Applications, Journal of Numerical Methods for Partial Differential Equations
- Member, Global Organizing Committee, World Congress of Nonlinear Analysis, to be held in Tampa, Florida, July 2008
- Member, Mu Alpha Theta Board of Governors.
- Member, SIAM Selection Committee for the W.T. and Idalia Reid Prize in Mathematics.
- Special Award Judge, Intel International Science and Engineering Fair, Albuquerque, NM, May 2007.
- Super Computing Conference, SC2006, Tampa, Florida, November 2006.

- Organized Virginia Tech Booth
- Presentations on Virginia Tech Research Programs

Other Virginia Tech appointments/obligations:

- Director Interdisciplinary Center for Applied Mathematics (ICAM)
- Virginia Tech Representative to the Coalition for Academic Scientific Computation
- Virginia Tech Representative for SURA Board
- Virginia Tech Liaison for ORNL
- Virginia Tech Councilor, ORAU Council of Sponsoring Institutions

Highlighted activities for Kevin Shinpaugh, Director, High Performance Computing

- Conducted project with Hayes, Seay, Mattern & Mattern in Roanoke to use System X for Architectural rendering. Sponsored Program project $16,569
- Attended HPC User Forum Fall 2006 Denver
- Lead Virginia Tech's booth at SuperComputing 2006, Tampa, Florida
- Co-PI on Virginia Tech's NSF submission with Argonne National lab on SPRUCE: Urgent Computing. If funded IT: $50K, VBI: $50K
- Attended HPC User Forum Spring 2006 Idaho
- Worked with SGI to design our HPC storage system. Delivered June 2007
- Investigated use of System X with AMA in Hampton Va. Project did not get funding. They would still like to use System X.
- Hired Vivek Venugopal to serve as an Intern in HPC. He is working on special projects with Virginia Tech researchers.
- 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 BladeCener-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 2006: AOE 4065 "Space Design"
  - Spring 2007: AOE 4066 "Space Design". 32 Students; AOE 4984 "Special Study: Rocket Flight Test Lab"
  - 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 for Visual Computing

- 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-PI 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 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 & 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 & referee)
- Numerous Vis Lab tours and for faculty, classes, and external groups
- NSF Center for eDesign Industry Advisory Board

Professional Service:

- Member and Director Web3D Consortium; Key Contributor X3D WG, Medical WG, X3D Earth WG; Co-Chair User Interface Working Group (WG)
- Key Contributor DICOM medical imaging standard: 3D surface representation, n-D Presentation States
- Refereed for: Presence Journal, IEEE Transactions on Visualization and Graphics, International Journal for Human-Computer Studies, International Conference on Computational Science and Its Applications
- Member ACM, IEEE

Other Virginia Tech appointments:

- Affiliate Research Professor, Department of Computer Science

Goals for fiscal year 2008

Research Computing/Visualization budget: It is obvious that the past mode of operation (seek support from colleges, departments, research groups, etc. to purchase hardware, to fund staff positions and provide other research computing needs) is becoming ineffective/unsuccessful. IT has provided the majority of the funds that allowed us to be successful in such efforts. We must find other ways to fund research computing and visualization. During this time period, different ways of producing a budget must be evaluated. The best possibilities must be pursued. We should seek a seat at the table when the university makes decisions on Equipment Trust funds and research initiatives for the university. Although computational science (and research computing) was one of the four Virginia Tech proposals that was submitted to the initial Governors Research Panel and was partially funded, we have received very little support from the governor's research initiative funds for the past few years.

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.

Conclusion and recommendations

Computational modeling and simulation represents a new branch of scientific methodology, alongside theory and experimentation. In many aspects, computational resources provide a virtual laboratory to conduct scientific and engineering investigations.

The computational resources that Research Computing offers the university research community are highly valued. A key principal investigator at Virginia Tech has generated over one million dollars per year in research funding and has published over 36 publications based on the use of the computational resources provided. The loss of these resources would severely limit his research.

Several new faculty members in the College of Engineering and the College of Science selected Virginia Tech based on our computational resources and the willingness of the research computing staff to work with them.

Continued support for this research computing infrastructure asset is critical for its continued success. Resources including System X, the SGI Altix computers, stereo walls, and the CAVE have shown their value to the Virginia Tech research community through a notable increase in sponsored research related to HPC. There is a great deal more that can and should be done to increase the utilization of computational assets that benefit the research mission of this institution. With additional support, these efforts can benefit a wider range of researchers and research needs.

Secure Enterprise Technology Initiatives

The mission for Secure Enterprise Technology Initiatives (SETI) is to develop secure applications, middleware, and interfaces to support the university's computing and network services. The department works in conjunction with the Information Technology Security Office to enforce auditable security standards that address privacy issues while providing a balance between system usability and system security. SETI research and development initiatives exploit leading edge, innovative technologies to enhance the ability of Virginia Tech affiliates to interact securely with new and existing computing and networking services.

In fiscal year 2006-2007, SETI was comprised of the Collaborative Technologies Unit, eProvisioning, Microsoft Implementation Group, Middleware, and the Test and Deployment group. These units contributed to the strategic goals of Information Technology by providing secure, robust, and highly functional enterprise systems that support teaching, learning, and research while protecting access to university data. Programming code developed by SETI is offered to the Open Source community.

Teaching and learning. The Enterprise Directory contains personal electronic credentials that allow university electronic services to authenticate and authorize their users. Contact information for employees and students is stored in the Enterprise Directory and viewable using PeopleSearch. Students can elect to remove any or all of their information from public display. The Enterprise Directory was designed to support services that recognize inter-institutional credentials used for collaborative teaching and learning environments.

Research. SETI continues to develop and maintain the Enterprise Directory and Virginia Tech's Public Key Infrastructure. Both of these services position Virginia Tech to participate in identity management federations that allow exchanging credentials with other institutions, including government research agencies.

April 16, 2007. SETI staff members were involved in implementing the VT Alerts notification system after the tragedy of April 16, 2007. The SETI director served on both the Security Infrastructure Group and the Information and Communications Infrastructure Group, contributing to the recommendations related to security and managing personally identifying information.

Secure access to university data. The Central Authentication Service provides a secure method for Web authentication, allowing people to enter their Enterprise Directory credentials without passwords being known by the application requesting authentication information.

The Hokies Active Directory contains credentials for users of Windows applications. Windows machines are kept up to date with patches using the Virginia Tech Windows Software Update Service (VT WSUS), an automatic patch subscription service. VT WSUS enhances the Microsoft automatic update service by providing reports for the help desk, departmental computing administrators, and individual computer users.

The Virginia Tech Certification Authority's Public Key Infrastructure issues digital certificates that encrypt information transmitted between servers. Personal digital certificates (PDCs) are also issued, which facilitate digital signatures and encryption of data at rest.

The security and usability of all SETI applications and services is scrutinized and enhanced by a group that specializes in testing. The testing methodology and documentation has improved the quality of applications developed by SETI and serves as a model for other Information Technology units to incorporate testing into their project plans.

Collaborative Technologies Unit

The Collaborative Technologies Unit (CTU) specializes in open source application development to enhance the ability of Virginia Tech affiliates to interact securely with new and existing computing and networking services. The following information outlines major projects undertaken by the group in 2006/2007.

My VT Web portal. Virginia Tech became a member institution in the JA-SIG organization. JA-SIG is a non-profit global consortium of educational institutions and commercial affiliates supporting open source software development and promoting open computing architectures for higher education. The organization maintains the uPortal code base on which My VT runs.

CTU began work on a new version of My VT. My VT 4 was to replace the aging My VT 3 framework in August 2007. However, development was halted after the events of April 16th in order to focus on new priorities within Information Technology.

Virginia Tech Central Authentication Services. In its second year of operation, the Central Authentication Service (CAS) continues to be a success. Many new clients were added to the service in 2007. CTU developed a new release of VT CAS based on the open source release of CAS 3.0. This will pave the way for future functionality such as providing authorization data. In June 2007, CTU successfully handed production responsibility for CAS over to the Middleware group.

VT Search/VT PeopleSearch. Two Thunderstone Search Appliances were purchased in order to bring VT Search back in-house so that Virginia Tech has more control over its enterprise search results. CTU is currently configuring and testing the appliances. A redesign of VT Search, based on the Thunderstone Search Appliances, is tentatively scheduled for Fall 2007. This project is currently behind schedule due to a shift in priorities after April 16th.

Instant Messaging pilot. The VT Instant Messaging (IM) pilot ended in Summer 2007. CTU established the production IM service and successfully handed it over to the Mail Team to maintain.

Board of Visitor's portal. CTU continued to maintain the portal for the board's Finance and Audit Committee. CTU and staff members from the Office of the Executive Vice President and Chief Operating conducted a number of meetings to discuss the future of this project. Potential changes are pending approval.

VT Alerts. VT Alerts was an emergency project that came about due to the events of April 16th. CTU collaborated with many organizations across department lines to develop this application. CTU was responsible for the user interface of VT Alerts and currently maintains the production software.

Content management system. CTU played a key role in the content management system project. Team members served on the various committees to specify and select the product. The team continues its involvement by participating in technical meetings and product training.

eProvisioning

The eProvisioning unit has continued its work to integrate public key technology into university business processes resulting in several significant achievements during the 2006-2007 fiscal year. These efforts were focused primarily on making public key technology available to the end user community by extending the Virginia Tech Public Key Infrastructure to issue personal digital certificates (PDCs). The deployment of PDCs at Virginia Tech is being phased in gradually beginning October 2006 with the issuance of personal digital certificates to faculty and staff members reporting within Information Technology. Members of the eProvisoning unit provided the project leadership and technical support that spearheaded the successful deployment and management of PDCs in several areas of this initiative.

User Certification Authority. The eProvisioning unit completed its work to establish the production VT User Certification Authority (User CA) during a key generation ceremony on September 20, 2006. The User CA provides the foundation for issuing Virginia Tech PDCs and complements the existing server and middleware certificate services provided at the university. PDCs are personal identity credentials that are based on public key cryptography that has increasingly become accepted as the de facto solution for ensuring a secure and reliable means for user authentication. In addition the benefits of PDCs can be extended to support the use of digital signature, data integrity and data privacy.

Token Administration System. The eProvisioning unit completed the development of Token Administration System (TAS) v1.0 an administrative software application to support the management of PDCs issued onto smart devices. The TAS system is being used to provide full lifecycle management of PDCs including subscriber registration for a PDC, issuance of a PDC onto a smart device (Aladdin eToken PRO USB), certificate revocation, and smart device password resets. TAS has been used to issue 455 personal digital certificates to university employees since it was released on September 25, 2006. It is expected that an additional 6500 PDCs will be issued onto eTokens to faculty and staff members during the 2007-2008 fiscal year. The eProvisioning unit is continuing with the development of a TAS v2.0 release that will add additional functionality including smart device inventory control, an enhanced administration interface, and extensive reporting capabilities.

Digital signature. Realizing a need for tools that application developers can use to integrate public key technology in their Web applications, the eProvisioning unit completed development of a set of generic PKI Web services. The PKI Web services provide an intuitive and easy to use high level Application Program Interface that application developers can use to implement digital signature in their Web applications. Working in cooperation with the HR office, the eProvisioning unit demonstrated how the PKI Web services could be used to implement digital signature in the university Leave Entry and Reporting Web System and the IRM Workflow applications. By providing the necessary PKI integration tools, the eProvisioning group has opened the door for use of digital signature in other Web applications at the university.

VT Policy Management Authority. The eProvisioning unit has worked closely with the Policy Management Authority of the Virginia Tech Certificate Authority (VTCA) to help develop and streamline the procedures needed for digitally signing and publication of the certificate policy and certification practice statement documents. eProvisioning has continued to provide the technical assistance needed to administer the VTCA hardware security module equipment during key signing events and other ongoing administrative operations of the VTCA.

Smart device support. The eProvisioning unit has been actively involved in ongoing research and evaluation of different smart device technologies and was instrumental in the deployment of Aladdin PRO USB tokens as the smart device selected for initial issuance of PDCs in October 2006. The eProvisioning group is currently working to design and implement an enhanced smart device infrastructure that will be capable of supporting devices from a variety of vendors. As a result, the university will be able to realize the benefits and support the deployment of many emerging smart devices technologies in the future.

Documentation and communications. Providing clear and easily understood documentation for users is key to the successful deployment of a complex technology like PKI. Members of the eProvisioning unit serving on the PDC documentation and communications project team have provided valuable assistance with the design and implementation of a PKI website to help address documentation and communication issues. As the enrollment of PDCs on smart devices is expanded during the 2007-2008 fiscal year, the contribution of the eProvisioning unit to this effort will help facilitate the deployment as users are introduced to this new technology.

Token middleware installation support. eProvisioning has continually emphasized the importance of using a deployment strategy that focuses on simplifying the end user experience when working with complex technologies like PKI. Because the implementation of PKI can

sometimes be a daunting task for the novice user, the eProvisioning unit has spent considerable time and effort developing software installers that can be used to automatically install and configure the necessary token middleware required on a user's platform. Because of their achievement in this effort, a complex endeavor has been reduced to a simple plug and play experience for the user.

Data encryption. Protecting university data is important because of privacy issues, legal requirements such as the Family Educational Rights and Privacy Act, financial implications, the need to avoid bad publicity, and the need to protect intellectual property. The proliferation and expanded use of mobile devices at the university has compounded the security risks of unauthorized information disclosure due to theft and loss. In November 2006, the eProvisioning unit responded to a request from the Virginia Tech Information Technology Security Task Force to form the Encrypted Data Storage (EDS) Workgroup. Their charge was to investigate the functional requirements for implementing file and disk encryption systems for mobile devices and to recommend solutions. As of August 2007, the eProvisioning, unit along with other members of the EDS workgroup, has evaluated several disk encryption products from a variety of vendors:

- PGP Desktop 9.5
- SafeGuard Easy 4.30
- TrueCrypt
- Guardian Edge
- BitLocker
- PointSec for PC
- SafeBoot

The EDS workgroup is nearing completion of its research and will be recommending solutions to prevent accidental or unauthorized disclosure of sensitive university data that resides on desktops and mobile devices. These recommendations will:

1. identify methods available for encrypting desktop and mobile device storage;
2. recommend baseline requirements for purchasing encryption software;
3. recommend commercial products or native built-in tools.

Certificate issuance statistics. As of August 2007, 998 certificates have been issued by the certificate authorities.

Certificate Authority	Beginning	Issued
User CA	9/2006	455
Server CA	4/2003	433
Middleware CA	7/2004	110

Microsoft Implementation Group

Active Directory and Windows support. The Microsoft Implementation Group (MIG) provides 24x7 support for Virginia Tech's Active Directory (AD) forest. The group began work on the ADAdmin project that will shift some administrative duties from Information Resource Management to organizational unit (OU) administrators. An account cleanup was done that helped free up space on the Network Attached Storage. Production Windows 2003 servers were upgraded to Service Pack 2, and an update for Daylight Savings Time was developed and deployed for unsupported university clients. An Active Directory Health Check was performed, with positive results. Hardware warranties and the Microsoft Premier Support Services were renewed.

Security. MIG created a secure multi-user kiosk for personal digital certificates on Aladdin eTokens. The kiosk provides a restricted Windows software environment in a secure hardware cabinet. The kiosk is currently located in the SETI office area, but could easily be replicated in other buildings. MIG staff members participated in the Encrypted Data Storage group for the IT Security Task Force. Research on Bitlocker resulted in valuable documentation, a presentation and work with University Development to integrate Bitlocker with the Active Directory. The VT Windows Software Update Service (WSUS) patch management tool developed by MIG last year was upgraded to support Vista, improve scalability, and to produce dynamic graphical reports (below).

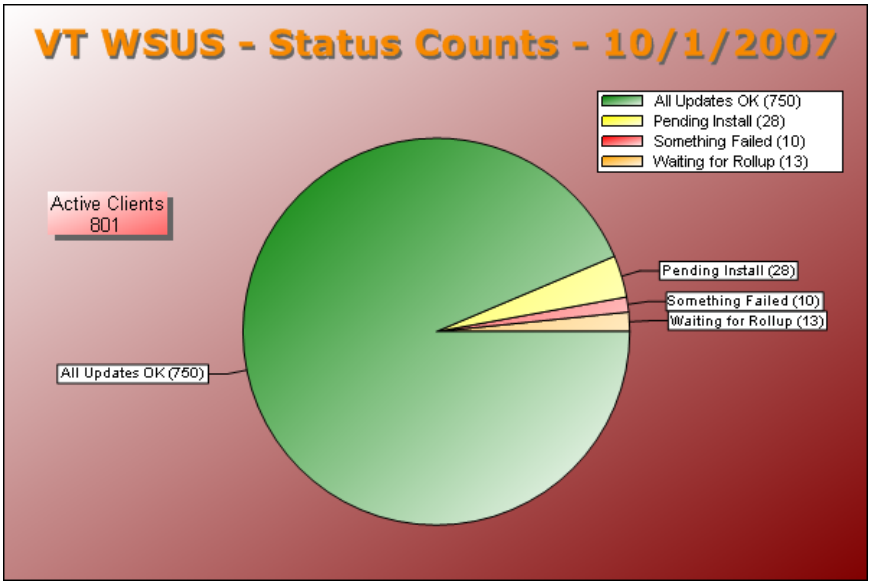
Research and development. MIG maintains a hardware and software test environment that was used to assist the Business and Management Systems department in testing Microsoft Live Communications Server for the Office of the Executive Vice President. 802.1x research was done in collaboration with Communications Network Services. A Virtual Machine environment was built and hosted to support testing a license key server for Information Technology Acquisitions. MIG continued to contribute to the open source software (OSS) community as indicated by their download statistics. (See *http://opensource.w2k.vt.edu/download_stats2.php*.) Hokies Self-Service was extended with My Services 2, which replaced the old interface with a Wizard-like user interface, added flash-based tutorials, expanded tooltips and screenshots, provided backup and recovery state, and added the ability to detect potential system and IP issues during the join process.

Consulting. Several other units benefited from MIG consultations this year. An Active Directory needs assessment was done for University Unions and Student Activities, the Department of Psychology, the College of Natural Resources, and the Institute for Critical Technology and

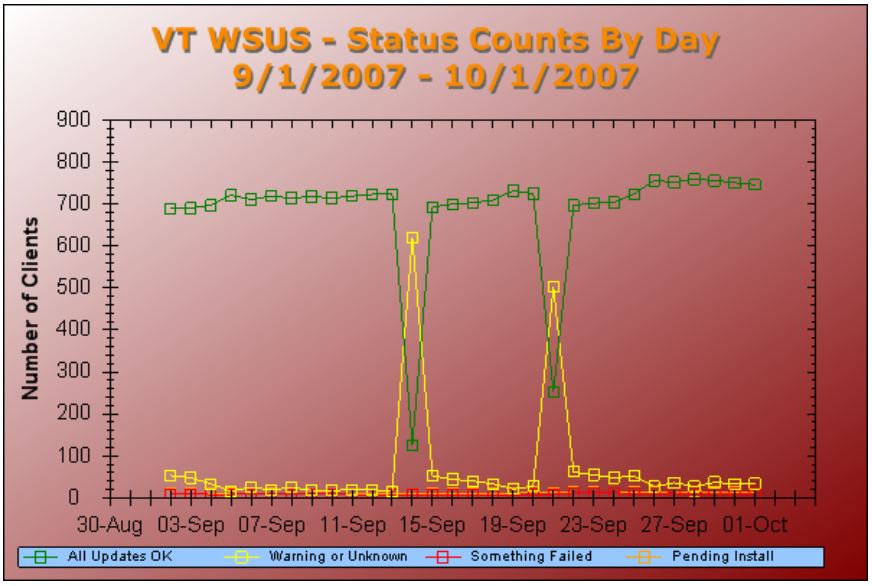
Applied Sciences. Vista licensing and activation was reviewed for 4Help and Information Technology Acquisitions, and Knowledge Base articles were reviewed. Best practices for migrating to Windows 2003 were developed with departmental personnel who support child domains. The MIG leader chaired a task force to review anti-virus products and participated in the Information Technology Project Management working group.

Professional development. MIG hosted a variety of professional development activities, including the Windows Users Group, classes for Microsoft .NET debugging, IIS 6.0 Critical Problem Management class, WSE, .NET Security for Developers, and MIIS. The MIG leader also attended Hokie Mart training, participated in VT, IT, and You student check-in and assisted another department with personnel interviews. MIG members made presentations on VT WSUS, Vista, and Bitlocker at the ACCS conference. The group engaged in cross-training activities to enhance their knowledge and their abilities to support production services. SANS Forensics Analyst certifications were earned for four MIG members, one of whom was asked to join the SANS mentor program!

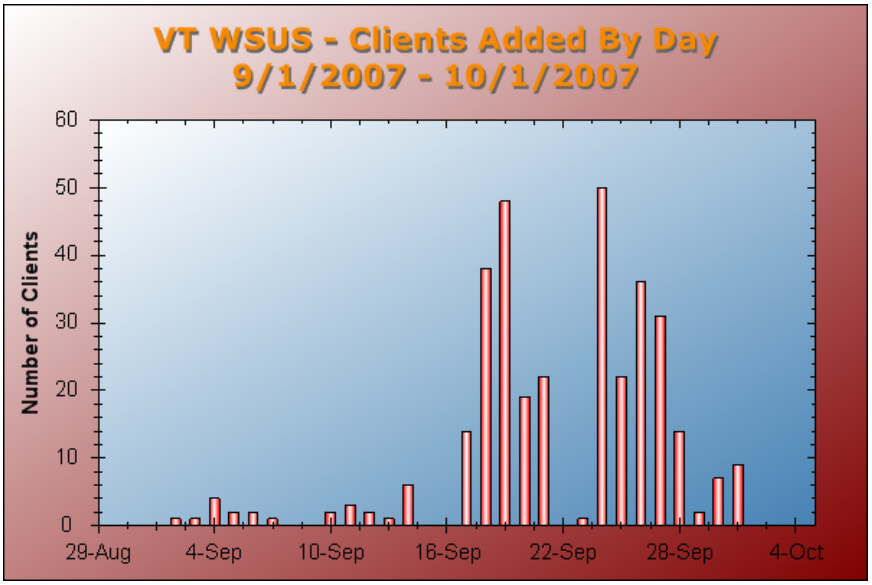
MIG statistics



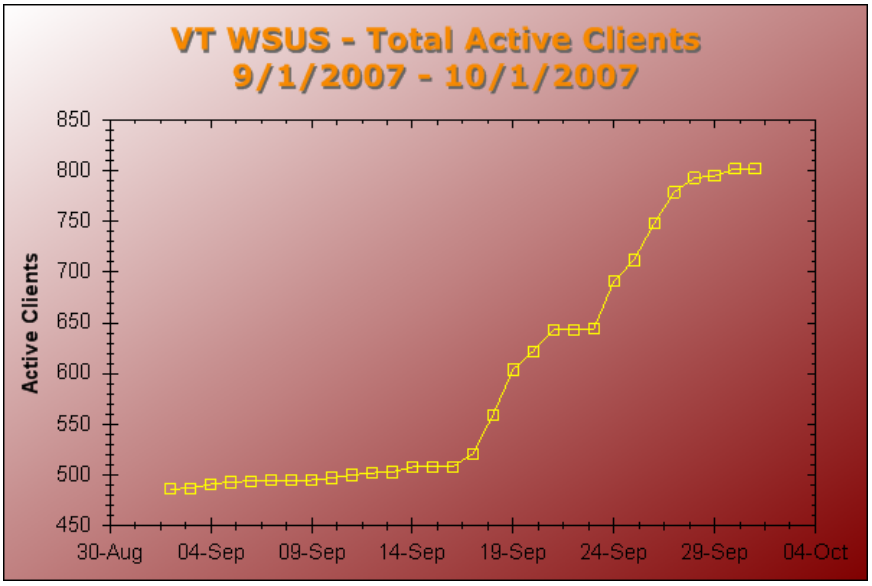
Number of clients in the VT WSUS system and their statuses



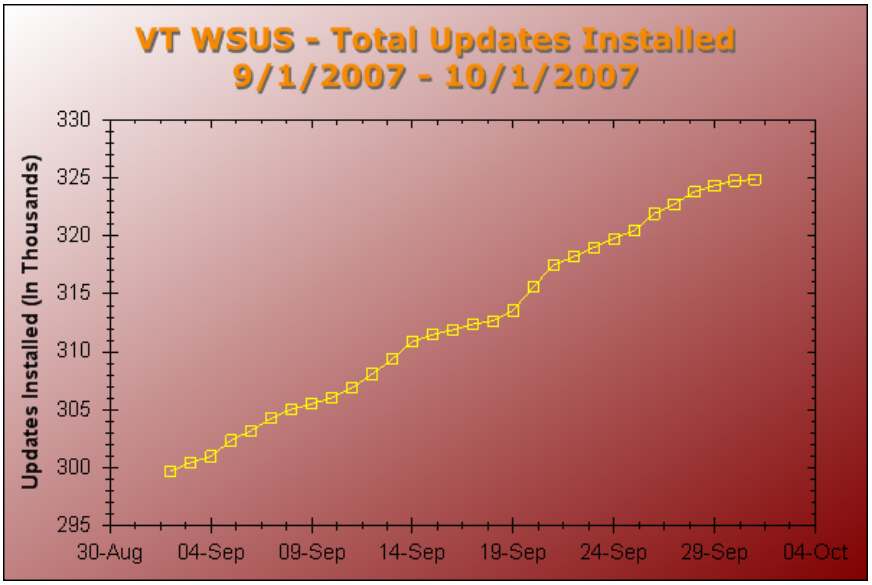
Client status as indicated over time. Note the speed of patching clients.



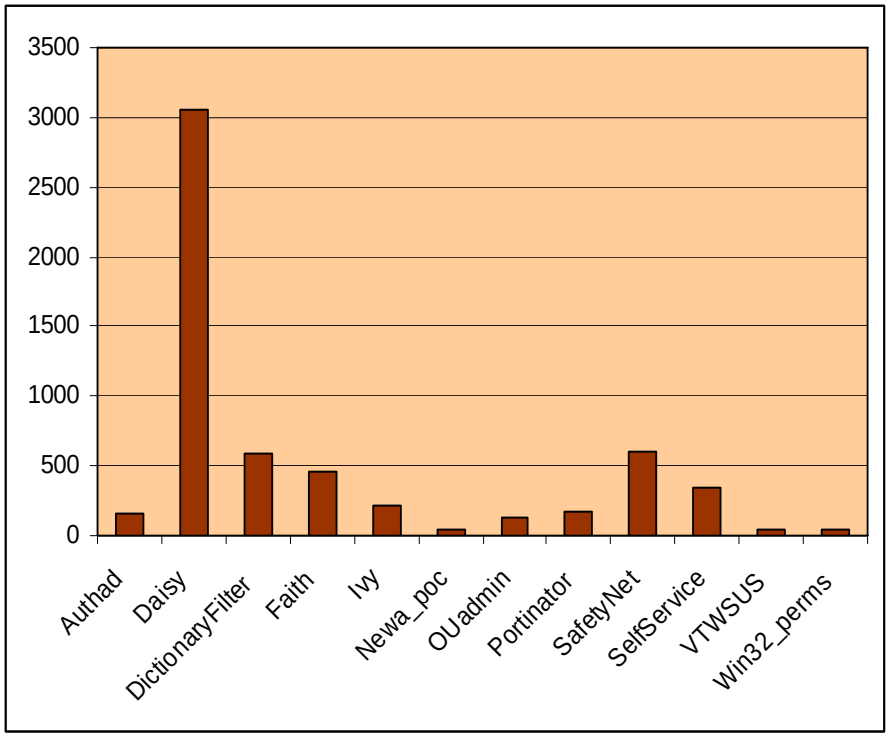
Clients added per day into the VT WSUS system



Clients added over time. Note the spikes over a month period.



Updates pushed to clients (in 1000s).



Open source download statistics

Middleware

The Middleware group supports the critical Enterprise Directory infrastructure that provides personal identifier (PID) authentication and authorization services for the university. The Central Authentication Service (CAS) provides a secure way for applications to utilize PID authentication. Middleware assumed responsibilities for CAS development and support during the summer of 2007.

Enterprise Directory. Maintenance to the Enterprise Directory (ED) infrastructure included upgrading OpenLDAP from version 2.2.x to 2.3.x. OpenLDAP performance tuning was done to improve search speed for applications such as VT PeopleSearch. The addition of more affiliations (vt-student-future and vt-student-recent) enhanced the ability of service providers to properly authorize potential service consumers based upon an ED affiliation.

Middleware replaced the Banner-to-ED PL/SQL replication code with a Java based solution that Middleware could support. Work was also done on code that will eventually replace the Registry-to-Banner replication. Junk Mail Manager (JMM) settings were replicated from ED to the VT e-mail server. Support for SynchroV3, which replicates data from ED to the Active Directory, was transferred to the Microsoft Implementation Group.

Web applications. The Central Authentication System (CAS) and Directory Access Tool (DAT) are Web applications that interface with the Enterprise Directory. Middleware took responsibility for CAS from the CTU group this year, and integrated the Middleware wiki (*www.middleware.vt.edu*) with CAS. The DAT, used primarily by 4Help and IRM, was converted to use the Struts framework, with the addition of many new features and bug fixes. Junk Mail Manager information was also added to the DAT.

Services. Middleware updated the PIDgen session bean for new PIDgen portlet. Namearbiter performance tuning and improvements were made.

Research, development, and other improvements. Rewriting of the DAT required evaluation of Struts. Time was spent evaluating Enterprise Java Beans 3.0, and Middleware began updating their Java environment to that release. Middleware also installed Oracle 10g for testing purposes. The group began using JIRA to track bugs and fixes. All Middleware machines moved to the new Foundry load balancer. Mail expiration processes were enhanced to do integrity checking and send notifications to the mail team on failure. The Oracle 10g upgrade was applied to the Middleware databases.

Test and Deployment

Test Team infrastructure. The test bed was moved upstairs to be wheel-chair accessible. Newer surplus equipment was obtained to replace aging surplus equipment. Two new Vista-capable computers were purchased, along with two Intel Macintoshes. New KVM switches and a better ghosting process have allowed a wider range of operating system installations and configurations.

The Jira instance at *https://bugs.cc.vt.edu* was used extensively to track test requests, issues, and resolutions. Efforts are underway to improve business processes and documentation to provide more efficient testing for SETI developers.

Testing for eProv. Implementation of the digital signing of leave reports required testing of the Certificate Authority and Registration Authority, the Token Administration System, personal

digital certificate webpages, and Aladdin eToken middleware installer packages for Windows XP and 2000, Linux, Macintosh PowerPC and Intel. (The Windows Vista installer is still being tested.) The installers required an extensive amount of re-testing and re-writing of instructions. Kimberley Homer also attended many committee meetings for the User CA, PDC documentation, and PKI implementation, and the Test Team provided data for Internal Audit.

Testing for Middleware. CAS (Central Authentication Service) was tested with a variety of operating systems and browsers, and was found to be robust when used with PID and password credentials. Authenticating with eTokens should improve in the coming year. Changes to employee affiliations, the Registry replication process and schema were also tested, as were improvements to the DAT.

Testing for CTU. CTU shared responsibility for the new PID Generation tool with Middleware and IRM. Testing projects with code developed by multiple units challenges the Test Team to determine which group should address problems that arise. Using Jira was helpful in documenting error messages so that conditions could be re-created. My VT also had some enhancements that required browser testing. The CTU developers were especially responsive to user interface suggestions.

Testing for MIG. The Test Team tested WSUS and MyStore2, which uses Hokies Self-Service for the user interface. MIG offered many good suggestions on improving our test/developer communication process.

Other projects. The VT Alerts notification service was developed and implemented in three weeks. Carl Harris and the development team responded to nearly 50 issues discovered in testing, issuing a new code release each day, and ultimately deploying a secure, easy-to-use service.

The Junk Mail Manager was a much-needed enhancement for the POP mail server. The Test Team staff used the JMM in the pilot stage, and verified accompanying changes in My VT and in the Registry.

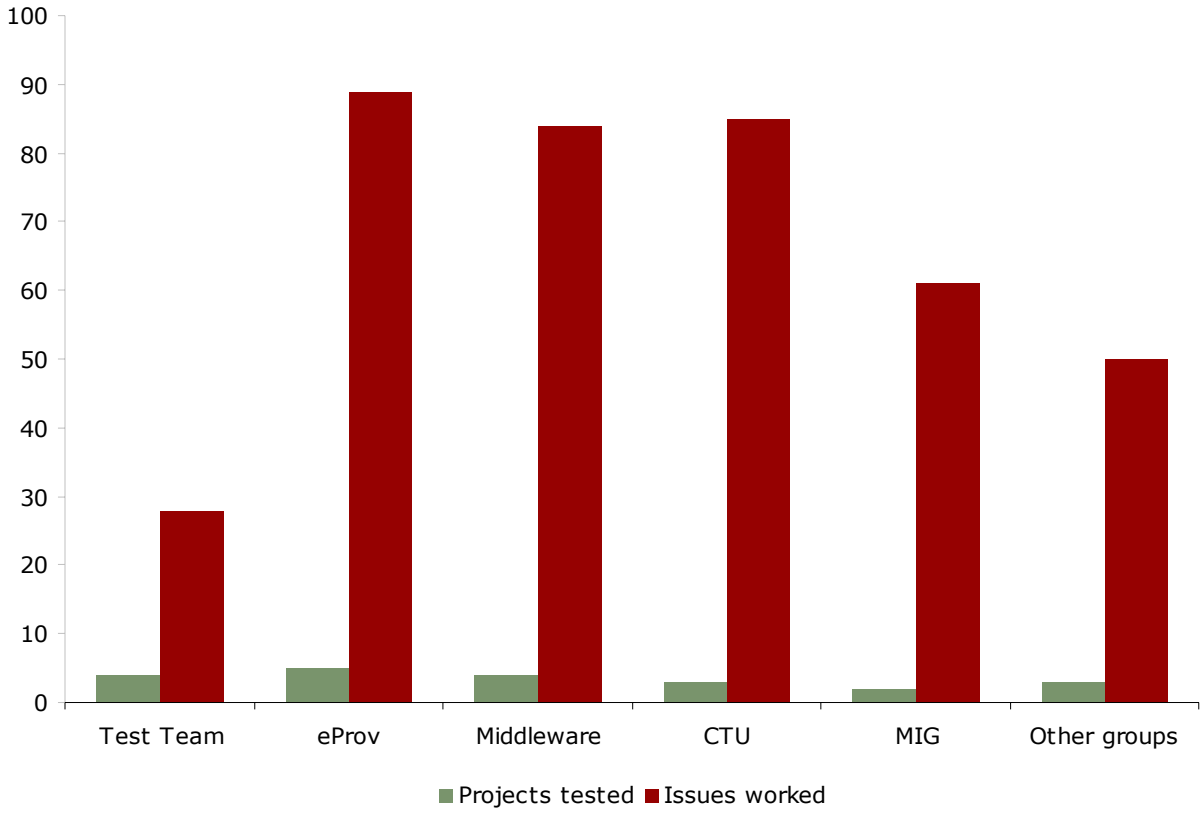
Kimberley participated in several rounds of interviews for Call Center and 4Help consultants, and continues to serve on the Data Quality committee.

Doug Atwater participated in both SANS and Vista training this year. Kimberley attended Greg Kroll's workshop on project planning.

Bradley Snyder, graduate assistant, tested the browser compatibility of David Bingham's campus accessibility maps. He also prepared a draft on PKI in a university environment. Sadly, he lost his friend Ryan Clark on April 16, and spent the remainder of the semester in mourning.

Cindy Woods transferred from the vice president's office, and is providing much-needed help with testing and documentation. We have also hired an undergraduate psychology major, Laurel Neidigh, who will help us set up a usability lab. JR Fleeman has been a mentor for Cindy, and he and Doug Atwater continue to test with cleverness and enthusiasm.

This chart shows the distribution of our testing load this year.



Professional development and education

Bahaa Alamood
Earned Masters of Information Technology May, 2007
Attended 6th Annual PKI R&D Workshop, April 2007
Attended Vista For Support Professionals Training, Dec 2006
Attended SANS Internet Security Training Workshop, System Forensics, Investigation and Response, March 2007

Ismael Alaoui
Attended Vista For Support Professionals Training, Dec 2006
Earned SANS GIAC Certified Forensics Analyst certification
Attended SANS What Works in Mobile Encryption Summit 2007, April 2007

Zeb Bowden
Earned SANS GIAC Certified Forensics Analyst Certification

Marc DeBonis
Earned SANS GIAC Certified Forensics Analyst Certification, with invitation to become a SANS mentor and teach classes locally.

Mary Dunker
Presented Virginia Tech's PKI Implementation at Internet2 PKI Workshop, December 2006

Co-chair, EDUCAUSE/Internet2 Security Task Force Effective Practices and Solutions Working Group, starting April, 2007
Program Committee for EDUCAUSE Mid-Atlantic Regional Conference 2008, began serving January 2007
Attended McComas Leadership Seminar May 3, 2007 – Bridging the Generation Gap
Attended EDUCAUSE and convened session, October, 2006

Daniel Fisher
Shibboleth developer attending Internet2 Meetings, October, 2006, December 2006

Frank Galligan
Presented at 15th Fed/Ed PKI Coordination Meeting, June 2007

Brian Long
Attended Tomcat training offered by VT Educational Technologies

Randall Price
Earned SANS GIAC Certified Forensics Analyst Certification

Steve Warrick
Earned SANS GIAC Certified Forensics Analyst Certification

Cathy Winfrey
Attended Tomcat training offered by VT Educational Technologies