# TABLE OF CONTENTS

3. Preface

5. I. Solid Foundation of IT Infrastructure & Sound Fiscal Planning

9. II. Access to Network Resources

13. III. Institutional Commitment: Faculty & Staff Engagement

21. IV. Teaching & Learning: Content, Access, Distributed Education

31. V. Research: Computation, Communications, Collaboration

47. VI. Information Systems: Managing IU’s Information Assets

59. VII. Telecommunications: Applications, Infrastructure, Convergence

69. VIII. Support for Student Computing

77. IX. Digital Libraries & the Scholarly Record

88. X. Security, Privacy, Intellectual Property

91. Appendix. Contact Information & Credits
The Indiana University Information Technology Strategic Plan was approved by President Myles Brand and the Trustees in December 1998, and the Office of the Vice President for Information Technology and CIO (OVPIT) was given responsibility for its implementation. Thus, 2004 was the sixth full calendar year, and FY 2004-2005 the sixth full financial year of the implementation of the Plan.

This document is a summary for this period principally of University Information Technology Services (UITS) accomplishments, but also of those of other parts of the University, in implementing the Plan and activities related to it. Though this document is, strictly speaking, prepared for FY 2004-2005 as part of the University’s annual budgetary process, realistically it reports accomplishments mainly for the calendar year 2004, given that it is prepared in early 2005. While the plan was designed as a five-year plan, its recommendations and principles guided IU’s activities and initiatives in IT through 2004. OVPIT has produced a document similar to this on an annual basis for each year of the Plan.

The Plan consists of 10 major Recommendations and 68 Actions. The accomplishments for 2004 are described under these.
Recommendation 1: The University should build a solid foundation of IT infrastructure that will help and enable IU to achieve a position of leadership, and to assure that sound fiscal planning permits the maintenance of this infrastructure at state-of-the-art levels.
**Action 1.** The University should build lifecycle replacement funding into its planning at every level of investment in information technology (including personal, departmental, and central systems, and network hardware and software); and UITS should develop a lifecycle replacement model to use where needed in conjunction with its investments in information technology. Implementation should begin immediately, with full funding of lifecycle replacement phased in over a fixed number of years.

**Action 2.** The University should budget a standard amount per year, per FTE to support lifecycle replacement of faculty and staff desktop computers, and to cover the cost of providing local support to that desktop.

**Action 3.** The University’s stock of computers should be systematically modernized so that they are all capable of supporting current releases of widely used software, Web access and other basic tasks of computation and communication.

In August 2000, after little more than two years of progress on these Actions, IU completed the implementation of lifecycle funding for desktop computers, operating systems, and common applications for all the campuses of the University and for all 110 IU Schools and service units. During the initial phase of this project, more than 10,000 obsolete computers in 110 Schools and service units were replaced at a cost of $11M. The replacement value of the inventory was calculated at $20M. Faculty and staff desktop computers were upgraded so that 15,000 computers are now less than three years old. A $6M annual lifecycle fund has been established to keep more than 15,000 faculty and administrative desktop computers up to date with the units and UITS sharing management and supervisory responsibility.

The impact of systematic renewal of desktop computers throughout the University goes far beyond personal productivity and satisfaction. A population of computers with common powers, offering software largely recommended by the University, makes the IT environment throughout Indiana University easier to support.

Agreements with major software vendors, including Microsoft, Macromedia, Symantec, Oracle, Corel, SPSS, and others, mean that all IU computer users have access to the most recent releases of popular desktop software. The most extensive of these agreements, the Microsoft Agreement, distributed in its first six years 592,194 copies of the Microsoft operating systems and personal productivity suites such as Microsoft Office. These agreements have resulted in savings for faculty, staff, and especially students of more than $96M thus far. In addition, a more easily supported common base of software and a common hardware platform allow for improved service to users.

University Information Technology Services (UITS) and IU Purchasing have negotiated to leverage the mass purchase power of the University to realize the lowest workstation and notebook prices in meeting lifecycle funding objectives. Similar negotiations have resulted in the purchase of more than 37,000 machines by IU Schools and departments, realizing savings of more than $15M.

In May 2003, IU entered a Preferred Partnership with Dell Marketing — IU’s first such agreement — that offers students, faculty, and staff the opportunity to purchase specially configured workstations, laptops, and multimedia computers at up to $600 below standard educational pricing, and discounts of up to 13% below educational rates on the full catalog of Dell computers, printers, and handheld devices.

The successful implementation of lifecycle funding and basic equipment modernization is an impressive achievement in a short time, and has brought IU national attention. (The *Chronicle of Higher Education*, October 4, 2002, featured a story including IU’s workstation bid process and software contract in an article on lifecycle funding.) This accomplishment should greatly enhance faculty members’ and students’ opportunities to make full instructional, administrative, and research use of information technology. The success of this implementation is illustrated by the fact that students and faculty know they can count on access to basic hardware, software, and networks, and generally
express high levels of satisfaction in the UITS annual User Survey. See http://support.uits.iu.edu/scripts/ose.cgi?anwq.help&osecat=about

UITs has been recognized for many years as a leader in the effective management of the cost and quality of its services. UITS was one of the first university IT organizations in the nation to develop a comprehensive services list, define all of the processes that comprise those services, and implement Activity Based Costing (ABC). As a result of the ABC effort, UITS is able to identify the total cost, utilization levels, and per-unit cost of everything it produces. Use of ABC metrics is a key tool in analyzing and modifying expenditures that ensure that budget monies are used most effectively.

UITs is also a national leader in assessing customer-based satisfaction. For more than a decade UITS has contracted with an independent survey organization to administer a survey of its customers (users within the University community) to assess satisfaction with UITS services; many service changes have been implemented in recent years as a result of the UITS User Survey. UITS is expanding its quality management efforts to include cost, user-perceived quality, innovation, and technology transfer/economic development factors.

The 2004 survey results indicate that of those in the IUB and IUPUI community that use UITS services, more than 98% are satisfied with the quality of those services. UITS has been experimenting with other quality methodologies, including the balanced scorecard (which measures innovation and staff satisfaction as well as cost and quality) and six sigma (a total quality management methodology designed to essentially eradicate errors from processes). UITS leadership in the management of cost and quality is indicated by the fact that for four years in a row representatives of UITS have spoken on this topic at national conferences.
II. ACCESS TO NETWORK RESOURCES

Recommendation 2: The University should provide students, faculty and staff with reliable access to computing and network services, on the campuses and off. (In the language of today’s technology, “No busy signals!”)
OFF-CAMPUS ACCESS

With the long-standing problem of inadequate capacity on the two core campuses solved in 1999, modem service was monitored for quality and usage during 2004. Modem access remains, as a normal operating condition, rapid and straightforward. Continued increase in the use of local, high-speed, off-campus Internet Service Providers has resulted in decreased use of the IUB and IUPUI modem pools as members of the IU community increasingly made use of these service providers.

In 2004, UITS reduced the number of IUB modem lines by 506 and the number of IUPUI modem lines by 115. Since elimination of the service is not likely, the core network was upgraded at the IUB and IUPUI campuses to ensure efficient and reliable service. However, the move to high-speed providers by the user community is yielding significant cost savings as UITS downsizes the modem pool into line with lower demand. As a result, UITS projects reduction of the IUB modem lines by 230 and IUPUI modem lines by 115 by the end of January 2005.

These high-speed connections to IU resources from vendor-provided services have been secured by Virtual Private Network (VPN) services. VPN provides a solid and secure link from these service providers, requiring authentication with an IU Network ID before use of the IU network is enabled. This VPN infrastructure also serves to secure the wireless network services being implemented on the campuses, and thus has provided a well-leveraged technology solution for security.

ON-CAMPUS ACCESS

I-Light continues to provide vast benefits to the University over previous connectivity, both for intercampus connectivity and connectivity to the commodity Internet. I-Light’s capacity, which is in addition to existing Internet2 connectivity, is allocated among campus housing at IUB, the IUB campus, and the IUPUI campus and its connections to the six regional campuses.

In early 2001, a new architecture was developed and implemented for the IUB campus that featured a separate commodity Internet connection for the campus and one for Bloomington campus housing. Since then, UITS has continued its successful partnership with the Residence Halls Association in helping to determine proper policy and practice for the residential commodity Internet connection. Filters of certain types of data traffic have been successful in managing the bandwidth in campus housing.

On the Bloomington campus during 2004, some 1,951 new data jacks were installed, and 2,544 were upgraded, bringing the total number of active Ethernet jacks to 36,482. Of these, 16,331 are capable of supporting up to 100Mbps. The number of buildings at IUB connected to the backbone at 1Gbps remained at 61, however all buildings requiring 1Gbps connections were completed as planned in 2003.

Efforts continued in 2004 to replace aging Ethernet equipment with 10/100Mbps-capable switches. GreekNet, a partnership involving SBC, IU, and the Greek Houses, facilitates access to the IU network from Greek housing.

Three new on-campus apartment buildings and the new Informatics and Communications Technology Complex at IUPUI were added to the network, bringing the total number of IUPUI buildings on the network to 59. In various buildings, removal of the HP4000 switches has begun. These are being replaced with HP4104s and HP4108s, which have a higher backplane bandwidth. All HP4000 switches will soon be phased out with the new switches in floor closets. At IUPUI some 6,562 new data jacks were installed during 2004, bringing the total number of active Ethernet jacks to 27,132. Of these, 18,029 are capable of supporting up to 100Mbps.

The Wireless Project implementation stage is complete, with wireless coverage available in all academic facilities at IUB and IUPUI. More than 900 VPN-secured access points were installed on the Bloomington campus, and more than 300 are installed at IUPUI. Coverage includes many outdoor areas surrounding buildings.

Installations will continue in perimeter faculty and staff facilities in Bloomington, and in medical facilities and remote locations at IUPUI. Bloomington campus
residences will have wireless coverage as well, with a focus on communal and lounge areas. At IUPUI new campus apartments will have total wireless coverage in addition to coverage in lounges.

UITS has installed a new wireless technology — a Vivato phased-array antenna — on the IUB Memorial Stadium. Vivato uses 13 highly focused antennas to cover large areas over great distances, allowing users to connect to the IU Network via the Virtual Private Network from more than one mile away. More Vivato antennas are slated to be installed at IUPUI on University College and on Inlow Hall.

For a list of UITS-supported secure wireless sites at IUB and IUPUI, see http://www.indiana.edu/~uits/telecom/data/waps.html
Recommendation 3: Appropriate incentives and support should be established so that faculty and staff are encouraged in the creative use and application of information technology for teaching, research, and service.

The Actions associated with this Recommendation cover a broad and diverse range of issues: fellowships and development grants for faculty (Action 7), IT support for faculty and staff (Actions 8, 10), space for IT staff to be accessible to users (Action 9), and issues involving promotion and tenure (Action 6).
**COMPENSATION FOR IT PROFESSIONALS**

**Action 4.** The University should review the market compensation levels for qualified IT professionals at each campus and in their surrounding communities, and seek to make compensation competitive with employment alternatives, within the context of overall University salary goals.

A primary goal of the University’s system-wide Compensation System Initiative (CSI) currently underway is to gather market data and benchmark position salaries accordingly. These data, in tandem with the CIC IT salary survey results, will provide particularly valuable information in the area of compensation for IT professionals.

Another outcome of the CSI will be new job evaluation methods. Broadbanding of IT positions will yield cost efficiency as well as provide an effective mechanism for recognizing increased competencies and levels of responsibility.

The Vice President’s bonus program continues to provide an effective and appreciated mechanism for rewarding staff members for outstanding performance and extraordinary effort on critical initiatives.

**PROMOTION AND TENURE**

**Action 6.** The Deans in each School should ask their faculty policy committees to review tenure and promotion guidelines to see whether they discourage creative activity involving the application of information technology, and refine these guidelines as necessary in a manner consistent with the mission and standards of excellence of the School.

When developing the IT Strategic Plan, the UITC recognized that there could be various incentives for faculty involvement in the use of technology for teaching and learning. Some, like promotion and tenure, are outside the scope of UITS or any IT organization, and should properly be addressed by faculty policy committees in each School. Ongoing dialog on the issues of faculty rewards and incentives, related to the use of IT in teaching and learning, is needed among academic affairs offices, faculty leaders, and leaders in information technology. As part of their responsibilities, two campus deans for information technology work closely on these issues with academic leadership and faculty council leadership at IUB, IUPUI, and across the campuses.

**FELLOWSHIPS AND DEVELOPMENT GRANTS**

**Action 7.** The University should review its current systems of faculty fellowships and staff development grants, with the aim of expanding these to offer financial support for the design, development, or innovative application of information technology to teaching, research, and service, including the use of information technology in creative activity and the design of instructional materials to advance learning.

Throughout the year effort continued to support faculty in their use of IT in teaching, research, and service through the provision of grants and fellowships offered in specific areas.

**IU/SBC FELLOWS PROGRAM**

The IU/SBC Fellows Program funds innovative faculty projects that integrate information technology into campus and distance teaching and learning. The
program calls upon innovators to serve as mentors to other faculty in their disciplines through workshops or departmental consultations, in coordination with the teaching and learning centers on IU campuses. The program also collects the fellows’ findings and draws upon their expertise for the benefit of colleagues throughout IU and beyond. Final project reports and examples of good practices in teaching and learning with technology are available on the program Web site at http://sbcf.iu.edu

IU/SBC SUMMER LEADERSHIP FORUM
In October 2004, the IU/SBC Fellows program, in its fifth year, granted 14 awards to University faculty for a total of $176,280. The Fellows showcased their projects at the fourth annual IU/SBC Summer Leadership Program in May 2004. Projects included “visualization learning modules” that will be used to teach methods of displaying information visually; research into the effectiveness of using virtual reality to train surgeons; a mathematics lab where non-majors apply math skills to a variety of disciplines; a Web-based system where radiology students practice interpreting radiology images; the digitization and Web delivery of Ars Femina, a unique collection of musical scores written by women composers; a program of certification in therapeutic outcomes evaluation; a project to integrate traditional instruction with existing technologies into a wireless, educator-oriented electronic environment; and a “virtual field trip” system that can capture complete visual data of an area. See http://sbcf.iu.edu/events.html

TECHNOLOGY ASSESSMENT GRANT PROGRAM
In 2001 the Office of Distributed Education, with the support of OVPIT, launched a small, one-time grant program to support projects that focused on the use of instructional technology in teaching and learning. The Technology Assessment Grant Program (TAG) provided funding to faculty studying the impact of educational technology on their practices and on student, course, or program outcomes. The TAG program awarded more than $68,000 to 14 winners from IU core and regional campuses. Winners submitted final project reports in June 2003 and presented a poster session along with the SBC Fellows at a Summer Leadership Forum.

TEACHING & LEARNING TECHNOLOGY GRANTS
Teaching & Learning Technology Grants, funded through Instructional Support Services and the IUB Dean of the Faculties, provide assistance for projects that need specialized knowledge or talents or that require concentrated or intensive efforts, or for materials or training that will make project development or implementation proceed more efficiently.

A committee of IUB faculty reviewed the 2004 proposals. Awards of up to $1,500 each will support four instructional technology projects designed to increase student engagement in the areas of: epidemics in history, representations of American Chinatowns, the search for habitable planets, and French Medieval and Renaissance civilization. Spring 2005 awards will again focus on increasing student engagement.
Action 8. Schools across the University should be encouraged to provide more resources for maintenance and training for department and School computing environments. They should work creatively and in collaboration with UITS to train, retain, and distribute knowledgeable individuals to maintain distributed server and desktop systems (UNIX, NT, MacOS, etc.).

Action 10. The University should continue to support the efforts to educate and certify IT professionals in needed functional areas of the profession. These programs should be expanded to reach a wider University audience, especially on the IUPUI and regional campuses.

Action 16. To support existing and emerging faculty initiatives in basic skills education, the University should explore the use of IT to aid in the teaching of these basic skills.

Action 23. UITS should work with Human Resources and other IU departments to explore ways of using teaching and learning technologies for the training and development needs of IU staff and faculty. Also, Human Resources should develop actions, in cooperation with UITS and other units, to improve staff access to (and use of) technology training.

LOCAL SUPPORT PROVIDER (LSP) SERVICES

LSP Services, with staff at IUB and IUPUI, provides technical support and consulting services to more than 650 technical staff (LSPs) in academic and other departments in Bloomington and Indianapolis, and on the regional campuses. These services give LSPs access to Windows OS and Apple OS server and workstation consulting and troubleshooting, lab resources for testing, technical training, Microsoft certification opportunities, online technical tools and resources, and reserved software.

During 2004 UITS consolidated second-tier Apple support within LSP Services to allow for a single point of contact for LSPs with Apple support questions. Additionally, LSP Services provides third-tier e-mail support for LSPs and the more than 26,000 Exchange/Outlook users on all campuses. LSP Services works closely with LSPs and other UITS service providers to ensure the successful implementation of new services, reviewing departmental technology, and creating and maintaining Knowledge Base documents. The group also plays a major leadership role in supporting mobility computing including PDAs and Blackberry devices. For-fee services are available for departments that require personalized, on-site server assistance.

UNIX AND UNIX EDCERTS

The Unix Systems Support Group (USSG) continues to refine and expand its EdCert program in Unix system administration. Since the inception of IU’s IT Strategic Plan, 150 students from IUB, IUPUI, and several of the regional campuses have passed the certification test. Twenty-nine students passed the test in 2004. The changes made to the EdCert program will also simplify future updates and maintenance. Spring, Summer, and Fall classes are being planned for 2005.

In addition to EdCerts, USSG offers online education through its Unix Systems Administration Independent Learning (USAIL) program. This resource is well known and used within the IU and the Unix communities, and along with other Unix resources, generates an average of 200,000 hits a day. In 2005 USAIL will begin incorporation into the Sakai Project. See http://ussg.indiana.edu/usail/

Unix users and administrators were also kept current through monthly Unix Users Group meetings. These meetings provided opportunities to more than 100 attendees in 2004 to share experience and learn about new programs and trends, including open source software. The USSG also offers personalized Unix support in person and by telephone and e-mail.

An important part of UITS educational activities includes efforts to inform students about alternatives to traditional commercial operating systems, including the open source movement. USSG hosts an annual event called LinuxFest, which draws hundreds of students, faculty, and staff to a series of talks and demonstrations that introduce the open source concept and open source software. The 2004 fest featured a keynote speech by Daniel Robbins, Chief Architect of Gentoo Linux, who
spoke about the open source, community-based Gentoo Linux distribution, as well as the ways that open source, community based Linux distributions fit into the big picture. His keynote address and presentations were very well received by the LinuxFest attendees.

**SELF-PACED LEARNING**

In 2004, UITS IT Training & Education negotiated an extension to its five-year licensing agreement with Thomson NETg to continue providing access to more than 1,200 self-paced courses. NETg courses cover topics ranging from basic IT skills for beginners to advanced training and specialized courses that prepare technical staff for certification. Exams are also available. In addition, free Microsoft self-study courses on Office applications and basic Windows computing skills were made available in Fall 2004 as part of IU’s site license agreement with Microsoft. All members of the statewide IU community can access NETg and Microsoft courses in self-study mode, and IU faculty can incorporate selected courses into their curricula. More than 1,500 users accessed or downloaded more than 15,000 online self-study courses in Fall 2004, the first semester the new self-study service was available. All courses may be accessed through IT Training Online. See [http://ittraining.iu.edu/online](http://ittraining.iu.edu/online)

**UITS IT TRAINING & EDUCATION**

UITS IT Training & Education offers instructor-led computing workshops and provides self-study training resources to the Indiana University community and beyond. It reaches more than 30,000 participants each year across all campuses through hundreds of instructor-led workshops and self-study training programs.

In September 2004, IT Training also began offering STEPS Certificate Series, enabling participants to earn certificates on select topics by taking a series of related STEPS workshops. IT Training awarded 79 STEPS Series Certificates in Fall 2004.

IT Training also offers Microsoft Office Specialist exams every semester on the IUB and IUPUI campuses to test beginning through advanced skills in all Office applications. These are the only available Microsoft-approved exams through which members of the IU community can certify their Office skills. Information on STEPS workshops, STEPS Certificate Series, and Microsoft Office Specialist exams is available on Training’s Web site. See [http://ittraining.iu.edu](http://ittraining.iu.edu)

**SOFTWARE SUPPORT**

UITS continues to leverage the buying power of the University to forge major software licensing agreements with leading software vendors for the desktop productivity tools and infrastructure server and messaging products that are fundamental in IU’s teaching, learning, research, and administrative activities. The difference between the costs paid by the University and academic list price amounts to more than an annual $12M. More important, ease of access to the best software tools for researchers and students greatly enhances the University’s activities in research and teaching.

IU continued the Macromedia Software Contract for the Studio MX suite of products and for Contribute. This contract operates on a cost-recovery basis but provides excellent pricing for IU departments and for personal purchase by students, faculty, and staff. Since its inception in 2002, the contract has saved IU and personal purchasers approximately $490,000 over the standard educational price for Studio MX.

The value of the Microsoft agreement remains stellar. In 2003-2004, an investment of $1,566,306 resulted in the distribution of more than $14.9M in Microsoft products. IU faculty, staff, and students acquired 92,447 Microsoft software packages in the past fiscal year. Since the beginning of the initial Microsoft agreement (3/31/98), 592,194 copies of Microsoft software, valued at $96,018,753, in educational pricing have been distributed. The benefits of this agreement to the University are tremendous, allowing faculty, staff, and students access to the most current software, and leveraging the buying power of all campuses.

The Apple Technology Assurance Program (Apple Tap) continues to provide departments with significant savings on Mac OS X. More than 70 departments on all IU campuses took part in the program, saving the participants more than $200,000 on upgrade costs during the first three years. The next OS X upgrade, expected in the first quarter of 2005, will result in an additional savings of more than $150,000 for those departments.

Symantec security software continues to be distributed University-wide on the IUware CD, the free IUware Orientation CD, the “Get Connected” CD for the residence hall community, and on IUware Online.
IU’s agreement with Shavlik for its HFNetChkPro software runs through June 2005. This software improves the security of IU’s computer systems and network by allowing system administrators (LSPs) to apply critical security patches to widely dispersed Windows computers from a central location. The software enables LSPs to react quickly to address vulnerabilities before they can be exploited.

The Center for Statistical and Mathematical Computing (Stat/Math Center) manages a large suite of software in support of quantitative research. Central to this is the Enterprise License Agreement for SPSS, the most widely used commercial statistical package at IU. Dozens of other software packages, including the mathematical software Matlab, are licensed and redistributed within the University at a very modest cost.

The Unix Systems Support Group (USSG) negotiates site licenses for commercial Unix software, providing the University with access to such software under very favorable site licensing terms. USSG also supports the use of Linux, an open source version of Unix that is popular among researchers and students. In December 2003, the University reached an agreement with Indianapolis-based Progeny for its Progeny Transition Service. This service provides software updates for users of Red Hat® Linux® versions 7.2, 7.3, 8.0, and version 9 updates.

UITS Digital Libraries groups and the IU Libraries collaborated to negotiate a University-wide site license for the popular bibliographic software ProCite, ReferenceManager, and EndNote. During 2004, more than 8,000 individual software copies were distributed. Widely used by scholars in many fields, most notably in the humanities, this software greatly enhances the scholarly output of the University.

**SBC/TAG Summer Leadership Forum**

The SBC/TAG Summer Leadership Forum, held in May 2004, provided an opportunity for IU SBC Fellows and Technology Assessment Grant (TAG) awardees to present their projects and discuss lessons learned during project development and implementation. See the discussion under Action 7.

**Teaching and Learning Center Expansions**

Teaching and Learning Centers on University campuses continued to grow and extend their services across their campuses in 2004. See the discussion under Action 11.
IUPUI

In an effort to leverage more effectively Indiana University’s information technology (IT) resources and investments, and make IT services more accessible, the University has added a technology-rich building at IUPUI. The building, which was completed in August 2004, will provide a major boost to IT in the state of Indiana — as IT becomes ever more critical to advances in research, teaching, and learning and a more prominent tool in daily life. The 213,815-square-foot, $45.6-million Informatics and Communications Technology Complex (ICTC) was dedicated during a public ceremony October 13, in the ICTC auditorium, IT 152, 535 W. Michigan St.

Designed by Robert A.M. Stern Architects, LLP, the ICTC houses the Indiana University Schools of Informatics, Journalism and Music; the Pervasive Technology Labs of Indiana University, and University Information Technology Services (UITS) — just steps away from IUPUI’s science and engineering buildings and within minutes from downtown.

The building houses essential tools for scientific research, technical support, and teaching that will help build a stronger high-tech Hoosier economy by supporting statewide IT initiatives. It also provides a setting to educate the current and future workforce on emerging technologies.

Given the central location of Indianapolis, the ICTC serves as a hub for telecommunications and I-Light, the optical fiber infrastructure that links IUPUI, IU Bloomington, and Purdue University to each other and to the Internet. Within the ICTC, IU manages nationwide networks such as the Abilene Internet2 network — an advanced research and education network used by more than 200 US university, industry, organization and government members. IU also manages global research and education network connections from the United States to the Asia Pacific and other countries.

The ICTC is equipped with new technology for every classroom, houses one of the nation’s most powerful supercomputers, and can accommodate massive computing data storage for the University’s students, staff, and faculty. The building also provides much-needed classroom space, including 33 classrooms and two auditoriums, which can accommodate 1,500 students at any given time. This additional space will help facilitate growth of academic programs and civic engagement. It also brings together 500 highly trained IT professionals responsible for the support, operation, and management of IU’s nation-leading IT infrastructure.

Furthermore, the building features a Student Technology Center that is accessible to the IUPUI community 24 hours a day, 365 days a year. Also located in the ICTC is the Indianapolis-campus branch of the UITS Adaptive Technology Center (ATC), serving IUPUI students, faculty, and staff with mobility impairments, learning disabilities, low vision, and blindness. ATC facilities, open 24/7, expand access to the tools of learning for the IUPUI community. (For more on the ATC see the narrative under Action 54.)

The ICTC also brings researchers and IT professionals together to collaborate on projects as diverse as digital music composition, computer-based character animation, and analysis of human organs captured in an MRI, using 3-D visualization. To that end, the facility will offer Indiana one of the most advanced sites for pioneering work in a broad range of information technology fields, while enabling students to learn and participate in the latest theoretical developments.

The new building facilitates communication among UITS staff, and between UITS and its academic partners, and encourages congress between UITS staff at IUB and IUPUI. Similarly, the future construction of the Computation and Information Building on the Bloomington campus will help IUB advance its efforts in building the information technology economy in Indiana.

IUB

The Trustees of Indiana University approved the design for the Computation and Information Building (CIB) on the Bloomington campus at the December 2003 Board Meeting. The CIB will be home to supercomputing, massive data storage, and enterprise information systems, and will bring IT resources, staff, and expertise to a central campus location to deliver IT support to IUB’s students, faculty, and staff. The design development is complete and fundraising plans for the CIB are moving forward. Once funds are raised, bids for construction will be solicited.
Recommendation 4: Indiana University should assume a position of worldwide leadership in the use of information technology to facilitate and enhance teaching and learning.

The Actions associated with this Recommendation cover a number of interrelated issues, among them: digital media and Web development (Actions 12, 13, 14), Web-based course services and infrastructure (Actions 18, 19), classroom technology (Actions 21, 22), and assessment (Action 25). Progress toward other goals outlined in this Recommendation (e.g.: faculty support and development services, Action 11), will also help address issues of faculty engagement detailed above, in the discussion of Recommendation 5.
Action 11. The Teaching & Learning Technologies Lab and the Center for Teaching & Learning should be expanded and new services developed where needed, to offer a standard level of teaching support services for all faculty at IUB, IUPUI, and the regional campuses.

Action 11 calls for a standard level of baseline support for teaching and learning technology for all IU faculty, increasing the opportunities to explore new applications of information technology. The promotion or introduction of technology in courses and disciplines, previously without access to relevant applications or support, is also an important component of the IT Strategic Plan. The objective of supporting faculty in their use of technology is further enhanced by second-tier, professional course development services provided through Actions 7, 13, and 20.

Enhancement of the University’s teaching and learning centers continued during 2003-04 with improvements to facilities and technology to provide a higher level of support to faculty.

IUPUI – CENTER FOR TEACHING AND LEARNING
The Center for Teaching and Learning (CTL) on the Indianapolis campus has created an online faculty development module series called Teaching in Support of Student Success. The series includes modules on learning theory, course design, classroom management, active learning, inclusive teaching, assessment strategies, and the new Teaching Online module. The Teaching Online module was designed to introduce faculty to concepts, ideas, and strategies that can be used when designing and teaching an online course. The Teaching in Support of Student Success module series is available at [http://www.opd.iupui.edu/tsss/](http://www.opd.iupui.edu/tsss/)

In May 2004, the CTL again offered the highly successful Jump Start program for 12 faculty members from a wide range of disciplines. More than 30 online courses have been created to date through the Jump Start program. The Office for Professional Development awarded the second course transformation grant program which is modeled after the work of the national Center for Academic Transformation and intended to provide support to departments in exploring how instructional technology can be used in dramatically different ways to produce cost savings and improved student learning.

The CTL continues to improve services for faculty and academic units on teaching and learning issues, multimedia, Web applications, and instructional design. This year the CTL consulting staff has helped faculty members with more than 2,380 consultations. However, as a result of the larger Jump Start and course transformation projects, smaller workshops have been reduced, resulting in 34 workshops this year.

IUB – TEACHING & LEARNING TECHNOLOGIES CENTERS
The Teaching & Learning Technologies Centers (TLTC) is a partnership of UITS and the Dean of Faculties/Instructional Support Services (ISS), with space provided by the IUB Libraries. Two TLTC locations serve faculty on different areas of the IUB campus: Main Library 505 (West Tower) and Ballantine Hall 307. Consulting focuses in general on the integration of technology in the support of teaching and learning, with special attention on Oncourse and the new Oncourse CL, Turnitin plagiarism prevention software, effective use of multimedia, and Web page design for courses. Projects range in complexity from simple annotated slideshows to interactive CD-ROMs. Examples include a tool to help students analyze telescope images for undiscovered novae and classify novae magnitudes; a database to help undergraduates experience real census data, then compare it with their own experiences; and a Web site built around a modified version of the Drake Formula, providing instant feedback and guidance to students about their assumptions about life in the universe. Through a partnership between TLTC and IT Training & Education, free computer training workshops are offered to IUB faculty.

IUE – TEACHING AND LEARNING CENTER
The IUE Teaching and Learning Center is making strides to create a community that inspires freshness of thought, creativity, and innovation. The year’s goals consist of promoting effective teaching strategies through the use of SMART classroom technology and participating in efforts for providing high-
quality distance learning. The Center also supports technology award participants in documentary writing and microbiology with the training and use of digital cameras. To explore and develop pedagogical strategies, the IUETLC is monitoring three sponsored learning communities investigating diversity in the curriculum, distributed education, and student-centered learning.

IU SOUTH BEND – CENTER FOR EXCELLENCE IN TEACHING

In 2004 the University Center for Excellence in Teaching (UCET) at South Bend developed a three-year action plan, closely linked to the campus Strategic Directions Initiative. Accordingly, computer technology has been upgraded in the Center, including installation of a technology desk, similar to those installed in campus classrooms. Faculty can now be trained in using the desks at the Center. UCET also houses an EPSON large format printer, purchased by the biology department. Professional posters have been printed for students and faculty in a variety of disciplines at a fraction of their commercial cost. The Center has offered workshops on creating online courses and UCET staff have assumed responsibility for campus OneStart and Oncourse training. The Center hopes to receive funding for a second full-time professional staff appointment to support increased technology applications and teaching excellence in 2005.

IU SOUTHEAST - INSTITUTE FOR LEARNING AND TEACHING EXCELLENCE

Sponsored by the Office of Academic Affairs, the Institute for Learning and Teaching Excellence (ILTE) provides consulting and development for integrating technologies into teaching and learning with a focus on using technology to individualize student learning. It provides a contact area for faculty in the design, implementation, and assessment of teaching and learning materials; it sponsors workshops, presentations, and symposia; and provides one-on-one consulting. The ILTE coordinates New Faculty Orientation, Welcome (Back) Week activities, and the annual Teaching Symposium, making special efforts to ensure new full-time and adjunct faculty are prepared for the new academic year. The ILTE consists of a half-time director, a technology coordinator, an instructional technologist, and a part-time administrative assistant/resource specialist.

IU NORTHWEST – CENTER FOR EXCELLENCE IN TEACHING AND LEARNING (CETL)

The Center for Excellence in Teaching and Learning is charged by the office of Academic Affairs to provide pedagogic support to faculty. The Center provides ongoing support to faculty using Oncourse through workshops and individual consultations. It promotes IT workshops offered on campus and participates in relevant campus IT initiatives, such as the AQIP Technology sub-committee and Making IT Happen. CETL was responsible for bringing Cingular Wireless into the pool of vendors for the 2004 event. In 2004, the part-time instructional design specialist became full-time, a change supported with IT funds, and one that has made a significant difference in the Center’s effectiveness in serving the campus.
Actions 12, 18, and 19 focus primarily on the Oncourse production environment and associated support services. As IU’s online teaching and learning environment, Oncourse has grown to become one of the University’s most-used information systems. Launched in 1999 at the core campuses, Oncourse has seen a dramatic increase in users each semester. Oncourse continues to see a substantial percentage increase in usage from year to year and UITS user satisfaction survey results continue to be above 90%.

In December 2003, Indiana University, along with three other core institutions, announced the formation of a community source project to build a course management and collaborative environment called the Sakai Project that was launched with a $2.4M grant from the Andrew Mellon Foundation. Sakai offers IU a unique opportunity to share its considerable intellectual property with all of higher education while improving IU’s local installation of Oncourse and reducing cost. See http://sakaiproject.org

The goal of the project is to develop open source tools that are the best of their kind for course management, research collaboration, assessment, portal, and workflow. The University of Michigan, Indiana University, MIT, and Stanford will be using a common set of major applications that have all been conformed for easy portability. The Sakai Project and another grant-funded project called ePortfolio will use common technology architecture to ensure their compatibility and interoperability. (See the narrative on Actions 24, 25, and 26 for more on ePortfolio.)

IU deployed Sakai locally as Oncourse CL in 2004, with plans to officially make Oncourse CL the default course management system at IU in Fall 2005. The Classic Oncourse system will be retired after the Spring 2006 semester.

IU made a strategic decision to build community source software over buying proprietary vendor modules. IU joined OKI in 2002 to speed development of a new generation of Oncourse, and help with the unbundling of services and the integration of chat, mail, forums, and calendaring through the OneStart portal. The Navigo Project, a framework for online assessment, was the first open source application that was released in beta to all Oncourse users in Spring 2004.

Oncourse hardware performed well in 2003-2004. Continued maintenance and upgrades in November 2004 ensured consistent performance and reliability. In May 2003, Oncourse moved to IU’s Central Authentication System (CAS), allowing users to seamlessly transition from one CAS-based service to another, including the OneStart portal.

In December 2003 the Andrew W. Mellon Foundation awarded Indiana University a $518,000 grant over two years for IU’s ePortfolio Project. ePortfolios provide a means for students to demonstrate levels of learning achievement and facilitate lifelong learning. IUPUI has already mobilized an academic change initiative based on ePortfolios as part of the University’s gateway courses and funded two developers as part of the Commitment to Excellence. IU will lead the development of this software in cooperation with the Open Source Portfolio Initiative. The software will integrate with Oncourse CL during the summer of 2005. A commercial partner, the rsmart group, will contribute to developing and supporting the application and effort.
**Action 17.** UITS, with the new Associate Vice President for Distributed Education, should help coordinate initiatives in distributed education, by helping departments and schools implement new programs, without duplicating existing services. UITS should continue to assist programs of distributed education, helping to identify supported and supportable technologies that can satisfy the complex requirements of those programs.

In keeping with nationwide trends, the decision was made in 2002 to take a decentralized approach to distributed education efforts at Indiana University. As a result, the Office of Distributed Education (ODE) was closed on June 30, 2002. The IT Strategic Plan Actions related to faculty, including promotion and tenure, commercialization of faculty products, fellowships and grants, development of DE courses and promotion of DE activities, is the responsibility of campuses and Schools, with leadership from the Offices of Academic Affairs and support through the campus Centers for Teaching and Learning. The underlying infrastructure and networks that support distributed learning, as well as IT systems such as Oncourse, digital media services, and faculty and student user support, are provided by UITS.

**DIGITAL MEDIA SERVICES**

**Action 7.** The University should review its current systems of faculty fellowships and staff development grants, with the aim of expanding these to offer financial support for the design, development, or innovative application of information technology to teaching, research and service, including the use of information technology in creative activity and the design of instructional materials to advance learning.

**Action 15.** The University should offer, on a selective basis, intensive help in developing instructional material for delivery to IU students, for eventual offering as a marketable IU product, or both.

**Action 20.** UITS and other units, including classroom and technology support providers, should develop plans to adapt the Leveraged Support Model to the support of instructional technology, student technology, and Web development in general.

Actions 7, 13, and 20 focus on expanding support for the design, development, and management of interactive Web-based content and digital multimedia in teaching and learning. These initiatives are blended to encourage faculty innovation, provide intensive professional support in developing instructional materials (Actions 7 and 13) and develop the Leveraged Support Model for instructional technology (Action 20).

In 2002, UITS launched the first phase of Digital Media Services (DMS). To support the activities of DMS, an advanced multimedia production studio was created at IUPUI. The studio is equipped with a nonlinear, high-definition video and audio editing system; high resolution flat-bed scanners; 35 mm slide scanners; an interactive classroom studio for capturing lecture-format instruction; Web servers; interactive CD and DVD duplication systems; 3-D modeling and animation software; 2-D interactive animation software; and digital still cameras.

DMS provides services in design, media creation, programming, Web hosting, software evaluation, testing, distribution, access, and project management. DMS works closely with University staff, including Local Support Providers (LSPs), as they assist faculty and staff in performing their own digital media work and in developing content. DMS also complements the instructional design and assessment services offered in the campus Centers for Teaching and Learning.

In Summer 2003, DMS partnered with the IUPUI Center for Teaching and Learning to complete nine online courses. The unit also provided duplicating services in support of Community Learning Network, IU School of Medicine, and IU Kelley School of Business courses. DMS also accompanied IU Bloomington geologists to Oregon to document field research for documentary purposes.
In 2004, DMS produced a wide variety of Web and multimedia projects for IU faculty, staff, and departments, including University courses delivered over the Web; specialized, interactive online Flash applications; video-based projects; and DVD duplication.

As part of the SBC Fellows Program, DMS created an online music theory placement test for the IU School of Music Program at IUPUI. The application allows the school and its faculty to create a variety of tests from a pool of questions. It also provides a medium for students to receive feedback on the results of the test. The application uses PHP and interfaces with an SQL database.

Other SBC Fellows work included the creation of an interactive energy efficiency analysis application for an IUPUI-based faculty member and a Flash-enabled, database-driven, interactive learning tools Web application for IU Kokomo faculty.

During the year, DMS created and redesigned various campus Web sites. Projects included a site redesign for the IU Bloomington department of anthropology, which features original artwork and Flash components. The addition of Macromedia Contribute enables department staff to easily make content changes to the Web site. In conjunction with Data Management Support, DMS created a Web site for the IUPUI Center on Philanthropy that included an e-commerce site where visitors can purchase Center courses and books. DMS also created an online application for the IU School of Law at IUB. The project allows applicants to submit applications via a secure Web site and view PDF versions.

To advance teaching and learning through the production of telecourses, DMS produced the video telecourse Z201: “History of Rock and Roll,” along with original art for packaging, and duplicated the course for sale at the IUPUI Bookstore. DMS provided live coverage of the G8 Preconference Summit held for two days at the IU Kelley School of Business at IUB, streaming proceedings to a worldwide audience. The unit also completed 19 online courses in such fields as medicine, geography, art, law, and geology, working with IUPUI faculty and the Center for Teaching and Learning.

In Fall 2004, work began on the first IUPUI Course Transformation Project course. DMS is capturing physics lectures and custom studio footage for the project. DMS will author an online interface to present the video footage along with stock demonstrations of common Physics concepts. Other projects include a 10-minute video for IUPUI’s new student orientation, JAG 101, and a short documentary on the move to the Informatics and Communications Technology Complex. DMS Flash developers also worked with IT Training & Education on an instructional preview of the upcoming Oncourse CL interface, which will help prepare faculty for the coming change.

Now housed in the new Informatics and Communications Technology Complex, DMS maintains an advanced tape room that houses the workstations, video-tape recorders, and a routing switcher capable of routing standard definition signals as well as high definition video. The room will allow editors and computer animation specialists to control various pieces of equipment through remote control Crestron interfaces located in each edit bay.

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**Action 15.** UITS should evaluate the opportunities to partner with faculty in the sciences to experiment with simulation-based laboratory courses, and should be alert to other possible partnerships for the enhancement of instruction through simulation and visualization.

The UITS Advanced Visualization Lab (AVL) partners with a variety of educators across the University to apply visual simulation and visualization technologies to a broad range of subjects and teaching scenarios.

The AVL continued to provide support and dedicated computing systems for finite element simulation of an aircraft wing for faculty in the School of Engineering at IUPUI. The visualization software for this project was developed by the AVL in 2003.
Additionally, the AVL continues to support a number of ongoing simulation projects and applications of virtual reality and visualization to education, including: scientifically-accurate astronomy simulation software for display in the CAVE and digital planetariums; VR software, scanning hardware, and haptic rendering methods for recording and experiencing cultural heritage sites and artifacts; exploration of new commodity-based hardware and software tools for student development and deployment of interactive art pieces; and immersive volume rendering and analysis software for studying human anatomy and medical scans.

**CLASSROOM TECHNOLOGY**

**Action 21.** Beginning immediately, all planning and renovation of classrooms and other teaching spaces should evaluate and incorporate information technology needs. The costs of information technology identified in prior planning efforts as well as future efforts, should be fully base funded to provide for acquiring and installing equipment, as well as for maintenance, repair, lifecycle replacement, and support.

**Action 22.** UITS, in partnership with the appropriate campus offices and committees, should continue to provide leadership in campus planning for classroom technology, leadership in classroom technology design, and coordination of classroom technology use.

Actions 21 and 22 represent IU’s first comprehensive, multi-classroom technology plan for general-purpose classrooms. This five-year plan, finalized in May 2000, calls for installation and support of technology in classrooms, and coordination of the design and renovation of classrooms to enable the use of that technology. The plan calls for more installed technology and less reliance on mobile equipment. Implementation is coordinated among UITS, Instructional Support Services, the University Architect’s Office, and campus physical plant offices. Individual campus plans are reviewed and updated annually.

**IUB**

Classroom technology support at IUB took a major step forward with the installation of Crestron’s RoomView™ 5.0 help desk software and e-Control™ IP-based control system. This software allows classroom technology support staff to monitor and control the technology in advanced technology classrooms from their offices. RoomView™ displays the status of system power and projector display power, and provides an estimate of lamp hour usage. This information helps staff identify and correct problems before they become challenges for faculty using the systems. Crestron e-Control™ provides a live view of the Crestron control screen, so staff can diagnose problems over the phone, and, when needed, take control of the system.

New installations, upgrades, and lifecycle replacements continue. Eight new advanced technology classrooms were installed, for a total of 113, or 42% of general-purpose classrooms. Five classrooms received major equipment/system upgrades, and 29 computers and 13 projectors were replaced according to the lifecycle calendar. In 2005, in addition to the annual computer and projector lifecycle replacements, an additional six advanced technology classrooms will be installed and 10 existing technology classrooms will receive major upgrades.

Requests for portable projectors and laptops reinforce the need for additional advanced technology classrooms. Use of laptops and computer display equipment increased 21% in 2004. Increases in requests for these items in 2003 and 2002 were 24% and 32% respectively.

**IUPUI**

Forty-seven Type III Classrooms were added in 2004 for a total of 82 installed technology classrooms at IUPUI. This total reflects the upgrade of 50 existing General Inventory classrooms and 17 new classrooms in the Informatics and Communication Technology Complex. Classroom Services continues to engage the support and input of Schools, faculty, and the IUPUI Learning Environments Committee in planning and installing instructional technology upgrades in classrooms. A notable success was the implementation of the Specialty Classroom project, coordinated by the Learning Environments Committee, in which selected academic units created classroom environments with specialized instructional technology. In one such
classroom, Speech Communications uses a video recording system that uploads digital recordings to Oncourse and ePortfolio. Fixed technology supported 1,414 class sessions at IUPUI during the 2003-04 fiscal year, and mobile technology supported 5,243 sections. Results from the annual UITS User Satisfaction Survey suggest that 91.8% of the users of all classroom technology are satisfied with the quality of service.

The pilot phase of the new classroom services model is underway and seeks to strengthen partnerships with several academic units to provide support for classrooms. With the implementation of the campus wireless network, informal learning spaces will be addressed.

**IU EAST**

In 2004, IU East installed seven advanced technology classrooms bringing the number of advanced technology classrooms to 19, 35% of the total classroom inventory. A multi-phase approach was developed to upgrade the classroom environment. The first phase ensures a minimum set of technology is available in every classroom to facilitate in-class multimedia presentation. The set includes an overhead projector, screen, TV, VCR, DVD, computer, ceiling-mounted projector, speakers, and microphone. A plan is in place to equip every classroom with the minimum set of technology by 2007. Additional technology will be selectively added to accommodate simultaneous in-class presentation and real-time Web-based multimedia conferencing.

**IU SOUTH BEND**

In 2004, Instructional Media Services (IMS) at IUSB began upgrading 44 generally scheduled classrooms on the main campus to advanced technology rooms. The upgrades are expected to be completed by the end of 2004 or early 2005, and will significantly reduce or eliminate mobile equipment delivery to classrooms. Rooms are equipped with a 2400-lumen XGA DLP video/data projector and a technology desk. The desk features an illuminated rack housing a PC, DVD/VCR combo player, an Extron System 5IP switcher, and interface cables for a guest laptop and AV device. The user interface is a keypad-style control panel, and the desk has a height-adjustable keyboard tray so the user has the option of standing or sitting. IP Link software allows for remote monitoring and control of the switchers. Plans for 2005 include fully integrating the IP Link support system, upgrading two larger auditorium-style classrooms, and reorganizing IMS in response to the change from mobile to fixed technology.

**IU NORTHWEST**

At IU Northwest, projection equipment and an instructor’s lectern with a Dell PC will be installed in Savannah Auditorium to allow for student video screenings and occasional presentations. Multimedia presentation equipment will be installed in three classrooms in the new Medical Education Building. A new strategic technology plan will be drafted in 2005 to guide further classroom expansion.

**IU KOKOMO**

At IUK three classrooms were upgraded to advanced technology status during Summer 2004. During Summer 2005 three more will be installed. Service Pack 2 will be fully implemented in Summer 2005 as well, to be consistent with IT improvements being made across Indiana University. Wireless Internet access is now available on 90% of the campus. A large open lab in the Main Building was closed and its 24 computers moved to the Library as IUK launched the first phase of its Information Commons. The IT Helpdesk was also moved to the Commons and an additional staff support person was added in the evening. Cable network improvements to the Observatory building are being developed to support a new telescope.

**IU SOUTHEAST**

IT-Media Services at IUS focused on the Crestview Hall project in 2004. Early in the year, the wiring infrastructure was upgraded to accommodate IP-based room control. Crestron RoomView™ technology was selected for remote monitoring and troubleshooting. Considerable effort was devoted to developing and refining a new instructor desk concept. Of the 20 classrooms in Crestview, 15 are being newly equipped, and the remaining five will receive equipment upgrades. The successful completion of Crestview Hall will reduce total mobile equipment deliveries by 30-40%.

A new advanced technology classroom was completed in Life Sciences in Fall 2004. Six new computer/LCD projector/VHS/DVD carts were added to the mobile fleet. Old VHS machines were replaced with combination VHS/DVD units. The AV Scheduler Web application developed by Media Services simplifies the reservation process for mobile equipment and provides valuable usage statistics to aid in planning for permanent installations. Plans for early 2005 include installing LCD projection for a computer classroom in the new IUS Library; a new advanced technology classroom specially equipped for speech classes in Knobview Hall; and two pilot projects using Sympodium and tablet technologies.
to aid art and music instruction. Room View™ will be added to three classrooms at the IUS Graduate Center in downtown Jeffersonville to facilitate remote management of that facility. A needs assessment of Hillside Hall will begin in late Spring 2005, and a plan developed to upgrade wiring and equip every classroom with a streamlined AV package. The goal is for all campus classrooms to have a permanently installed computer, LCD projector, and VHS/DVD. The completion of all these projects (excluding Hillside Hall) will bring the number of advanced technology classrooms to 49 (of a total of 88 classrooms). Since early 2001 all installations have been performed by IT-Media Services staff.

**EVALUATION & ASSESSMENT**

**Action 24.** The core campuses should collaborate to create an interdepartmental advisory group that will provide advice and guidance on assessment and planning for assessment.

**Action 25.** Faculty who participate in university-funded programs that support innovative applications of technology in teaching and learning should have access to the expertise and support resources needed to carry out an assessment of their project.

**Action 26.** A program of applied research in teaching and learning with technology should be considered as a means of identifying faculty and student needs and identifying opportunities for improving teaching and learning.

In addition to the activities described in connection with the SBC Fellows Program and the SBC/TAG Summer Leadership Forum (see Action 7), in 2002, the University explored new strategies for supporting assessment through the development of an electronic portfolio (ePortfolio) in partnership with IUPUI. As part of the ePortfolio strategy, IU joined the Open Source Portfolio Initiative to develop the ePortfolio in open source code. See http://www.theospi.org/

The ePortfolio design is based on the idea that portfolio is individual centric and enables a user to gather work products to be stored and shared with others. More important, it can be used for personal growth and development. As individuals experience events and learning, they flow in and out of groups and develop knowledge that illustrates their development. The ePortfolio repository enables a user to “reuse” artifacts in multiple presentations, assessments, and projects, while maintaining one version of the artifact that affects each rendering of it across the portfolio. Through a series of portfolio-based tools, ePortfolio creates an environment that allows users to seamlessly manage their portfolios by aggregating artifacts into presentations or participating in guided processes such as competency assessments or checklists. The ePortfolio toolset is being developed on the Sakai infrastructure, providing a standalone application while also integrating rich portfolio tools in the full suite of Oncourse tools. (See also Actions 12, 18, 19.) These are the core components of ePortfolio:

- **Workspace and Repository.** The workspace represents the portfolio owner’s interaction experience with artifacts stored in the repository.

- **Profile.** Based on IMS eportfolio specifications, the profile will provide extensive user and interoperability information.

- **Groups (Common Interest Groups).** This provides a space for shared interests or activities with group-specific interactions and assessments.

- **Scaffolding and Assessment Tools.** This includes guided processes such as assessments and checklists. Participants upload evidence to indicate competencies.

- **Presentation Tools.** Users construct presentations such as resumes and class projects to share or use for viewing and reflection.

- **Reporting Tools.** These collect and aggregate data in ePortfolio to display or export for more specific analysis.

IU is represented in the governing body of the Open Source Portfolio Initiative for the development of this open source electronic portfolio.
Recommendation 5: In support of research, UITS should provide broad support for basic collaboration technologies and begin implementing more advanced technologies. UITS should provide advanced data storage and management services to researchers. The University should continue its commitment to high performance computing and computation, so as to contribute to and benefit from initiatives to develop a national computational grid.

The Actions associated with this Recommendation address several services and initiatives for IT support of research, including high performance computing and grid computing (Actions 29, 31); computation- and information-intensive applications (Actions 30, 33); massive data storage (Action 32, also Action 43 under Recommendation 6); and collaboration and communications (Actions 27, 28).
**VIDEOCONFERENCING SERVICES**

Videoconferencing systems can be categorized into two models: group systems, comprising classroom and conference room systems; and desktop systems. The models have certain similarities, but have differing features of scale, complexity, capabilities, and support. Common to all is the H.323 videoconferencing standard. H.323 is a collection of complex protocols, with the important specification that H.323 systems utilize standard Internet data networking for communications.

During 2004 steady growth continued in the deployment and use of videoconferencing. At the end of December 2002, the number of group systems deployed in the university system was 163. In November 2003, that number rose to 187, with an additional 210 desktop systems 397. In 2004, growth continued at a steady pace. By November 2004, the number of group systems was 209, with approximately 225 desktops.

In 2003, IU’s core videoconferencing servers (MCU, Gatekeeper, Global Addressbook) were made fully redundant by installing failover hardware. In the event any of these systems goes down, the failover device will activate, assuring continued service.

In 2004, Digital Media Network Services (DMNS) completed its initiative to make all Indiana University endpoints compatible with the ViDeNet Global Dialing Scheme hierarchy, which allows for direct in and outward dialing to H.323 compliant systems at college campuses worldwide by a numerical “telephone” alias called E.164, eliminating the reliance on IP addresses to connect. Currently, IU is working toward meshing with H.323 global directory services based on LDAP, and is seeking partnerships with industry professionals to investigate how Session Initiation Protocol (SIP) can advance integrated directory services at IU and multimedia communication among SIP and legacy H.323 devices.

As IU’s Web collaboration service goes into production, DMNS has kept pace by insuring that publicly available videoconference rooms at all IU campuses will have the hardware (networked PCs and data projectors) necessary to conduct a tandem H.323 videoconference and Web-collaboration session. DMNS encourages owners of legacy hardware to upgrade their systems by January 2006 to take fullest advantage of the improved video and audio quality inherent in the new lineup.

**STREAMING MEDIA**

Digital Media Network Services launched IStream in Fall 2002 to allow for the automatic streaming and archiving of classes, meetings, and special events. In 2003, the service grew to support nearly 40 semester-long class sections in addition to numerous meetings and other events. In Fall 2004, DMNS began development of the next major version of IStream that adds increased management capabilities, improved user interfaces, and improved audio and video quality.

In Summer 2003, the implementation and migration began for a new, large storage system. This multi-terabyte system from EMC allows for replication of streaming data between IUB and IUPUI, ensuring the service is available and that recovery from a catastrophic failure should happen relatively quickly. Additional storage and improved replication software was purchased in Summer 2004 to increase capacity and reduce risk of data loss and downtime.

DMNS has been involved in a large project called EVIA-DA that is funded by the Mellon Foundation in collaboration with the University of Michigan. This project strives to preserve and share ethnomusicological videos for future study. Production service is expected to launch in early 2005. The Speech Archiving Pilot Project uses in-house-developed hardware and software that enables a professor to take a notebook computer and DV camera to the classroom and capture a student’s speech in high-quality digital video. With a single mouse click, the speech files are transferred from the notebook to a transcoding server where they are...
converted to streaming media files. These files are then automatically delivered to the IStream system, from which they can be viewed or downloaded for editing.

In addition, DMNS has implemented the means to restrict access to licensed streaming media in a way that satisfies the copyright owners, and also allows access from all Regional Centers for Medical Education. DMNS has also developed ways to stress test its streaming media infrastructure, utilizing clusters of computers within Student Technology Centers. This simulates the load placed on IU resources by hundreds of simultaneous users and allows detection and correction of performance problems before they impact the end-user experience.

**WEB COLLABORATION**

DMNS continues to work toward selecting an institutional Web conferencing and collaboration tool. Through joint efforts with UITS voice bridging unit, an RFP was distributed to select a vendor to provide a combined phone bridge and Web collaboration solution in late 2003. DMNS evaluated Macromedia’s Web collaboration solution, Breeze, and purchased it in Summer 2004. Pilot testing is planned for Sprint 2005, in view of a Fall ’05 offering to faculty and staff. In the interim, academic and administrative collaboration needs continue to be met using NetMeeting and locally developed chat tools.

In 2004, DMNS began using Microsoft Outlook resource calendars to simplify videoconference room scheduling across all campuses. DMNS began a migration toward allocating MCU capacity to certified groups to allow “always-on” ad hoc multipoint conferences. The unit will attempt to extend this idea in 2005 by using Outlook to streamline requests for other DMNS advanced services (multipoint videoconferencing, streaming, and Web collaboration sessions). Among its peer institutions of higher education, Indiana is recognized as one of the leaders in the deployment, support, and operation of videoconferencing networks.

**ACCESS GRID**

The Advanced Visualization Laboratory (AVL), in conjunction with the School of Informatics and DMNS, installed several Access Grid (AG) nodes on the Bloomington and Indianapolis campuses. AG nodes complement the standard videoconferencing services supported through DMNS by using multicast protocols and by supporting multiple participating sites and multiple video and data streams per site. AG technologies are a useful and growing standard for distributed research collaborations. IUB installations include rooms in the School of Informatics and the Wrubel Computing Center; IUPUI installations include facilities in Medical Sciences and the ICTC. The AG node in Informatics was used to teach a semester-long, distributed course on virtual reality technologies between students and instructors at IUB and at Purdue University in West Lafayette during Spring 2004.

**COLLABORATIVE VISUALIZATION**

The AVL has integrated a range of visual collaboration capabilities into its new facilities in the ICTC and planned upgrades for its IUB facilities. The high-resolution display wall and the reconfigurable virtual reality theater in the ICTC are ideal for supporting collaborations with groups of local and remote colleagues. (See the narrative under Actions 30 and 33 for more details on these facilities.) The graphics supercomputers driving these systems can employ several different “visualization serving” technologies that operate over local- and wide-area networks to allow collaborators to view and control the same graphical application at multiple sites. Full-scale teleimmersion applications continue to be supported and have proven to be especially beneficial for educational and artistic endeavors. The broader deployment of the AVL-developed John-e-Box visualization systems (see Action 30) has placed advanced 3D capabilities in laboratories and classrooms across the University and is a key component of plans for an advanced visualization and visual collaboration infrastructure.
IU has set a goal of enabling IU researchers to perform massive new analyses and simulations at the same time as, or before, their peers at other leading research institutions. Indiana University’s high performance computing and communication environment makes this possible, enabling researchers, artists, engineers and clinicians to explore new areas and approaches in science, the arts, and education. Computing resources, and the software and support needed to make use of these advanced facilities, are freely available to the IU community, which has enabled IU to take a leadership position nationally and internationally in terms of the number of people and the diversity of disciplines that take advantage of IU’s high performance computing environment.

During 2004, the Research and Academic Computing Division sharpened its organizational focus on its core services and activities. Research computing comprises these “front-office” activities: researcher consulting and education, and grant initiation, collaboration, and fulfillment; and these “back-office” activities: systems administration, and engineering computing frontiers. These combine to deliver robust and reliable research computing services while helping to forge the research of the future in collaboration with the IU community.

High performance computing activities touch all areas of RAC activity. The Research SP supercomputer delivers extremely robust and reliable services and serves a wide variety of IU researchers. IU’s AVIDD facility is part of the UITS effort, in collaboration with IU computer scientists, to forge the research of the future. It has tremendous capabilities for new data-centric research, but requires more maintenance, and more sophistication on the user’s part, than the UITS Research SP.

Supporting high performance computing are the back-office efforts of the many systems administrators and programmers who operate some of the most powerful supercomputers owned by any US university. IU’s high performance computer systems are at the leading edge in providing raw processing power, but the programming required to harness this power is specialized and demanding. The “front office” activities comprise an array of consulting and support services that enable the IU community to harness this power to create new innovations and discoveries.

The intellectual impact of IU’s high performance computing environment is broad and far-reaching, as indicated in the extensive list of publications, presentations, and artistic works that rely on UITS high performance computing systems, massive data storage facilities, and advanced visualization environments. See http://racinfo.uits.iu.edu/publications/

UITS high performance computing services fall into four key areas: delivery and support of advanced hardware; participation in national and international efforts to create a cyberinfrastructure supporting advanced research; the use of high performance computing in undergraduate and graduate education; and creation of new, high performance computing technologies. The term “cyberinfrastructure,” coined by the National Science Foundation, refers to an array of high performance computing systems, massive storage systems, advanced visualization systems, and advanced instruments, all linked by high-speed networks. The concept evolved from that of grid computing, but is more far-reaching, focusing on creating a system of advanced IT facilities that enable pathbreaking research.
This section covers UITS activities in three of these areas. The creation of new high performance computing technologies and their economic development impact are discussed under Action 34.

DELIVERY AND SUPPORT OF ADVANCED HARDWARE
IU continues its strategy of providing high performance computing systems of the three types of system architectures commonly used in the US, and strives to provide the systems considered best in class in each category:

- Linux clusters (part of the AVIDD facility)
- Distributed shared memory (the IBM SP)
- Shared memory (the Research Database Complex)

Details on these systems follow.

Linux clusters (the AVIDD facility). AVIDD (Analysis and Visualization of Instrument-Driven Data) is an innovative facility for processing and analyzing data generated by large scientific instruments and is a major new tool for research and teaching at IU. The system has an aggregate capacity of 2.2 TeraFLOPS, 0.5 TB RAM, and 10 TB of disk. AVIDD consists of computational, data storage, and data visualization components as follows.

The computational component includes a set of large PentiumIV clusters located at IUB and IUPUI tied together as a single computational resource. This was the first geographically distributed Linux cluster to achieve 1 TFLOPS in real calculations. In addition, a PentiumIII Linux cluster at IUN is used for instruction in parallel programming as well as research. A fourth AVIDD component, an Itanium2 Linux cluster at IUPUI, was the first IU computing resource dedicated to the NSF-funded grid project called the TeraGrid. In 2005, the AVIDD PentiumIV clusters as well as IU visualization and data resources will also be integrated into the TeraGrid.

The overall AVIDD facility also includes enhancements to the UITS massive data storage and visualization systems; these are described under actions 32 and 43, and 30 and 31, respectively.

Distributed shared memory (the IBM Research SP). The 646-processor UITS Research SP provides an extremely robust research computing environment, supporting a broad range of serial and parallel applications. It features 644 gigabytes of memory, 3 terabytes of disk storage space, a high-speed switch to facilitate communications between nodes, and a wealth of application software. Total theoretical peak processing speed exceeds one TeraFLOPS. The Research SP, the cornerstone of IU’s strategies in high performance computing, is IU’s high performance computing workhorse. Its users range from first-year graduate students in statistics classes to senior and internationally recognized researchers in computer science. It offers a clear migration path for IU researchers from relatively straightforward analyses with statistical software to specialized custom-written applications to parallel computing (using many processors together to solve a single, very large problem). It enables researchers in a wide variety of fields to tackle innovative and important problems using the most powerful supercomputing techniques in existence.

Shared memory (the Research Database Complex). The Research Database Complex (RDC) serves research database needs, providing a large-memory SMP environment, Oracle software, and significant disk storage. The RDC comprises two Sun V1280 systems and a Sun V880, with 28 CPUs, and 200GB memory and 6TB shared disk, dedicated for high performance database and information management research. The complex is used by IU’s leading database researchers, especially those in the School of Library and Information Sciences and the School of Informatics who study knowledge management and database performance. The RDC also hosts several important biomedical data suites and geographic information system (GIS) datasets for IU and the State. GIS datasets about the State have served in practical applications from urban planning to real-time use fighting forest fires.

CREATING AN ADVANCED CYBERINFRASTRUCTURE
The term “cyberinfrastructure” (defined above) has succeeded “grid computing” as a central concept in the development of high performance computing for two reasons. First, cyberinfrastructure focuses on the role of advanced instruments that produce digital data at unprecedented rates. Such instruments, ranging from unique, internationally shared supercolliders to new proteomics spectrometers being developed by IU researchers, produce data at rates that are so great that the output cannot be analyzed by any single
computer. Analysis and understanding of the most complicated physical and biological systems can be greatly accelerated by connecting such instruments to a massive, geographically distributed suites of storage, computation, and visualization systems. This goes far beyond "grid computing." Second, "cyberinfrastructure" implies that the nation’s most advanced research IT systems are sufficiently easy to use that they are viewed as infrastructure in much the same way as are electrical and plumbing systems.

Indiana University is involved in two major cyberinfrastructure activities. The International Virtual Data Grid Laboratory, also known as iVDGL, focuses on the massive data challenges of new particle physics research. The TeraGrid is the National Science Foundation’s flagship effort to build a flexible, general-purpose national science cyberinfrastructure.

PHYSICS DATA GRID PROJECTS
The Large Hadron Collider (LHC) is a particle accelerator under construction at CERN (the world’s premier institution for advanced particle physics research in Europe in which the US participates) that will start operations in 2007. There has been tremendous consolidation in particle physics research: probing the frontiers of the basic components of matter requires ever larger and more powerful accelerators. The international particle physics community shares a very small number of accelerators and experiments. When the LHC begins operations in 2007 it will produce PetaBytes of data per year, which thousands of physicists worldwide want to probe and analyze as they seek to understand the basic constituents of matter. A key challenge is managing the data. A PetaByte is one thousand TeraBytes of data, and a TeraByte of data is roughly 1,200 CDs. The LHC experiment may well require, over the course of the experiment, a total of 100 PetaBytes of storage, or the equivalent of 120,000,000 CDs of data. Storing this amount of data is well beyond the capability of any individual location. A grid approach to data management is essential to the LHC project.

One experiment slated for the LHC is called ATLAS (A Toroidal LHC ApparatuS); it will study particular types of particle interactions. Under construction is a prototype system for distributing the data that involved placing data at national repositories (Tier 1 centers), then replicating that data at regional centers (Tier 2 centers). UITS is operating a prototype Tier 2 center as part of the ATLAS project.

Tremendous challenges in computer science must be overcome in creating tools that will enable the US and international physics community to use LHC data. The International Virtual Data Grid Laboratory is a computer science project that aims to build a data-oriented cyberinfrastructure that will enable the particle physics community to use LHC data. IU is among the 15-university consortium that received National Science Foundation funds in 2001 to create this international data grid. The iVDGL consists of a seamless network of thousands of computers at 40 locations in the US, Europe, and Asia. During 2004 UITS made available 8 TeraBytes of disk storage for use by iVDGL and other physics grid experiments.

The enormous task of managing this grid of computers is assigned to the iVDGL Grid Operations Center (iGOC) that IU is creating. Building the iGOC is a key part of IU’s participation in iVDGL, particularly the development of systems for formal and informal problem management and a status map for the iVDGL grid resources. The iGOC trouble ticket system handles more than 20 trouble tickets a week, and the number of tickets has been rapidly increasing.

Grid3 is a US-led project that unites several data-oriented grid projects, including ATLAS and iVDGL and that aims to create a cyberinfrastructure for data-intensive research in several fields of research, including physics, astronomy, biology, and environmental sciences. IU participated in demonstration projects lead by Grid3 called data challenges that demonstrate the capabilities of these physics grid facilities, monitoring key servers in the computing grid. A key issue in such monitoring is classifying problem severity, and escalating the resolution of high-impact problems. IU is refining a prototype system for communicating with the computing sites that participate in Grid3 and with the physicists that depend on it.

IU’s involvement in data-intensive cyberinfrastructure projects builds on IU’s investments in several key areas of information technology, including advanced networking (Internet2 Abilene, TransPAC, and the Global Network Operations Center), high performance computing, and massive data storage.

TERAGRID
The TeraGrid is the US flagship effort to build a general-purpose national cyberinfrastructure to serve the nation’s most advanced researchers in all disciplines. It builds upon the physics cyberinfrastructure but also
faces a more complicated set of challenges. In September 2003, Indiana and Purdue Universities jointly received a $3M National Science Foundation (NSF) grant to link their systems, via the statewide I-Light network, to the TeraGrid. In so doing, IU became one of just nine institutions involved in building this important national project – a cornerstone of the NSF long-term strategy for enhancing and expanding the nation’s research capabilities. IU is contributing more than three TeraFLOPS of computing capability (computers capable of three trillion mathematical calculations per second), 400 TeraBytes of data storage capacity, visualization resources, and access to life science data sets deriving from the Indiana Genomics Initiative.

The TeraGrid, which went into production in October 2004, is a computing construction project. Creating the network that connects the nine participating institutions, then enabling their computing systems to work together, was the main challenge. Applications using the TeraGrid, including tornado prediction systems being developed by IU computer scientists, were demonstrated in November 2004 at SC2004, the annual international supercomputing conference (see the narrative under Actions 29 and 31.) During 2005, IU will work with scientists in Indiana and nationwide to enable computing applications to use TeraGrid capabilities. IU’s involvement in the TeraGrid is helping the US vision for a national cyberinfrastructure become a reality.

INDIANA UNIVERSITY AT SC2004
The annual Supercomputing conference sponsored by the IEEE and ACM is the world’s premier international conference related to high performance computing. This year, Indiana University unveiled a new display featuring highlights of Pervasive Technology Labs’ and University Information Technology Services’ new inventions and recent accomplishments, including those in life sciences, wireless network security, and the TeraGrid. IU life science applications are also featured in the November issue of Communications of the Association for Computer Machinery at http://www.acm.org/pubs/cacm/

RESEARCH COMPUTING IN GRADUATE AND UNDERGRADUATE RESEARCH
The National Science Foundation describes the three components of its mission as tools, people, and discovery. The application of new discoveries to engineering and clinical medical practice requires an innovative, better-educated workforce. UITS efforts to build this 21st-century workforce also have three components: providing research computing tools for undergraduate and graduate education, encouraging undergraduate and graduate students across American society to engage in advanced research, and encouraging the students of tomorrow to pursue careers in research and research computing.

UITS provides a variety of tools that facilitate and improve undergraduate and graduate research. Software distributed by UITS (see Actions 30 and 33) enables IU students to use and install on their personal computers the most advanced research software available for scientific research. Software includes the widely used statistical analysis packages SPSS and SAS, and the mathematical packages Mathematica and Matlab. These and dozens of others are available to students, staff, and faculty at all IU campuses. The quality of education at IU is greatly enhanced by access to the best research software tools in their fully functional professional forms – not the “student versions” widely used at other institutions of higher education.

UITS also provides computer systems geared towards undergraduate and graduate research. Undergrads who hope to become researchers find an ample suite of services provided by the RAC Division. A group of computers collectively referred to as the Steel cluster provides an interactive Unix environment for some 30,000 students, with a platform for learning research-related skills that range from programming and scripting to Web publishing. The Steel cluster is widely used by computer science and Informatics students, and by undergraduates in other disciplines who want to learn and use the most sophisticated programming tools. IU makes it easy for graduate students to access supercomputers: those in the sciences commonly gain access in their first semester of graduate work, in contrast to peers at other institutions.

UITS, and IU as a whole, provide services and support programs that ensure that interested students are encouraged to pursue advanced research, including advanced information technology. Overcoming the visible and invisible barriers to participation requires special attention to women and students from traditionally underserved groups, defined by the National Science Foundation as African Americans, Hispanics, and Native Americans.

UITS, the Office of the Vice President for Research and Information Technology, and the School of Informatics together helped sponsor the 10th Grace Hopper Celebration of Women in Computing. More than 20
IU women (from undergraduate students to faculty) attended the 2004 Grace Hopper Celebration – by far the largest and most enthusiastic contingent of IU women ever to attend the event.

RAC offers graduate assistantships and internships to students from traditionally underserved groups, encouraging diversity and helping to build paths to careers in advanced information technology in the State.

RAC helps build diversity among future university-age students by reaching out to younger students. The UITS Advanced Visualization Laboratory conducted a series of demonstrations as part of the Marion County Public Library system in the Indianapolis area. Demonstrations were geared to all ages, especially elementary school children. More than 450 people – mostly children, especially those from traditionally underserved groups – attended. The 3D visualizations included health education videos created by an Informatics student, a Mars movie featuring photos taken by the Rover and distributed by NASA, and an interactive fly-through of downtown Indianapolis using LIDAR data acquired from recent GIS initiatives. The AVL also partnered with the Brownsburg Challenger Center for its 10th anniversary celebration where staff showed the Mars movie along with a recently developed interactive tool for solar system exploration.

By generating enthusiasm for sciences and information technology in elementary school students, UITS will help encourage more students to pursue high school curricula that will enable them to study science and technology at the university level. By informing parents about the career opportunities in advanced technology, UITS helps shape the opinions of those with the greatest impact on children’s curiosity and ambition.

During 2004 UITS partnered with IU’s American Indian Research Studies Institute (AIRSI) to support the development of online tools for the preservation and teaching of Native American languages, particularly the languages of those who once inhabited what is now the State of Indiana. America’s future accomplishments in research and development will be their finest if they engage the finest minds. That can happen only if America’s researchers are drawn from the full richness of its society. UITS is helping to make this happen.

**COMPUTATION & INFORMATION-INTENSIVE APPLICATIONS**

**Action 30.** The University needs to provide facilities and support for computationally and data-intensive research for non-traditional areas such as the arts and humanities, as well as for the more traditional areas of scientific computation.

**Action 33.** The University through UITS should provide support for a wider range of research software including database systems, text-based and text-markup tools, scientific text processing systems, and software for statistical analysis. UITS should investigate the possibilities for enterprise-wide agreements for software acquisitions similar to the Microsoft Enterprise License Agreement.

The UITS focus on computationally and data-intensive research spans many areas and strategic plan Actions. Especially important is delivering software tools that enable computationally-intensive research, and creating and providing advanced visualization facilities scientists can use to analyze massive data sets that would otherwise be beyond comprehension.

**SUPPORT AND DELIVERY OF RESEARCH SOFTWARE**

RAC provides access to software, along with consulting support services, to IU faculty, staff, and students across the University. RAC manages site licenses and software accessibility in many areas of scholarly endeavor. The primary areas of focus are statistical computing, mathematical computing, and bibliographic
tools. Consulting is available for short- and long-term projects in many areas of research, including statistics and mathematics, high performance computing, Unix systems, bioinformatics, and visualization, as detailed by area, in the narrative below. Help is available through online resources, user groups, in person, and via telephone. The satisfaction rate for RAC services remains high, with an overall satisfaction rate of 98% recorded in the 2004 UITS User Survey.

Statistical and mathematical software. The Center for Statistical and Mathematical Computing (Stat/Math Center) manages a large suite of software in support of qualitative and quantitative research. The centerpiece of this effort is the Enterprise License Agreement for SPSS, the most widely used commercial statistical package at IU. More than 1,980 copies of SPSS were distributed across IU in 2004, facilitating research and education at all campuses. SAS, the most widely used statistical software package in business environments, is also distributed via site licenses to IU.

Dozens of other software packages, including the mathematical software Matlab, are licensed and redistributed across IU at a very modest cost. Through agreements with Minitab Inc. and Wolfram Research, signed in 2004, Minitab and Mathematica are available to students for home use for $20 a year. This significant savings over academic list price enables more students to take advantage of these tools. The difference between the costs paid by the University and academic list price amounts to a savings of more than an annual $3.25M. More important, the ease of access to the best software tools for researchers and students greatly enhances the University’s activities in research and teaching.

Among its other activities, the Stat/Math Center delivers (in cooperation with the IT Education and Training Program) short, non-credit classes on statistical and mathematical computing. The Stat/Math Center also provides instructional and consulting support, and a Web site of online resources. See http://www.indiana.edu/~statmath/

Unix and open source productivity tools. The Unix System Support Group (USSG) negotiates site licenses for commercial Unix software, providing the University with access to such software under very aggressive site licensing terms. The USSG supports the use of multiple variants of Unix, focusing on Linux and Solaris, and provides access to those operating systems.

In December 2004, the USSG and the University reached an agreement with Red Hat, Inc., for an unlimited, all-campus site license of the most widely used variant of Linux – Red Hat Linux. This site license provides access to all current Red Hat operating system versions: WS, Red Hat AS, and the Red Hat Up2Date network. The USSG administers a local server that enables the IU community to easily access this software. Management facilities provided by this license make it simple for department staff who manage large numbers of Linux systems to easily manage groups of computers.

Linux is one part of the broader open source software movement, an important force in making high-quality software available to research and education communities – often in market areas or with capabilities that are too specialized to attract commercial software developers. A key part of USSG services is the operation of a system that provides copies of a wide range of open source software. The USSG Open Source Mirror contains a local repository of dozens of open source software tools, including the very popular Open Office productivity suite, as well as many security-related applications and updates. Downloads from USSG servers amount to 10 TB per month. The cost avoidance achieved by USSG negotiations for commercial Unix variants, and through enabling use of open source productivity tools for word processing, spreadsheets, and presentations, exceeds $1M per year. It is impossible to put a financial value on the open source tools that have no commercial counterpart, but their value in expanding the research capabilities of the IU community is tremendous.

To increase awareness of such tools the USSG hosts an annual event called LinuxFest. The theme of the 2004 LinuxFest was “The State of Linux,” with Daniel Robbins, chief architect of Gentoo Linux (the most sophisticated Linux variant) as keynote. Presentations and discussion groups focused on how Linux fits into the academic community, security issues, and an open question and answer forum. More than 500 people attended the 2004 LinuxFest.

Bioinformatics support. Bioinformatics and computational biology are important new disciplines, and UITS support is helping IU carve out a leadership position in these areas. Two full-time consultants (one funded by the Indiana Genomics Initiative) support bioinformatics and bioinformatics databases. IU researchers have access to various innovative software applications that enable searching for genes in more
than a dozen different genomic databases, analyzing evolutionary trees, and searching for potential new drug compounds. As part of IU’s life sciences research relationship with IBM, Inc., IU researchers, UITS experts, and IBM are collaborating to create a system for managing and searching information on related groups of proteins. This will be key in using information on the genetics of animals to understand the human genome.

UTIS leadership in bioinformatics is indicated nationally by staff activity in presenting workshops and papers at national conferences, and in leading the authorship of important position papers on the use of high performance computing and bioinformatics in biomedical research. Research at IU is enjoying an advantage relative to its peers in advanced information technology in the life sciences because UITS is making it easier for biomedical researchers of long standing to learn about and adopt new technologies, while also providing massive and sophisticated resources for researchers already steeped in this technology.

ADVANCED VISUALIZATION & VIRTUAL REALITY

Many types of data-intensive computing involve the analysis of data sets which, when printed as numbers on paper, are beyond the cognitive capabilities of the human brain. The only way to understand such data sets is through visualization. In addition, many types of scientific data involve data that consists solely or largely of images. The UITS Advanced Visualization Lab (AVL) provides software, consulting, and facilities that enable IU scientists, clinicians, engineers, and artists to use advanced visualization and virtual reality technology.

During 2004 the focus of AVL activities was the creation and installation of new visualization facilities in the ICTC building at IUPUI, including a high-resolution display wall and a virtual reality theater.

High-resolution display wall. The centerpiece of the new UITS Research and Academic Computing lab in the ICTC building is a high-resolution display wall integrated by Fakespace Systems. This wall comprises eight 50" projection cubes tiled in a 4 x 2 configuration. Each cube has a resolution of 1600x1200 pixels, resulting in a display 160" wide by 60" high, with more than 15.3M pixels. All pixels are addressable using a video scaling system capable of taking multiple input sources (video and RGB) and scaling and distributing those sources over the entire display. Together, these technologies will enable large groups to simultaneously view multiple video input sources, teleconferencing sessions, and/or high resolution advanced visualizations. Also available in IT 414 will be a smaller-scale tiled LCD wall driven by an 8-node Linux cluster, a John-e-Box, a ReachIn/Phantom haptics unit, an IBM T221 display, and varied video conferencing technologies such as Access Grid and Polycom.

Virtual reality theater. IT 403 at IUPUI is home to a reconfigurable virtual reality theater - the MOVE Lite system from BARCO Simulation, installed in December 2004. This display provides a bright, high-resolution, immersive experience using four 10’x7.5’ screens featuring 1400x1050 pixels at 6000 lumens. It is among the highest resolution and brightest 3D projection systems available anywhere. The side screens are motorized to support flat, panoramic, “L”-shape and cube configurations. The system is driven by a state-of-the-art SGI Onyx4 system as well as an Opteron-based Linux cluster, and features wireless, optical tracking of multiple input devices over a 30’ x 10’ space. The variety of configurations, computing systems, and input devices will allow researchers, educators, and artists to customize the VR Theater for their applications and audiences, and will support scenarios ranging from wide screen design reviews for collaborative teams, to panoramic, semi-immersive visualization for classes, to fully immersive artistic environments for small groups. Because of the computing system deployed for the virtual reality theater, the AVL has partnered with SGI to be a test site for Prism, SGI’s new Linux-based visualization system.

John-e-Boxes. The AVL continued to support its portable, large-format, 3D stereo display John-e-Boxes, developed with the IUB Chemistry Department and licensed in 2003. Eight John-e-Boxes have been deployed under the AVIDD (Analysis and Visualization of Instrument Driven Data) NSF grant, including one used routinely at IU Northwest in Gary, Indiana.

The AVL has also helped apply new and continuing applications of visualization technologies to traditional
scientific and data-intensive areas. Projects include integrating advanced stereo and high-resolution displays with standard GIS packages, such as ERDAS IMAGINE and ESRI ArcGIS, to visualize aerial photography and Light Detection and Ranging (LIDAR) elevation models of Indianapolis and Marion County; extending CNC (computer numerically-controlled) milling simulation software to virtual reality displays; developing new visualization software tools for a finite element simulation of an aircraft wing and a cellular automata simulation of material corrosion; visualizing 3D plots resulting from high-energy physics experiments; visualizing, filtering, and segmenting volumetric data sets resulting from medical microscopy and radiology scans; visualizing molecular simulations involving hundreds of thousands of atoms; and modeling and rendering astronomical datasets, including interstellar gas clouds and accurate Earth models and satellite animations.

**Markup Language Service.** In 2005, RAC will create a new unit to focus on electronic markup technologies (primarily XML-based) to provide a “front door” for providing data-oriented services for the research community. MLS goals include establishing a service to help researchers use markup languages to represent data and knowledge; providing an infrastructure to store, archive, and publish data for use by IU and national communities; collaborating with IU Libraries to harmonize MLS and Library services in the area of managing data; and taking the lead in markup languages in the national scientific and library communities.

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**Action 32.** The University should evaluate and acquire high-capacity storage systems, capable of managing very large data volumes from research instruments, remote sensors, and other data gathering facilities.

**Action 45.** UITS should implement massive storage technology for storage of the University’s institutional data, migrate tapes over time to the new environment, and integrate this technology with database management systems to support image, sound, and video data types.

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IU’s Massive Data Storage System (MDSS), based on the High Performance Storage System (or HPSS) software, gives researchers (faculty, staff, and students) at all IU campuses instant access up to an 880TB capacity. The number of users totals 1,303. Of these, 1,056 are at IUB, 212 are at IUPUI, and 35 are on the regional campuses. Some 105TB of data are stored in HPSS. Of this, 78TB are used by IUB, 27TB by IUPUI, and 160GB by the regional campuses.

The architecture of the MDSS system is unique in many respects. IU supercomputing resources are connected to MDSS using a high performance switching infrastructure based on non-blocking switches from Force-10 Networks. Data are automatically mirrored across the IUPUI and IUB campuses over the I-Light network, and connected to San Diego Supercomputer Center, Pittsburgh Supercomputing Center, NCSA, and other TeraGrid partner sites via a 10 Gb/sec TeraGrid network connection to Chicago. With this architecture, IU’s MDSS is the first disaster-tolerant high performance mass store system anywhere. Automatic duplication of data between Indianapolis and Bloomington (resulting in nearly 210TB of data stored on tapes) assures that biomedical and other data, often irreplaceable, will not be lost were a disaster to strike one of the University’s two machine rooms. The unique architecture of the MDSS provides a considerable competitive advantage for those seeking research grants that require substantial amounts of storage.

During 2004, MDSS was expanded at IUPUI. Tape drives capable of storing 200GB per tape were added, in addition to the 20GB and 60GB drives previously relied upon at IUB and IUPUI. New tapes were also added, nearly doubling system capacity.

The IU Massive Data Storage System was connected to the TeraGrid in 2004. The physical resources of the system were expanded to provide a connection between MDSS and the TeraGrid network switches at IUB and IUPUI, and staff worked with HPSS and other TeraGrid developers to install novel software on IU’s HPSS servers that integrate MDSS with the common software stack used on the TeraGrid.
CFS
With a total capacity of about 1.63TB, CFS provides all IU campuses with an easy-to-use, Web-based file storage service that is accessible from anywhere in the world. The number of CFS users currently stands at 56,986. Of those, 46,292 are at IUB; 4,884 are at IUPUI; 3,821 are at IUS; and 1,989 are at other regional campuses. About 1.3TB of data are currently stored on CFS.

RESEARCH INITIATIVES IN INFORMATION TECHNOLOGY

Action 34. UITS should participate with faculty on major research initiatives involving information technology, where it is appropriate and of institutional advantage. Further, UITS should provide proactive encouragement and supportive services that create opportunities where faculty from diverse disciplines might come together on collaborative projects involving information technology.

UITST is involved in research initiatives for many reasons: to create new discoveries and technologies by taking advantage of the skills of its own staff; to enable new intellectual discoveries and practical research and development by IU researchers, clinicians, and engineers; and to help IU enable the State of Indiana to achieve the technology transfer and economic benefits of IU’s research and creative activities. UITS is active in ensuring that the results of its research efforts are understood internationally and statewide. These efforts are detailed below.

RESEARCH LED BY UITS

AVIDD. The AVIDD facility, discussed in the narrative on Actions 29 and 31, is the result of a grant awarded to IU from the National Science Foundation. This grant included representatives of OVPIT and UITS, as well as faculty from several Schools and the IU core campuses. UITS staff are working with the faculty participating in the AVIDD grant to create new advances in computer science and in sciences that depend upon advanced information technology.

TeraGrid. The TeraGrid, funded by the National Science Foundation, is the nation’s premier effort to create a national cyberinfrastructure for research. This system of advanced instruments, massive data storage systems, large supercomputers, and visualization systems all linked by high-speed networks, will expand the nation’s capabilities for advanced research. IU was awarded a grant by the NSF in 2003 to participate in the TeraGrid. After a year of construction, IU joined the eight other TeraGrid participants in putting the TeraGrid into production at the beginning of October 2004. Particularly important parts of IU’s contributions to the TeraGrid include data sets and portals in the life sciences. More information on grid-related research activities is contained in the narrative under Action 50.

IBM Institutes of Innovation. In June 2003, IU was named one of IBM’s charter Institutes of Innovation. As part of this honor, researchers at IU collaborate with IBM on life sciences research projects of mutual interest. IBM is funding two postdoctoral associate positions and two graduate assistantships. IU’s research under this program focuses on the 3D modeling of cells. Through the use of parallel and grid computing, IU researchers are creating a computer-based simulator of living cells. This is of particular importance in drug discovery and targeted treatment solutions. The Centralized Life Sciences Data system, discussed below, is also part of the IU-IBM partnership.

Creation of new software. A critical part of UITS research activities involves the creation of new software. Many of these efforts result in open source software tools of tremendous use to IU researchers, and that aid the broader US and international research community. New software created and released during 2004 includes the following:

• XLiveCD. RAC staff created XLiveCD, a suite of open source software and IU-developed scripts and programs that allow Microsoft Windows users to connect to remote Unix computers, run graphical applications, and have the graphics displayed on their desktops. The software runs from the CD without being installed, provides access to remote
computers, and displays remote X graphics windows automatically. XLiveCD enables campus users of Windows to use research Unix systems. This software inspired the rap group 2LiveCrew to stage a reunion to record its own CD in honor of this one.

- **Simple Message Brokering Library.** During 2002-2004, UITS developed and deployed technology for bringing MS-Windows workstations into a computational grid, on a temporary basis, giving priority to interactive users. This involved a Web portal, a Condor server, and the SMBL communications library which partially mimics the functionality of the Message Passing Interface (MPI) standard. This system scavenges cycles, currently equivalent to well over 500 processors running continually.

- **PViN.** PViN (Pedigree Visualization and Navigation) enables visualizing the appearance of human hereditary diseases in family trees. Such data are difficult to visualize and study. This highly effective tool for data visualization helps scientists at IU and elsewhere understand the genetic origins and heritability patterns of human genetic diseases.

Other software tools developed by UITS prior to 2004, and that continue to be used and distributed by IU, include the following:

- **Centralized Life Sciences Data (CLSD).** Molecular biologists require external data from a wide variety of sources to properly analyze their lab data. The Indiana Genomics Initiative IT Core created the CLSD service to provide that external data locally, freeing researchers to spend more time on their research.

- **IU Batch Scripts (HPC interactive job scripts).** IU Batch Scripts simplify the process of submitting jobs on supercomputers by reducing it to a single command.

- **Parallel fastDNAml.** Maximum-likelihood inference of phylogenetic relationships is notoriously compute-intensive. UITS provides the parallel implementation of the leading software tool for this increasingly strategic biologic tool.

- **PINY_MD** is capable of performing a wide variety of molecular dynamics, electronic structure, and geometry optimization calculations. Such capabilities include force-field-based simulations on systems ranging in complexity from simple molecular liquids (e.g.: water, ammonia, liquid alkanes) and crystals (e.g.: ice) to large biomolecular systems such as the HIV-1 protease in solution. UITS has modified and extended the original serial version of PINY_MD that is available from the original authors’ Web site and optimized it to run in both serial and parallel modes in an IBM AIX environment.

- **GeneIndex,** a basic bioinformatics tool, finds the frequencies and positions of all words of a given length in a DNA sequence.

- **NBPack** provides a tree-structured code for dealing with very large N-Body particle simulations. These are useful for modeling proteins or star clusters.

- **Penelope** is a leading radiation transport code. UITS developed a parallel version of this code, in support of the Department of Radiation Oncology, and returned it to the nuclear science community.

For copies of these software tools, and information about them, see [http://rac.uits.indiana.edu](http://rac.uits.indiana.edu)

**RESEARCH PROJECTS INVOLVING UITS**

Indiana Genomics Initiative. The Indiana Genomics Initiative was launched in December 2000 with a $105M grant from the Lilly Endowment, Inc. – the largest grant ever received by Indiana University. The advanced information technology facilities for the Initiative comprise five components: supercomputing, massive data storage, advanced visualization, high-speed networking, and staff support. In each area, IU’s facilities, resources, and expertise repeatedly gained national and international recognition. The Indiana Genomics Initiative builds upon this infrastructure and history of excellence to create facilities that are unique in university-affiliated genomics research institutes. The excellence of IU’s advanced IT infrastructure was critical in the success of IU’s proposal to the Lilly Endowment, Inc. to create the Indiana Genomics Initiative.

**METACyt.** In December 2004 Indiana University and the Lilly Endowment, Inc. announced a $53M grant to IU Bloomington to create the Indiana METACyt Initiative. This projects starts in early 2005. This grant supports the development of new IT-based research in the life sciences, building on the foundation of genomics and proteomics and moving scientists closer to understanding the complete function of living organisms. UITS is a key participant in METACyt, and as with the Indiana Genomics Initiative, the excellence of IU’s advanced IT infrastructure was a critical factor in the success of this proposal to the Lilly Endowment, Inc.
Sakai Project and OncourseCL collaboration. Indiana University is working with the University of Michigan, Stanford, MIT, the uPortal consortium, and the Open Knowledge Initiative (OKI) on a $6.8M software development project to develop a Collaboration and Learning Environment with the support of the Andrew W. Mellon Foundation based on the Sakai software. OncourseCL, based on Sakai, will provide a distributed collaborative environment to allow members of the IU community to form virtual community worksites. OncourseCL worksites provide the tools necessary for activities that include grant writing, group research projects, and student work groups. The Sakai Educational Partners’ Program (SEPP) extends the Sakai community source project to other academic institutions around the world, and is supported by the William and Flora Hewlett Foundation and SEPP member contributions.

Collaboration for the Interdisciplinary Study of Fetal Alcohol Spectrum Disorder. Fetal Alcohol Spectrum Disorder covers a range of maladies that affect those exposed to alcohol in the womb. This disorder, affecting thousands of people mainly in economically deprived populations, is difficult to diagnose early, yet early diagnosis is essential to mitigating its impact. The Collaboration for the Interdisciplinary Study of Fetal Alcohol Spectrum Disorder (CIFASD) aims to develop new means for diagnosis, improve understanding of the role of alcohol in the disorder, and develop and evaluate treatments. The RAC Division leads the CIFASD Informatics Core, which is responsible for managing data. The UITS Advanced Visualization Lab (functioning as a part of the IT Core) is participating in the CIFASD facial dysmorphology core. AVL led the development of techniques for using 3D laser scanners to map children’s facial features and is leading the development of software image analysis tools that will help develop better methods for diagnosing the disorder.

National Gene Vector Laboratories. The IT Core maintains the Pharmacology/Toxicology Database for the National Gene Vector Laboratories (NGVL), an effort led by the IU School of Medicine with funding from the NIH. NGVL is a network of laboratories and production facilities that fund support and provide materials for gene therapy clinical trials and studies. The Pharmacology/Toxicology Database is used by the NGVL management and biomedical researchers worldwide.

Digital Library Program. In close collaboration with IU Libraries, UITS supports the efforts and grant activities of the IU Digital Library Program. This year, the DLP was awarded new grants from the Institute for Museum and Library Services (IMLS) program Librarians for the 21st Century, and the National Endowment for the Humanities. The accomplishments of the DLP this year are described in the narrative under Recommendation 9, Digital Libraries and the Scholarly Record.

Center for Computational Homeland Security. UITS is working with Purdue University’s Krannert School of Management and Homeland Security Institute to create new knowledge and tools for sustainable homeland security. The Synthetic Environment for Computational Experimentation under development is a scalable, data-driven, agent-based technology with human-in-the-loop capability, designed to help assess, understand, counter, and recover from economic and social consequences of terrorism. This activity is funded by the Indiana Twenty-First Century Research and Technology Fund.

iVDGL and ATLAS. UITS involvement in the NSF-funded iVDGL and ATLAS projects is discussed in the narrative on under Actions 29 and 31. UITS leads part of the effort to develop cyberinfrastructure and aids IU physicists in their efforts involved in this cutting-edge research.

Pervasive Technology Labs. The Pervasive Technology Labs at Indiana University continued to make progress in 2004 on the Lilly Endowment-funded research agenda. Lab accomplishments for the year are detailed in separate documents. The Research and Academic Computing Division of UITS collaborates with and provides services used by the Pervasive Technology Labs.

BENEFITING THE INDIANA ECONOMY

Research activities benefit the Indiana economy directly and indirectly. Securing grant funds from federal government agencies and national funding organizations creates new, high-paying jobs in Indiana. More than 20 RAC professional staff are funded by grants to Indiana University. The public sector plays a leading role in attracting top talent to the State of Indiana. The American Electronics Association report CyberStates
An important companion to UITS research and development work is ensuring that these advances are appreciated by the international and national research communities, as well as the residents of the State of Indiana.

The major effort to disseminate the results of UITS research efforts to the international computer science community is the annual display at the world’s premier international conference related to high performance computing, sponsored by the IEEE (Institute of Electrical and Electronics Engineers) and ACM (Association for Computer Machinery). This year, IU’s display featured the inventions and accomplishments of the Pervasive Technology Labs and UITS, including new computing technology in the life sciences and IU’s participation in the TeraGrid.

IU’s development of new life science applications was featured in the November issue of Communications of the Association for Computer Machinery, guest-edited by a RAC staff member. A feature article focused on UITS leadership of an award-winning computing grid for analysis of evolutionary relationships of invertebrates (animals without backbones).

UITS public outreach efforts are described in the narrative on Actions 29 and 31. UITS has been active in informing members of the Indiana business, healthcare, and arts communities about IU research activities and their impact on the State of Indiana. The Advanced Visualization Laboratory showcased the John-e-Box (described above) at programs at the Indianapolis Museum of Art, the Indiana GIS Conference, Explore IUPUI, Making IT Happen at IUK, and GIS Day at IUB. RAC led displays at other statewide conferences and events, including meetings of the Indiana Health Industry Forum, TechPoint, and BioCrossroads.

UITS is engaged in meaningful research, supporting the research mission of Indiana University, and participating in efforts to help IU achieve President Herbert’s goal of doubling Indiana University’s external grant funding by the end of the decade. UITS is working diligently to transfer its own research developments into practical use, enhancing the high-tech economy of the State of Indiana, and ensuring that the residents of the State are informed about the valuable work their tax dollars support.
Recommenda­tion 6: University-wide prioritization, coordination, oversight and planning are required in the implementation and development of institutional information systems. In order for these systems to work together in a seamless manner and accommodate an ever-increasing number of users, UIS should implement common interfaces and a common information delivery environment that facilitate their integrated use. A new Student Information System should be a top University priority.
**ADVISORY COMMITTEES**

Advisory committees remained active during 2004. The Student Information System Steering Committee and the Human Resource Management System Steering Committee met regularly to review progress in their respective areas. The OneStart Steering Committee met twice during the Fall Semester 2004. The Fiscal & Procurement Steering Committee has been revised in order to advise during the upcoming fiscal (FIS) and procurement (TOPS) systems rewrites.

**COMPLETED INFORMATION MANAGEMENT SYSTEMS**

Since the inception of the IT Strategic Plan, the following information systems have been completed and put into production:

- Financial Information Systems (FIS), an enterprise-wide computing application designed to manage the majority of IU’s finances, comprises the central functions of transaction processing and decision support.

- The Electronic Research Administration (ERA) system provides IU researchers with an electronic system for developing and submitting research proposals.

- The OneStart Web-based application portal offers a common front door to online services at Indiana University campuses.

- Oncourse, an IU-developed online course management application, allows faculty and students to create, integrate, use, and maintain Web-based teaching and learning resources.

- IUIE, the Indiana University Information Environment, provides a Web-based, enterprise-wide reporting environment.

- A new, Web-based Purchasing/Accounts Payable system interfaces with the FIS and other applications.

- IU’s e-commerce initiative facilitates transactions for goods and services online. IU Press and the IU Bookstore are among the merchants using its B2C (Business to Consumer) project.

- The comprehensive Maintenance Management System application tracks much of the University’s maintenance functions, supporting the University’s physical plant operations.

- The Library Information System provides access to a wide array of online resources.

- The Human Resource Management System provides services for human resources information including personnel records, benefits, and payroll for all of IU’s more than 35,000 faculty, staff, student workers, and retirees. See the detailed discussion under Action 36b.

- The Student Information System (SIS) provides services for all students interested in, or applying to, any campus of Indiana University and enables IU’s 100,000 students to move easily through the admissions, enrollment, financial aid, and student financials processes — all in a Web-based environment.

**SCHOOL OF MEDICINE**

In October 2002, the IU School of Medicine appointed former UIS Director Vince Sheehan CIO and Associate Dean of Information Technologies, overseeing all aspects of the School’s IT environment. The IU School of Medicine Strategic Plan, introduced in October 2002, supports the critical missions of the School and presents a vision of making the School a leader in the management of information technology to support teaching, research, and service.

In 2003, an Information Services and Technology Management (ISTM) department was created, a Chief Technology Officer and Security Officer were appointed, and security policies to support compliance with HIPAA and other regulations were introduced.

Three new systems were rolled out in 2004: the Medical School Admissions system, the Faculty Annual Summary Report system, and the Compliance Tracking Audit system. The Service Level Agreement business continued to grow and ISTM now supports as many customers through SLAs as are supported in the Office of the Dean. Additionally, several joint clinical projects were completed with Clarian Health Partners, Wishard Health Systems, and the Roudebush Veterans Administration Hospital.
Action 36. IU should implement as soon as possible a new Student Information System in a way that integrates identified best practices in providing services to students and is adaptable to future changes.

Action 36 is subdivided in the UIS Implementation Plan as follows:

- 36a. Student Information System
- 36b. Human Resources Management System
- 36c. Library Information Systems
- 36d. Fiscal and Procurement Systems
- 36e. Departmental Information Systems

36A. STUDENT INFORMATION SYSTEMS

The new Student Information System (SIS) now enables IU’s 100,000 students to move easily through the admissions, enrollment, financial aid, and student financials processes — all in a Web-based environment. The SIS implementation has enabled IU to streamline operations and re-engineer processes to take advantage of best practices. It provides an information environment (the IU Information Environment or IUIE) for academic and administrative decision making with consistent, integrated data, along with tools for analysis, reporting, and extraction.

Admissions. The first module of the SIS, implemented in September 2000, included prospect management, recruiting, communications, and event management for prospective students. The project team configured such data structures as campuses, Schools, degrees, majors, minors, and grading schemes and also converted prospective student data from departmental shadow systems on all IU campuses into PeopleSoft. The second phase of Admissions functionality was implemented in October 2001. Core functionality for processing and evaluating applications for admission for undergraduate, international, graduate, and professional Schools is available to staff in the Undergraduate, Graduate, and International Admissions Offices. The system includes an automated process that can be used by IU staff to make admit and denial admission decisions en masse. Much more data and functionality are now available to the campus Admissions offices.

Phase II. October 2003 marked the beginning of implementing all of the remaining core functions of the SIS. In preparation for Fall 2004, this phase supported the all-important construction of the Schedule of Classes within the new system and set the stage for all future work. In this phase, a new way to launch the SIS for administrative tasks within IU’s OneStart portal was implemented for current and new administrative users in Admissions, Student Records, and other offices. New quick clicks within OneStart allow users to avoid lengthy navigation for commonly used components. A single click can give the same results as four clicks, saving administrative staff time.

Students also saw additional self-service functions in their OneStart pages as a result of the Phase II implementation, including transfer credit services and financial aid links to national and federal Web sites. Current students, as well as applicants and those admitted to IU, can see how credits from other institutions or credits from advanced placement courses will transfer to IU.

IUIE. The IU Information Environment (IUIE) is a comprehensive strategy for providing Web-based data reporting and analysis tools to facilitate access to and use of the University’s enterprise data stores. A personal reporting environment, the IUIE keeps users informed about the report objects that have been published across the University. The Student Information Environment was released in step with the SIS implementation.

Room management. The room management software package Ad Astra was placed into production during the October 2003 implementation. This software enables campuses to automate classroom assignments and match them with the schedule of classes. The package matches rooms and classes based upon locally configured rules and priorities, while it attempts to maximize facility usage.

Schedule of Classes. Also in the October 2003 implementation, SIS functionality to support the construction of the Schedule of Classes was deployed. Data from the legacy version of the Schedule of Classes were converted into the new SIS set of tables. The IUIE contains 23 new Report Objects to support reporting and data analysis of Schedule of Classes information.
Remaining Phases. In 2004, the remaining phases of the SIS implementation were put into place. Late Winter 2004 saw the implementation of the Student Registration module, paving the way for Fall 2004 Registration that took place during the Spring registration period. The major implementations in preparation for the Fall 2004 Semester proceeded in later phases through Spring, Summer, and Fall 2004.

Web Registration. The new Web environment for Fall 2004 registration commenced during the normal Spring 2004 period.

Financial Aid. Financial aid officers and their staff are able to access a tightly integrated environment containing all student modules, giving the financial aid system direct access to personal demographic data from admissions, student records, and student financials modules. Staff automatically receive annual financial aid regulation changes, significantly decreasing the effort needed to apply these yearly changes and ensure federal compliance. Business processes are consolidated into a centralized environment. Using similar tools and methods, the separate campuses can accomplish their goals in a more coordinated fashion. Students use the accept/decline functionality in the new system to manage their financial aid information in the online self service environment.

Academic Advising. The SIS enables academic advisors to identify students’ active and former majors, dual degrees, minors, and certificates and access an analysis database for strategic enrollment planning and student progress assessment. Advisors can process and track academic standing (honors, warnings, probation, dismissal, etc.) and use an online degree audit tool to assess a student’s degree progress, obtain a printed report, and perform “what if” analyses to view potential impact due to a change in a student’s school or major. They can also obtain online information regarding the articulation of transfer credit, test scores, and other academic credit to IU academic credit.

In addition, advisors can:

• Access a central store of integrated, shared, and secured institutional student academic data for all campuses
• Access institution-specific articulations of external courses to IU courses for manual or automatic processing of transfer, test, and other credit

• Support the communication of academic rules about repeated courses through a notification/warning students will receive when they attempt to enroll in a course that is not eligible for repeat credit
• Track and notify students, faculty, and staff of relevant information (e.g. signed Release of Information forms or problems that may not necessarily require withholding registration privileges)
• Track non-course events for students. These can be included in their degree audit and the unofficial transcript without setting up false course catalog courses (called milestones).

Student Records. Registrars, school recorders, and others who work with student records benefit from a modern data retrieval, decision support, and operational reporting environment that replaced cumbersome processes requiring dedicated personnel. Departmental users can retrieve data on their own using simple tools and interfaces to support both their own decision support and daily operational needs.

Student Financials (Bursar). Staff on all campuses who work with student financial accounts benefit from new functionality in fee assessment, income distribution, adjustment, calendar options, and administrative options relative to multiple sessions. They are able to assess separate rates for courses/classes and to distribute course/class income to multiple income accounts. Fee assessment and income distribution can be tied directly to a course or class (section) if so desired.

The Student Information System is integral as a tool to conducting and managing the business processes of the University. As a systems development project, it was a major undertaking for functional experts and technical staff to implement a system and services that meet user demand and provides for maximum flexibility in the future.

36B. HUMAN RESOURCES MANAGEMENT SYSTEM
Indiana University’s Human Resource Management System (HRMS) was implemented in December 2002. HRMS provides the University community with improved services for most aspects of human resource information including personnel records, benefits, and payroll for all of IU’s more than 35,000 employees, student workers, and retirees.
The system comprises the PeopleSoft Client, Electronic Documents (E-Docs), and the Information Environment (IUIE) (see Action 39). HRMS provides users with more functionality and easier access to data and information to perform their respective roles. Employee data share a common database with student data to minimize redundancies for those with dual roles, such as staff who are also students.

The HRMS continues to evolve as a means for the re-engineering of the University’s human resource functions. This success continues to be achieved through ongoing collaboration among University staff from human resources, academic affairs, and the payroll offices on IU’s campuses, and technical staff from UITS.

One example of a re-engineering success is related to the HRMS electronic documents. Currently, when personnel transactions, such as hiring employees or processing pay adjustments, are initiated by Schools or departments in the HRMS environment, they are automatically routed for approval based on predetermined routing specifications. Both “initiators” and “approvers” access these transactions through the OneStart portal. This electronic routing eliminated the use of paper forms and facilitates quicker routing and approval of all personnel transactions by sometimes as much as two weeks.

36C. LIBRARY INFORMATION SYSTEMS

The SIRSI Unicorn software, the basis of IUCAT (the Library’s Web-based, public interface) and Workflows (the client used internally by librarians and circulation desks) continues to mature with regular software upgrades and enhancements. Library patron self-service features through IUCAT now allow faculty, students, and staff to check their accounts, to renew their materials, and to place requests for delivery against items. See http://www.iucat.iu.edu/

Two systems related to IUCAT and electronic databases were under development in the past year. IU-Link, a system that uses the NISO OpenURL standard to link directly to electronic full texts of articles was implemented in production for several campuses. Federated Search functionality — the ability to place a single “broadcast search” across groups of electronic databases and consolidate the results — was researched and is currently implemented as a prototype for customization and usability testing.

The IUIE has been expanded to include new financial data for the Library Acquisitions Department and new bibliographic data. This increases its usefulness for analysis of the libraries’ collections and for fund management. The catalog database continues to grow, keeping pace with acquisitions of the IU Libraries statewide. The system is expanding to handle electronic order and payment transfers between the Libraries and vendors and to automate the loading of vendor records.

A major task in 2004 was adapting the library systems infrastructure to keep in step with the implementation of PeopleSoft. Library systems interact with the Bursar, Student Information Systems, and Human Resources; a new XML interface to the Bursar was written and major modifications were made to loaders from PeopleSoft SIS and HRMS data. Conversion of the patron table, replacing the Social Security Number with the University ID as the common identifier among systems, was completed. In development is a rewriting of the interface to TOPS (the new PDP system). Numerous changes were also made to improve accuracy of authentication and authorization against the Global Directory Service.

The Library Information Systems team collaborates with Library Information Technology and the IUB Library Web and manages several of its servers. It supports the Libraries’ current strategic goal of better integrating the library catalogs with electronic databases and full-text services.

36D. FISCAL AND PROCUREMENT SYSTEMS

FIS. IU announced its intentions to lead an initiative to create a community (open) source version of its Financial Information System (FIS). Called Kuali (http://kualiproject.org) it will be developed by five core partner institutions. To date, IU, Michigan State, and the University of Hawaii have formally joined the initiative.

E-commerce. Indiana University continued developing e-commerce solutions in 2004 that facilitate online transactions for goods and services. During the year, the infiNET Corporation’s QuikPAY student tuition payment system was implemented and deployed through the OneStart portal.

IU provides three options for conducting business-to-consumer (B2C) e-commerce on the Web. The B2C project consists of three Web-based applications that can work together, or stand alone:
• **E-Store.** E-Store is essentially a catalog and shopping cart for B2C retailing associated with the University. Merchants can download this software and use it to build their Web storefronts. Customers can view items in the store, add items to their shopping carts, and view an itemized total of their purchases, including adjustments for quantity, special discounts, and more.

• **IPAS (Internet Payment Authentication System).** IPAS is a method of securely processing credit card transactions over the Web. Through a partnership with CyberCash cash register service and the IU Treasury department, University merchants can accept payment online.

• **TransformEP.** This is a form-processing tool that enables retailers to send customer forms by e-mail, or add form data to a log file. It also interfaces with CyberCash for payment processing. Using TransformEP, merchants can track all transactions that go through their sites, and send e-mail confirmations for orders received.

**TOPS.** Development continued in 2004 on a new Web-based version of TOPS (The Online Purchasing System) that will replace the existing mainframe system. The new system will be Unix-based, and written in Java, with the data stored in Oracle. It will be accessible through OneStart and will interface with the FIS and other applications. Two modules were implemented in 2004.

**TIME.** The Time Information Management Environment (TIME) is an enterprise-wide computing application available through OneStart that tracks the hours that hourly employees work. Employees use TIME to electronically clock in and out, and supervisors use the same system to approve those hours. TIME is tightly integrated with the new HRMS system. When staff are hired via HRMS, they are immediately available to the TIME system. Plans for 2005 include enhancing TIME to accommodate bi-weekly (non-exempt) employees.

**ERA.** The Indiana University Electronic Research Administration (ERA) system is a Sponsored funding application which hosts a suite of modules to provides researchers and their administrative assistants a means to create and submit the major components of grant applications. The first module released was the Proposal Routing Form for internal routing and approvals; all investigators are encouraged to use this. The second major release was the Budget Development Module that facilitates the creation of budgets and provides agency outputs.

The module for creating a protocol for research on human subjects is under development, and slated for release in early Fall 2005. This will also provide the means for submission of study amendments, serious adverse event reports, and continuing review reports. The Human Subject Module will include many new management tools that will help streamline the administrative activities that support the operation of the IRBs.

The revised ERA Communication Web site provides a service and support Web form to help manage client services and support calls. Other features include ERA Bits and Bites and a Routing Form Basics virtual tour. Predefined reports from the ERA system will be accessible through the IUIE reporting environment, including the Pipeline Report, the Keywords report, and Approval Hierarchy report. The Keywords report allows researchers to make direct contact with each other.

In June 2004, the ERA system was made available to the University research community. Departments are encouraged to schedule demonstrations and training sessions to address application implementation and adoption issues. Requests of such assistance should be submitted to either the IUB or the IUPUI Sponsored Research Offices.

**MMS.** The Maintenance Management System (MMS) is an enterprise-wide application that tracks many of the University’s maintenance functions, including maintenance requests, current project costs, new building plans and additions, inventory, timekeeping for departmental billing, financial data for maintenance, and project management. For accounting purposes, MMS has a linked interface with the FIS, and with the FMS application Interdepartmental (ID) Billings. To more effectively manage inventory and its cost, the system also interfaces with TOPS.

**36E. DEPARTMENTAL INFORMATION SYSTEMS**

Various departmental applications were developed in 2004 and others were enhanced.

• **Bursar.** Maintenance was done on the BARRS online system that permits departments to upload their individual student charges.
- **Career Development Center.** Work was done to assist the Center at IUB with implementation of a vended career contact system known as C3M. Efforts included software and hardware consulting and a program that merges and imports student data.

- **Center on Philanthropy.** This was a joint effort, including staff at the Center, the Herron School of Art, and Digital Media Services to deploy a new, improved Web site for the Center.

- **Department of Communication and Culture.** A Web-enabled, searchable films database was developed for internal use by members of this IUB department.

- **IU Professional Staff Council.** Administrative functionality was added to the Professional Staff Council’s nominations and election system to enhance ease of use.

- **Indiana University Student Association (IUSA).** This group’s elections application was moved to a new server.

- **IU Union Board.** A Web-enabled accounting application was created to handle tracking of special event proposals, awarding of funds, and tracking costs.

- **Office of Publications.** Changes were made to the staff function report and the time summary report to allow for specifying additional selection criteria.

- **Student Activities Office.** The application CQL was implemented to track student information and student involvement in clubs and other student organizations at IUB.

**University Division.** The University Division’s Records Office Multifunction Access system ROMA was converted to be able to use data from the new Student Information System (SIS). Also, the Student Advising Records Network (StarNet), developed in 1997 for the University Division, was redeployed using updated client software, and made able to use Microsoft SQL Server for its database back end and to draw some data from the new Student Information System (SIS).

**COMMON INTERFACE & USABILITY**

*Action 37.* UITS, working with the users of IU’s administrative systems, should develop a common interface environment that will support the efficient and effective accomplishment of the day-to-day administrative tasks of the University.

*Action 44.* UITS should incorporate user-centered design techniques and Usability Lab testing into all major systems development projects.

*Action 45.* The UIS Division and the Advanced Information Technology Laboratory should continue evaluation and experimentation that will keep IU on the leading edge of new information systems technologies to be employed in the University’s business systems.

**ONESTART**

OneStart is a Web-based application portal designed to provide IU faculty, staff, and students with streamlined and integrated access to online services at Indiana University.

OneStart provides a common front door to online services at IU campuses, including checking e-mail, registering for classes, performing financial transactions, hiring faculty or staff, looking up grades, paying tuition bills, purchasing event tickets, and checking benefits information. OneStart is customizable and flexible, offering easier and more direct access to online services.

Many improvements were made to the OneStart portal in 2004. The OneStart user interface was improved to provide easier navigation and simplified default views based on user feedback and usability testing. The OneStart Workflow engine was introduced in 2003 as the mechanism for routing and approving electronic documents for the new HRMS E-Docs and ERA applications. In 2004, the new Purchasing application, EPIC, began using OneStart Workflow for the routing and approval of electronic purchasing documents. The Action List feature in OneStart provides a common inbox for all electronic-document routing through
OneStart Workflow. This will eventually provide one place for users to approve HR E-Docs, purchase requisitions, time-off requests, and the like. As more applications convert their workflow process over to using OneStart Workflow and E-Docs, standard business processes at IU will become increasingly streamlined through the use of the Action List in OneStart.

Many new services were added to OneStart in 2004 including all remaining SIS Self-Service channels as part of the completion of the new SIS system. A new Forums tool was added as well. OneStart Forums provides threaded discussions surrounding particular topics of interest, ranging from online support of a particular service to classroom discussions on a particular homework assignment. In 2004, OneStart also provided an improved and more integrated Web-based calendar that allows users to merge class schedules, personal appointments, Oncourse events, and other University events, all in one location. OneStart Calendar also provides the ability to publish group calendars for viewing and organizing events surrounding a particular group or organization.

Central Authentication Service (CAS)
Central Authentication Service (CAS) provides secure authentication to Web applications at IU as well as single sign-on. IU CAS, based on an open-source product from Yale University, now provides single sign-on for dozens of applications, including OneStart, Oncourse, SIS, HRMS, and the IU Information Environment. CAS processes an average of some two million logons each month.

Enterprise Directory Service
The Enterprise Directory Service (EDS) is an LDAP directory populated with information about University faculty, staff, students, and affiliates. OneStart and applications like it use EDS data to perform authorization and personalization based on individual attributes. Data are collected from a variety of sources, including the HRMS/SIS (PeopleSoft) system. A large proportion of this is updated in real time, allowing applications to instantly access up-to-the-minute information about people at IU.

User Experience Group (UXG)
The UXG at IUB (formerly called the Usability Lab) provides expert consulting in the areas of user-centered design, usability, accessibility, information architecture, and graphic design. The UXG concluded another successful year in 2004. More than 20 projects internal to IU were completed, including several repeat projects such as OneStart, Travel, KB, ERA, and Purchasing. The UXG also engaged external clients, among them Hiron and Company in Bloomington and the Clarian Group in Indianapolis. UXG applies a user-centered approach to systems design, development and evaluation using a variety of methods to help increase the efficiency, effectiveness, satisfaction, and ease of learning for users of a particular system. User feedback is incorporated into all phases of development including requirements analysis, conceptual design, development, and testing.

The primary research focus in 2004 continued to be the OneStart portal. The UXG conducted a survey on the types of services faculty, staff, and students would like to see in OneStart. UXG has also begun providing standard user interface components for use across University Information Systems applications to provide a common look and feel across the multitude of services available in OneStart. The UXG also began meeting with key constituent groups on each IU campus to begin to define the default content in OneStart for each campus and each role group – faculty, staff, and students. Given the ambitious goals for the portal and the complexities involved in bringing many disparate information systems into one environment, the UXG will continue to play a role in design decisions regarding OneStart.

The UXG continues to play a role in the development of the open source collaboration projects Sakai and Kuali whose design requires a consistent, usable, and user-centered approach. The opening of the ICTC building at IUPUI makes another usability lab available for use that will help expand the availability and convenience of UXG consulting in user-centered design, usability, information architecture, and graphic design.
38A. THIN CLIENT

The goal of the thin client environment is to migrate all systems to a browser-based application environment. The early phase of this project used the Citrix Metaframe product to enable a thin client delivery of traditional client/server applications. In this environment, software is loaded onto servers rather than onto several PCs. This environment allows for greater manageability and a more efficient delivery of support. This environment still enables users of the FIS and MMS to access their systems over the Internet. Onbase, Room Scheduling, and other smaller applications also use this environment.

The OneStart Portal and OneStart Workflow (formerly called EDEN Workflow) provide a foundation for true thin client computing at IU. The Java Enterprise computing environment (J2EE) is supported for the delivery of the foundation services and applications including OneStart, Electronic Research Administration (ERA), Purchasing on the Web, E-Docs for HRMS, and the Central Authentication Service (CAS). Using combinations of technologies allows a seamless access to systems even when the underlying technologies are significantly different.

38B. ENTERPRISE UNIX ENVIRONMENT

UIS continues to maintain and improve the computing environment that supports the University’s enterprise wide information systems. The focus for this initiative is to provide an advanced, robust, and cost-effective computing environment that leverages consolidation and centralization of services. In 2004, several steps were taken to improve these goals by greater investment in virtual machine technology that allows for greater use of common resources while still providing the flexibility the application areas need.

The main focus for all of UIS was the implementation of the PeopleSoft-based Student Information System (SIS). Several changes were made to the EUE to refine processing for the student “self-service” environment that supports registration, degree audit, grade distribution, and other student functionality. These changes included adding application and Web servers and fine tuning the environment for self-service usage. The first Fall semester using PeopleSoft passed without significant capacity or technical issues.

UIS also upgraded the server for the Library database replacing a four-year-old environment. A large IBM server was installed that takes advantage of the new Power 5 chip architecture that allows extended functionality for supporting Logical Partitions (IBM’s term for virtual machines). This will be used for OneStart, Central Authentication System, Enterprise Help Desk, and for the implementation of Oncourse CL, the new collaborative learning environment powered by Sakai. A new environment to support the growing Java Enterprise Servers (J2EE) was implemented based on Linux, running in a virtual machine configuration using the VMWare software product. This provides high-end virtual machine capability on commodity hardware. The Library, OneStart, CAS, Timekeeping, Oncourse CL, and others now run in this new environment. A new high-end fiber channel switch was added to the Storage Area Network environment to provide the robustness and performance needed for data volumes that now approach 20TB.

Although the strategic environment is based on Unix and Linux, a large Windows server complex is supported for niche applications. A new Citrix farm, replacing five-year-old servers and environments for the SafeWord Card, Room Scheduling, and e-commerce, was implemented in 2004. The Oncourse Classic environment was upgraded to ensure best possible support for the course management system as faculty switch to the new CL implementation.

38C. STRATEGIC DATABASE MANAGEMENT

Oracle is the primary database management technology supporting data storage and delivery for IU’s enterprise
information systems. UIS supports nearly 100 separate Oracle databases, or “instances.” All the systems run the 9.i release level. The Oracle Enterprise Software License Agreement signed in 1998 was upgraded in 2004 to include the Data Partition Option that has quickly become Oracle’s foundation for large database support. The large PeopleSoft databases, the growing FIS, DSS, and Library systems, all benefit from this option. This also allows the continued use and expansion of Oracle as a database server in large-scale research computing projects and in other areas of the institution.

The most significant new use of Oracle for 2004 was in support of Oncourse CL, the new collaborative learning environment powered by Sakai. The first release of Oncourse CL was placed in production in September 2004. In 2005, Oncourse CL will see extensive updates and full-scale use at IU. Significant growth in the use of Oracle in 2004 also came in the SIS, HRMS, and the Decision Support Environment.

The list of applications using Oracle now includes:

- HRMS (Human Resource Management System and Payroll) - PeopleSoft
- SIS (Student Information System) - PeopleSoft
- Visa Management System (part of SIS functionality)
- Room Management (part of SIS functionality)
- J2EE (Java development environment)
- FIS (Financial Information System)
- ERA (Electronic Research Administration)
- MMS (Maintenance Management System)
- Timekeeping
- OneStart
- SIRSI Library Automation System
- TOPS Web Purchasing System
- The University Register
- Decision Support Environment
- IUIE (IU Information Environment)
- Onbase (document imaging)
- Modem statistics
- Oncourse CL
- Enterprise Help Desk

THE IU INFORMATION ENVIRONMENT (IUIE)

**Action 39.** **UITS should develop a consolidated information delivery environment, leveraging technologies already in use and expanding on those with newer tools. And UITS should complete implementation of an enterprise-wide data warehouse environment, currently in progress, to support university data access and information about this data. The participation of information users and all units affected is essential.**

Decision Support Services (DSS) designs, develops, and supports a consolidated environment for storage and facilitated retrieval of institutional data. Users and information systems developers work with DSS in the development and maintenance of two main service tools: the Data Warehouse and the IU Information Environment (the IUIE).

The Data Warehouse contains intelligent data collections modeled to support the operational reporting needs of its users. It offers a central location where those who develop or maintain institutional data systems can make their data available to staff and faculty for their reporting needs.

A major accomplishment in 2004 was the implementation of the SIS Information Environment in step with the SIS PeopleSoft implementation. Other noteworthy projects for 2004 were the implementation of Student Census and the redesign of the HR Paycheck data structure. Both projects employed dimensional modeling, the standard in the data warehousing industry, which is new territory at IU.
The IU Information Environment (IUIE) is a comprehensive strategy for providing Web-based data reporting tools to facilitate access to and use of the University’s enterprise data stores. A personal reporting environment, the IUIE keeps users informed about the report objects that have been published across the University.

IUIE was enhanced in 2004 with the addition of such features as the ability to create e-mail distribution lists based on user entered criteria, distribution of generic as well as personalized e-mail notifications, and enhancements to the Data Manager functionality.

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**YEAR 2000**

**Action 41:** The UIS Division must continue the Year 2000 readiness initiative. This work must be completed according to a demanding timeline or the business systems of the University will fail.

No new problems related to Year 2000 emerged in 2004. All systems continue to function correctly.

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**COMMITTEE ON INSTITUTIONAL DATA**

**Action 40:** OVPIT should reconvene the Committee on Institutional Data and conduct regular meetings with the goal of defining data administration and access policies for institutional data.

The recent implementation of PeopleSoft HRMS and the new SIS capabilities provide a rich information environment via the IUIE that is much improved over previous services.

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**DISASTER RECOVERY**

**Action 42:** UITS should complete a disaster recovery plan with increasing levels of recovery based on systems priorities.

In 2004, planning progressed to the information gathering stage for Phase II of comprehensive disaster recovery planning. Phase II is defined as completing a comprehensive recovery program that includes recovery of the IUB and IUPUI data centers.

Two critical tasks were completed to reach this level. All UITS directors submitted reports about the survivability of all their services if the host data center were lost. This helped service managers analyze risks inherent in their current implementations, and will allow recovery planners to begin populating a database of such information that will be used for planning and during any recovery of services. UITS directors also conducted a collective ranking of UITS all services. This list will be used to ensure top priority services get appropriate attention in planning and recovery. These activities will help determine where gaps exist in recoverability of critical services, and the estimated cost of filling those gaps.

Cabinet and floor space has been allocated in the data center in the new ICTC building at IUPUI so that service owners at IUB may begin placing their redundant or backup services geographically distant from the main installations.

In 2005 remaining gaps in recoverability of critical services will be identified, and funds will be allocated to ensure that such services are made fully redundant, or that they are recoverable within a time relative to their importance to University missions.
VII. TELECOMMUNICATIONS: APPLICATIONS, INFRASTRUCTURE, CONVERGENCE

**Recommendation 7:** The University should accelerate planning for a converged telecommunications infrastructure. The University and campuses must ensure that there is appropriate funding for telecommunications services and infrastructure in the base. Specific attention must be given to improving the state of the inter-campus networks, planning for and deployment of adequate commodity Internet connectivity, a University-wide base level of campus telecommunications connectivity, advanced networking infrastructure and applications, wireless networks and support for multimedia and streaming media.
Action 46. UITS should accelerate planning for a converged telecommunications infrastructure that aims to maximize the benefits to IU of this emerging technology direction. It should be accompanied by an aggressive program of testing and trialing of new “converged” technologies.

While VoIP (Voice over IP) is currently judged not mature and cost-effective enough for broad implementation, progress is encouraging and IU continues its involvement in investigations involving other higher education institutions. A UITS staff member continues to participate in the Internet2 VoIP Working Group, which initiated projects in interconnecting voice systems at participating national and international sites, using a H.323 gatekeeper located at IUPUI. Furthermore, UITS has taken steps to make the IU gatekeeper SIP.EDU compliant. Both a SIP (Session Initiation Protocol) gateway and a proxy server have been installed and initial tests have been positive. However, this project is still in the early stages of development.

Currently, UITS participates in the EDUCAUSE Net.edu Integrated Communications Strategies steering committee, which explores a full spectrum of telecommunication issues, particularly mobility.

In November 2003, IU hosted a two-day VoIP workshop preceding the Internet2 member meeting. The workshop was attended by more than 70 people, including international participants. Another workshop took place in May 2004. Also in 2003, UITS partnered with Interactive Intelligence, Inc., to develop Unified Messaging and Call Center systems for deployment at IU. UITS continues to beta-test the company’s software and provides guidance in feature development.

During Fall 2004, UITS rolled out a limited pilot project among UITS staff, to further test Unified Messaging. The trial currently has about 130 participants. Another 50 will be added in early 2005. This trial will conclude during the first quarter of 2005. Based on initial results, Unified Messaging could be rolled out across the campuses in 2005.

Action 47. The University as a whole and the campuses individually should establish base funding for the lifecycle replacement and ongoing development of telecommunications services and infrastructure.

IU’s two largest campuses, IUB and IUPUI, have established lifecycle funding for the telecommunications infrastructure, which covers the wire and cable plants and voice, video, and data switching and routing equipment. The smaller campuses have made major progress in implementing a similar program.

Action 48. A five-year plan for the University’s intercampus networks and commodity Internet connectivity should be immediately developed, funded and implemented.

Action 49. A uniform base level of telecommunications connectivity and standards should be defined, communicated, and where necessary, implemented for all campuses.

As a key infrastructure component in IU’s IT environment, the telecommunications standards that were reviewed and implemented across the institution in 2000 ensure interoperability and high-quality network services.
I-Light continues to provide vast benefits to the University over previous connectivity, both for intra-campus connectivity and connectivity to the commodity Internet. I-Light's capacity, which is in addition to existing Internet2 connectivity, is allocated between the campus housing at IUB, the IUB campus, and the IUPUI campus and its connections to the six regional campuses.

In 2004, UITS continued its successful partnership with Residence Halls Association in helping to determine proper policy and practice for the residential commodity Internet connection. Filters of certain types of data traffic have been successful in managing the bandwidth in campus housing.

In 2004, a new core network merged the IUB and IUPUI campus networks into one homogeneous network to provide consistent network services and increased reliability between the two core campuses. The new network is highly resilient and provides fast fail-over between primary and backup components. The new architecture allows cutting-edge services to be deployed without compromising the stability of existing production services. Bandwidth has been increased more than ten fold through extensive use of 10 Gigabit Ethernet technology. A resilient Dense Wave Division Multiplexing (DWDM) ring capable of 320Gbps has also been installed between IUB and IUPUI to further enhance the reliability and capabilities of the I-Light infrastructure.

IU has maintained its position as a leader in advanced networking through a variety of endeavors. These advanced networks effectively separate advanced research activities from those of the commodity production Internet, providing IU researchers with separate high-speed links to other researchers across the nation and around the world. Several separate endeavors are underway; progress is described below.

**I-LIGHT**

I-Light, a fiber-optic network connecting IUB, IUPUI, and Purdue’s West Lafayette campus to each other and to the national Internet2 infrastructure, launched in December 2001, made Indiana the first state in the nation to have a fully operational network of this kind.

I-Light enabled greater independence in telecommunications through decreased dependence on telecommunication providers. With multiple strands of optical fiber, I-Light increased networking capacity by many orders of magnitude, providing more than enough capacity to meet demand over the next 10 to 20 years. In August 2002, IU achieved a near four-fold increase in capacity for normal Internet traffic — at no increase in cost — by leveraging I-Light and its connectivity and co-location with the national Internet infrastructure in Indianapolis. This increased capacity is in addition to existing Internet2 connectivity. Purdue and the State of Indiana, via the Indiana Higher Education Telecommunication System, also obtained similar capacity improvements at no additional cost using I-Light.

Along with supporting research applications, I-Light supports voice communications, e-mail, and videoconferencing between the campuses and is the primary artery for communications between IUB, IUPUI, and Purdue University West Lafayette. I-Light presents countless possibilities for collaborative research and is an unparalleled platform for distance education. I-Light has allowed its partner universities to pool their high-end computational resources in such new research initiatives as the creation of a distributed supercomputing grid with an aggregate theoretical peak capacity of 1.5 TFLOPS (trillions of mathematical operations per second).

In Fall 2002, IU achieved redundancy for I-Light by striking an agreement with Smithville Telephone to share fiber-optic connections, should either system ever suffer cuts in fiber. A second phase of expansion, called I-Light2, was approved by the Indiana Legislature in May 2003.
At its annual conference in November 2003, EDUCAUSE chose Indiana University and Purdue University to receive its 2003 Award for Excellence in Networking for I-Light. This prestigious award recognizes strategic, innovative networking programs or practices that improve the quality of campus network services through new or enhanced network architectures, infrastructure, integration, management and/or operational practices. The EDUCAUSE Network Award committee commended the collaboration between University, city, and State entities to create I-Light.

**NATIONAL LAMBDARAIL**

In 2003, Indiana University, as a member of the Committee on Institutional Cooperation (CIC), became a founding member in the National LambdaRail (NLR) initiative. NLR is a consortium of US research universities and private-sector technology companies dedicated to building a national-scale infrastructure for research and experimentation in networking technologies and applications. NLR is the largest higher-education-owned and -managed optical networking and research facility in the world, with approximately 10,000 route-miles of dark fiber, with an initial four 10-gigabit light waves (or lambdas) provisioned for research. NLR is the first national infrastructure that will allow researchers to dedicate lambda wavelengths to a set of different problems, giving the community the freedom and flexibility to stress the network in order to identify ground-breaking solutions and applications. Representatives of OVPIT and UITS played the key role in bringing the CIC into the NLR, and have been closely involved in all facets of the consortium’s formation and initial implementation. In 2004, Indiana University’s Global NOC was chosen to provide networks operations services for the NLR.

**IP-GRID**

The IP-grid, an NSF-funded collaboration of IU and Purdue universities, connects university resources to the TeraGrid connection point in Chicago. TeraGrid is an ambitious national project undertaken by the US to build the world's largest, most comprehensive grid computing cyberinfrastructure for open scientific research. IU is one of nine TeraGrid partner sites. Through IP-grid, IU has integrated its world-class computational, data storage, networking, visualization, instrumentation, and data collections resources to the TeraGrid. The IP-grid network consists of two 10-gigabit-per-second links from Indianapolis to Chicago, over Level(3) fiber and Cisco optical equipment.

**ABILENE**

The Abilene Network, with its Network Operations Center at IUPUI, achieved nationwide connectivity in February 1999. Abilene is a packet-over-SONET (POS) network, providing coast-to-coast IP transit (10,000 miles of fiber) for Internet2, with connectors attaching to one of 28 regional network aggregation points, called Internet2 GigaPoPs, with either POS or IP-over-ATM access circuits.

Abilene continues to provide high performance network services to enable advanced applications such as high-definition television, tele-medicine, and remote access to scientific instruments. It also serves as a testbed for advanced network capabilities, such as Quality of Service standards, multicasting, and more.

In 2002, Abilene began providing native next-generation Internet Protocol (IPv6) service. IPv6 offers several improvements over IPv4, among them 128-bit-long Internet addresses. This vastly increases the number of available addresses, and along with other improvements, paves the way for a range of new applications. This deployment makes high performance IPv6 service available to more than 200 Internet2 member institutions and thousands of other research and education institutions across the United States that have access to Abilene.

In September 2002 Abilene established a 10-gigabit-per-second (Gbps) optical connection to StarLight, a Chicago-based advanced optical infrastructure and proving ground for international network services. This link will enable institutions participating in Abilene to leverage high performance research and education networks around the world that also connect to StarLight. Abilene’s native IPv6 service complements existing IPv6 deployment in other research and education networks around the world, such as ESnet in the United States, Renater in France, and SURFnet in the Netherlands. Deploying native IPv6 continues Abilene’s evolution as a leading-edge network environment that supports the development of new applications. IPv6 is the next version of the Internet protocol, updating the data packaging and routing standard. The current version is IPv4; IPv5 was experimental and was never widely deployed.

In December 2001, Qwest Communications International Inc., and Internet2 reached a new five-year agreement to quadruple the capacity of the Abilene Internet2 network. Qwest’s investment in the initiative is valued at $300M.
IU network engineering staff provided leadership for a major upgrade to the Internet2 Abilene network, upgrading Abilene coast-to-coast backbone connectivity to OC-192, or a speed of 10M bits per second, a four-fold increase in the previous capacity. IU’s engineers were solely responsible for the April 2003 logistical and technical implementation of this major enhancement, and delivered it on schedule and on budget. The remainder of the backbone — the southern route — was completed by July 2003.

**TRANSPAC**

TransPAC was the high performance network connecting scientists in the United States with their counterparts in the Asia-Pacific region. TransPAC provided fundamental network infrastructure to support e-science collaborations between these researchers in a broad range of scientific disciplines including astronomy, molecular biology, high-energy physics, medicine, meteorology, visualization, and computational science.

As a vehicle for encouraging collaborations between groups in the US and the Asia-Pacific, TransPAC had notable success. By participating in and supporting the growth of new research communities such as Pacific Rim Applications and Grid Middleware Assembly (PRAGMA), Global Grid Forum, and Asia-Pacific Grid (ApGrid), TransPAC leveraged the infrastructure investments made in the network. The idea that science depends on global collaborations and that these collaborations depend on international, reliable, high-speed networking and advanced networking services is borne out in the formation of such communities as PRAGMA and ApGrid.

The US National Science Foundation and the National Institute of Information and Communications Technology in Japan agreed to fund the TransPAC project for an additional year. The project concluded at the end of 2004. During the extension year, TransPAC increased both production and experimental bandwidth from Asia to the US. Closer relationships were developed with international network research efforts such as PlanetLab.

**TRANSPAC2**

TransPAC2 is the five-year continuation of the highly successful TransPAC project. The National Science Foundation (NSF) and the National Institute of Information and Communications Technology in Japan will continue funding TransPAC2. TransPAC2 is part of the NSF’s International Research Network Connections (IRNC) program and will continue the NSF efforts to provide fundamental network infrastructure to support e-science collaborations between these researchers.

Architecturally, TransPAC2 will connect US national and international networks with the Asia-Pacific Advanced Network (APAN) in Tokyo, Japan. Indiana University will provide technical and administrative support for TransPAC2 in the US. KDDI Corporation will provide similar support for TransPAC2 in Japan. The TransPAC2 Project will continue to provide high performance connectivity between the US and Japan. In addition, TransPAC2 will work with its partners in Asia to establish an inter-Asia backbone connecting Tokyo to Hong Kong to Singapore.

TransPAC2 will provide scientists worldwide with high performance access to data and computing resources located throughout Asia. In addition, TransPAC2 will provide scientists with remote access to exceptional, world-class instruments such as electron microscopes, telescope arrays, and satellite-based imaging devices.

The US National Science Foundation grant will fund the TransPAC2 Project for five years, concluding in January 2010. Research goals for TransPAC2 will center on increasing production and experimental bandwidth from Asia to the US and within Asia. Two specific research projects involve measurement—both capacity and the very important end-to-end measurements. Also, a goal for TransPAC2 is to act as a vehicle for increasing security cooperation between the US and Asia and globally. Closer relationships will also be developed with other NSF-funded International Research Network Connections (IRNC) efforts such as GLORIAD, the Global Ring Network for Advanced Application Development.

**GLOBAL RESEARCH NETWORK OPERATIONS CENTER**

The Global Research Network Operations Center (Global NOC) at Indiana University provides engineering and operations services for leading high performance research and education (R&E) networks and for international connections to US and global R&E networks, and is undertaking research and development for support of Grid operations. The mission of the Global NOC is to create and maintain the world’s most advanced network engineering and operations service organization for global high performance R&E.
networking, thereby enabling the advancement of global R&E networks and the applications that utilize those networks.

Through the interconnection of national and international advanced R&E networks in a global framework, researchers and educators in all endeavors are provided access to such resources as large-scale datasets, grid computing, scientific instruments, tools, colleagues, and collaborative spaces, that would otherwise not be possible. The Global NOC plays a key role in establishing and maintaining the persistent advanced networking infrastructure that makes possible access to these global resources and collaborations.

Some of these global collaborative activities include:

• **International Virtual Data Grid Laboratory.** The iVDGL global data grid serves forefront experiments in physics and astronomy. Its computing, storage, and networking resources in the US, Europe, Asia, and South America provide a unique laboratory that will test and validate grid technologies on international and global scales.

• **Advanced Networking for Telemicroscopy.** Scientists at Osaka University and the University of California, San Diego, utilize international research networks to couple the world’s largest and most powerful transmission electron microscope at the Research Center for Ultra High Voltage Electron Microscopy, Osaka University, to a remote-use computer pavilion set up at UCSD.

• **Grid Datafarm.** The Grid Datafarm is a data-intensive computing project initiated in Japan to develop a peta- to exascale parallel file system exploiting local storages of PCs spread over the worldwide Grid.

• **Data and Information Access Link.** DIAL is a Web-based distributed system to search, access, and visualize satellite remote sensing data for global change research. 3D data are transferred from NASA to NASDA using TransPAC/APAN, then processed and visualized for the Web.

The networks, international connections, and services managed by the Global NOC are listed below.

• **Internet2 Abilene** is a 10-Gigabit-per-second national backbone supporting high performance connectivity and Internet innovation within the US research university community.

• **National LambdaRail (NLR)** is a major initiative of US research universities and private sector technology companies to provide national scale optical networking infrastructure for research and experimentation in networking technologies and applications. Phase One of the NLR network, a fiber path taking a northern route from Jacksonville, FL to San Diego, CA was completed on August 25, 2004. In conjunction with efforts by fiber provider Level(3) and Cisco Systems, the NLR NOC helped deliver, install, test and turn-up the Cisco 15808 optical systems in more than 100 locations.

• **TransPAC/TransPAC2** provides high performance international Internet service connections from the Asia Pacific Advanced Network to US and global advanced networks for the purpose of international collaborations in research and education.

• **The Science, Technology, And Research Transit Access Point (STAR TAP)** is a persistent infrastructure to facilitate the long-term interconnection and interoperability of advanced international networking.

• **The Manhattan Landing (MAN LAN)** is a high performance exchange point in New York to facilitate peering among US and international research and education networks.

• **AmericasPATH (AMPATH)** provides interconnection of the research and education networks in South and Central America, the Caribbean, and Mexico to US and non-US international research and education networks.

• **The Indiana GigaPoP** provides a Midwest regional aggregation point for connections from research and educational institutions to national R&E networks and the commercial Internet.

• **The IP-grid** connects computing and visualization resources at IU and Purdue to the TeraGrid national backbone. TeraGrid is a multi-year effort to build and deploy the world’s largest, most comprehensive, distributed infrastructure for open scientific research. IU and Purdue are connected to the 40-gigabit-per-second (Gbps) TeraGrid network via two 10 Gbps connections from Indianapolis to Chicago.

• **The International Virtual Data Grid Laboratory’s (iVDGL) Grid Operation Center (iGOC)** provides a repository for information regarding network, storage, and computing resources of the iVDGL, and serves as
a central monitoring point for operational activity at each site and among the sites (the iVDGL in total).

- The Global NOC serves as the watch desk for the REN-ISAC (Research and Education Networking, Information Sharing, and Analysis Center). The REN-ISAC has responsibility for receiving and analyzing network security threat, warning, and attack information within the R&E networking infrastructure.

- The Global NOC was selected to serve as the Services Desk for the new National LambdaRail (NLR) network, and IU engineers were selected to head a task force that will define detailed network services that IU will provide to NLR in the coming years. These roles will grow incrementally as the NLR network grows to completion in 2005. IU’s selection further solidifies its leadership role in providing network operation and engineering services to advanced research network initiatives nationally and internationally.

The Global NOC is the initial point of contact for all operational matters concerning these connections. Operating 24/7/365, the Global NOC provides problem, change, security, and performance management; resource allocation, monitoring, communications and coordination; and reporting. The Global NOC is located at Indiana University’s Indianapolis campus and is co-located and operated with the NOC for Indiana University campus and State networks. The Global NOC is funded in part by international connections grants from the National Science Foundation High Performance International Internet Services (HPIIS) program, and the State of Indiana.

In 2002, IU made major strides toward a goal of complete wireless access in a VPN-secured environment. In June the Vice President for Information Technology directed UITS to provide the University’s campuses with comprehensive wireless access within the next 15 months. As a first step, a fulltime Project Analyst was hired in July 2002 to oversee the wireless initiatives for IU, beginning with assessing the needs at IUB and IUPUI and further providing stable, robust, and secure wireless access to students, faculty, and staff.

The VPN-secured wireless network has been in production since July 2001. This provides solid encryption for the wireless link and requires authentication with an IU Network ID before use of the network is allowed. This infrastructure also secures remote access to IU network resources for users who are increasingly accessing these resources through high-speed vendor networks utilizing DSL and cable modem technology.

The wireless initiative for IUB and IUPUI is divided into three phases: Phase A, which constitutes an immediate-impact effort targeted at student access, and Phases B and C, which cover the longer term.

Phase A, geared toward the student population, called for providing wireless connectivity in indoor and outdoor communal areas, auditoriums, large classrooms, and conference rooms. This was completed in June 2003.

Phase B calls for extending wireless service more widely into faculty and staff locations, including offices, lounges, conference rooms, and most building locations where coverage might be needed, not including such areas as equipment rooms, janitorial closets, and the like. This phase was more complicated than the former, because of the potential for signal interference created by building infrastructure and by the fact that some areas are considered private spaces. UITS worked closely with LSPs, building facilities managers, and staff to coordinate the wireless installations in these private spaces. This phase was completed in Fall 2003. Efforts are now underway to create a completely wireless environment for the School of Medicine facilities including the Cancer Research Institute, Krannert Institute of Cardiology, Medical Research Facility, and Research Institute.

Phase C will provide coverage to any areas not covered by the first two phases. This phase will extend wireless
Action 52. The networking demands due to the increasing use of multimedia applications should be addressed as the University network continues to develop.

Action 53. The University should begin the production deployment of streaming media services such as videoconferencing and video and audio stores. It should ensure that support is provided for quality of service on the University networks to ensure that emerging instructional and research applications relying on interactive or streaming media (including digital libraries and distributed education) can have consistent and acceptable performance.

MULTIMEDIA & STREAMING MEDIA

VIDEOCONFERENCING SERVICES

Videoconferencing systems can be categorized into two models: group systems, comprising classroom and conference room systems; and desktop systems. The models have certain similarities, but have differing features of scale, complexity, capabilities, and support. Common to all is the H.323 videoconferencing standard. H.323 is a collection of complex protocols, with the important specification that H.323 systems utilize standard Internet data networking for communications.

During 2004 steady growth continued in the deployment and use of videoconferencing. At the end of December 2002, 163 group systems had been deployed. By November 2003, that number was 187. Growth continued at a steady pace such that by November 2004, the number of group systems had risen to 209, involving approximately 225 desktops.

In 2003, IU’s core videoconferencing servers (MCU, Gatekeeper, Global Addressbook) were made fully redundant by installing failover hardware that activates in the event of a system failure, to ensure continued service.

In 2004, Digital Media Network Services (DMNS) completed its initiative to make all Indiana University endpoints compatible with the ViDeNet Global Dialing Scheme hierarchy, which allows for direct inward and outward dialing to H.323-compliant systems at college campuses worldwide by a numerical “telephone” alias called E.164, eliminating the reliance on IP addresses. IU is working toward meshing with H.323 global directory services based on LDAP, and is seeking partnerships with industry professionals to investigate how Session Initiation Protocol (SIP) can advance integrated directory services at IU and multimedia communication among SIP and legacy H.323 devices.

As IU’s Web collaboration service goes into production, IU will ensure that publicly available videoconference rooms at all IU campuses have the hardware

services into typically non-academic areas, which are generally more difficult to cover because of distance and limitations of current technology. Technology continues to evolve, including phased-array antennas that cover much larger area at longer distances. For these areas, UITS is installing Vivato phased-array antennas that use 13 highly focused antennas that enable such connectivity as connecting to the IU Network via the Virtual Private Network from more than one mile away. One Vivato antenna is installed at the IUB Memorial Stadium. At IUPUI antennas will be installed at University College, covering the courtyard area to the north and the University Place Conference Center and Hotel food court; and Inlow Hall, pointing west to cover the outdoor areas near University Library as well as minimally covered locations in Engineering/Science and Technology Building (SL), Science Building (LD), and the Library. These devices are expected to be much more cost-effective than individual access points at covering such open areas as dormitories, athletic arenas, and other outdoor areas.

As a result of these efforts, IUB was recognized by Intel Corp and ranked first in its 2004 Most Unwired College Campuses survey. The survey was based on the number of wireless hot spots — areas where Wi-Fi users congregate. It also took into account the computer-to-student ratio and the percentage of campus covered by Wi-Fi technology. A list of secure wireless sites at IUB and IUPUI is available at http://www.indiana.edu/~uits/telecom/data/waps.html
(networked PCs and data projectors) necessary to conduct a tandem H.323 videoconference and Web collaboration session.

In 2003-2004, Polycom introduced new endpoint products with distinct feature advantages over its legacy videoconferencing hardware line. IU will encourage owners of legacy hardware to upgrade their systems by January 2006 to take fullest advantage of the improved video and audio quality inherent in the new lineup.

Testing of H.323 compatibility with the proposed IU border firewall continues, as well as providing AES encryption for users who require secure H.323 conferences.

**STREAMING MEDIA**

Digital Media Network Services launched IStream in Fall 2002 to allow for the automatic streaming and archiving of classes, meetings, and special events. In 2003, the service grew to support nearly 40 semester-long class sections in addition to numerous meetings and other events. In Fall 2004, DMNS began development of the next major version of IStream that will add increased management capabilities, improved user interfaces, and improved audio and video quality.

In Summer 2003, the implementation and migration began to a new, large storage system. This multi-terabyte system from EMC allows for replication of streaming data between IUB and IUPUI, ensuring the service is available and that recovery from a catastrophic failure would be relatively quick. Additional storage and improved replication software was purchased in Summer 2004 to increase capacity and reduce risk of data loss and downtime.

DMNS is involved in the EVIA-DA project, funded by the Mellon Foundation in collaboration with the University of Michigan, that is working to preserve and share ethnomusicalogical videos for future study. More than 3TB of video have been created since Spring 2004 and are being stored and streamed at IU. DMNS is developing a network transcoding server to automatically transcode (convert one digital format to another) content for the EVIA project, Digital Media Services, and a speech archiving pilot project, with production service expected to launch in early 2005. The Speech Archiving Pilot Project uses in-house-developed hardware and software that enables a professor to take a notebook computer and DV camera to the classroom and capture a student’s speech in high-quality digital video. With a single mouse click, the speech files can be transferred from the notebook to a transcoding server where they are converted to streaming media files. These files are then automatically delivered to the IStream system, from which they can be viewed or downloaded for editing.

DMNS has implemented the means to restrict access to licensed streaming media in a way that satisfies the copyright owners, and also allows access from all Regional Centers for Medical Education. DMNS has also developed ways to stress test IU’s streaming media infrastructure, utilizing clusters of computers within Student Technology Centers. This method simulates the load exerted by hundreds of simultaneous users and enables detection and correction of performance problems before they impact the end-user experience.

**WEB COLLABORATION**

DMNS continues to work toward selecting an institutional Web conferencing and collaboration tool. An RFP was distributed for a combined phone bridge and Web collaboration solution in late 2003 and in Summer 2004 DMNS selected Macromedia’s Web collaboration solution, Breeze. A UITS support team will guide the rollout of Breeze to the University community in Fall 2005, following a Spring pilot. In the interim, academic and administrative collaboration needs continue to be met using NetMeeting and locally developed chat tools.

As videoconferencing, streaming, and Web collaboration services merge into a unified environment, the ability to reserve, control, and monitor the network elements behind these services has not kept pace. In 2004, DMNS began an initiative to use Microsoft Outlook resource calendars to simplify videoconference room scheduling across all campuses. At the same time, DMNS began a migration toward allocating MCU capacity to certified groups to allow “always-on” ad hoc multipoint conferences. The unit will attempt to extend this idea in 2005 by using Outlook to streamline requests for other DMNS advanced services (multipoint videoconferencing, streaming, and Web collaboration sessions).

Among its peer institutions of higher education, Indiana is recognized as one of the leaders in the deployment, support, and operation of videoconferencing networks.
Recommendation 8: IU must provide the information technology tools, infrastructure and support services so that students effectively engage in learning and research, appropriate to their various academic disciplines and areas of study. IT support for students should include technology support centers and a computing environment that is seamless across boundaries of campus, home, residence hall, and community.

The Actions associated with this Recommendation address IT support services for students, including Student Technology Center and Support Center services (Action 54), access in student residence halls (Actions 55, 56, 57), and student ownership of computers (Action 58).
**STUDENT TECHNOLOGY SUPPORT**

*Action 54.* UITS, with the departments, schools and campuses, should develop a model for student technology support that provides:

- A basic level of support and technology infrastructure to all students;
- Advanced support, typically for advanced degree students in graduate and professional programs, that is discipline-specific and may be integrated with the teaching or research activities of a school or department; and
- Advanced support to undergraduate students, as needed, especially for students in disciplines that do not provide such specialized support.

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**INFORMATION COMMONS**

The renovation of the first floor of the West Tower of the Indiana University Main Library began on January 6, 2003. The project transformed the 27,000-square-foot space into the Information Commons (IC), a state-of-the-art, highly integrated technology and information center that fosters student learning and enhances faculty research and teaching opportunities.

A joint effort between the Indiana University Libraries and University Information Technology Services, the Information Commons, opened in August 2003, provides valuable space for collaborative learning. In addition to housing print collections, the Commons is a centrally located place for students and faculty to interact, attend technology training classes, consult with reference librarians, and find full-service access to technology and technologists.

The technology- and information-rich environment in the Commons today includes individual seating and comfortable study areas along with workspace for groups, equipped with more than 250 individual- and group-configured computer workstations and wireless networking. On hand to assist students are IT support resources and consulting, including the UITS Support Center.

The Information Commons brings together several campus units in one place. The University’s Writing Tutorial Center offers on-site help for students writing research papers. IU’s Adaptive Technology Center occupies a prominent location at the entrance of the IC and provides technology-based solutions for students with disabilities, offering, for example, Braille printing and voice-recognition software. Housed within the Commons is a multimedia production lab and IT Training & Education classroom and instruction areas.

On hand are library reference services, providing links to other library research and instruction services, campus resources, and connections beyond Indiana; a library circulation area for materials, laptops, video equipment, and the like; and a career reference center. The Commons benefits IU students by offering seamless access to a broad and integrated suite of information and resources, accessible 24 hours a day. See [http://ic.indiana.edu/](http://ic.indiana.edu/)

In response to the overwhelming popularity of the Information Commons, construction has begun on a second-floor extension called Information Commons 2 (or IC2) on the second floor of the West Tower of the Main Library. With tree-top views of the campus arboretum, IC2 will include 68 computer workstations; seating and electrical power for more than 100 laptop users in individual and collaborative spaces; current, high-use core book collections; technology consulting during all open hours; library reference assistance; printing; wireless networking; and quiet study space.

In September 2004, the Trustees of Indiana University approved architectural plans for the extension, which will convert an additional 9,600 square feet of the Main Library to help meet student demand. Construction should be completed in January 2005. The Information Commons is a partnership of the IUB Libraries and University Information Technology Services.

**SUPPORT CENTER ENHANCEMENTS**

The UITS Support Center, with locations at IUB and IUPUI, enhanced services in 2004 by providing frontline support via telephone for IUSE, IUE, and IUK on evenings and weekends, when local campus help desks are closed. This coverage extends hours on those campuses to 24/7/365, providing the same level
of round-the-clock support that is in place on the core campuses.

Walk-in support was expanded in Bloomington to include a location in the Information Commons in the Main Library. Designed to deliver the services, technology, location, and hours that students have requested, the Information Commons was an early and immediate success, drawing crowds of students before the official start of Fall classes. (For more, see the narrative above.) The Support Center also continued work on enhancing the system that includes help desk inquiries, service requests, account management, and requests for instructional technology resources. An automated customer survey delivery and data collection system was added in 2003 and development began on programming interfaces between Falcon and the new Online Support Environment (OSE), discussed below. New support tools from the company Control F-1 were obtained to provide all Support Center consultants with state-of-the-art workstation tools to assist in diagnosing customer problems. The Support Center extended a new service in 2004 to enable IU faculty, staff, and students to engage in live support chat with a consultant.

In 2004, the Support Center logged 113,600 phone contacts, 26,950 walk-in contacts, and 33,000 e-mail contacts. The Knowledge Base and online support totaled 7,950,000 hits for the year from the IU system, IU affiliates, and the public.

ONLINE SUPPORT ENVIRONMENT

In Fall 2003, the UITS Teaching and Learning Information Technologies Division and Communications and Planning Office completed the first stage in the development of a new Online Support Environment (OSE) by redesigning the UITS Web space to focus on support and services. Built on the best of IU’s current support structure, including the Knowledge Base and strong human help presence, the OSE incorporates more than 3,500 pages on accounts, passwords, networks, hardware, and software. It provides an efficient, intuitive virtual support center with help and information 24 hours a day, year-round, that will empower users to make the best use of the University’s IT environment.

A UITS research paper titled “Customer-Centered IT Support: Foundations, Principles, and Systems,” was published by the EDUCAUSE Center for Applied Research (ECAR) on November 9, 2004. This paper has been one of the most popular downloads from the ECAR Web site, and has resulted in many inquiries and visits by other universities interested in IU’s online support model.

An initiative of the OSE called ITHelp Live! provides tools for remote desktop assistance including computer diagnostics, automated repair tools and scripts, and full remote control. Users can control the level of access to their computers and view a log of activity in Falcon, IU’s enterprise trouble-ticket system. Other interfaces to user support resources include telephone, e-mail, and a real-time online chat.

UITS is building additional automated tools and systems to encourage use of online services and support. UITS developed and released a desktop client called ITNow to push communication of IT news, alerts, and events directly to the user. This enables user communication even in the event that e-mail or Web servers are unavailable. See http://uits.iu.edu/

ADAPTIVE TECHNOLOGY CENTER

The Adaptive Technology Center (ATC) is a hub for alternate media production where print material can be rapidly converted to accessible media for those who face challenges in using traditional print media. The ATC practices of creating electronic text to provide accessible formats for individuals with a variety of disabilities, including dyslexia, blindness, low vision, and mobility impairment, have been adopted by many post-secondary institutions that have robust adaptive technology programs.

In 2004, the Adaptive Technology Center saw a number of initiatives, enhancements, and collaborative efforts along with an increased demand for its premier service — conversion of print materials to electronic format for access by students, faculty, and staff with disabilities. Client contacts also grew, and the Center continued to support students who are working with academic advisors in several programs, including the Groups program, which serves students who are the first in their families to attend college, who have limited financial resources, or who have disabilities.

The ATC Intranet was updated with assistance from student volunteers. Volunteers are also developing a PDA-based reading program that will process voice and highlight text as it is read. The ATC continues to offer to non-profit organizations and educational entities via the Web its OCR Rocket software (written in-house)
that automates many of the scanning/recognition steps of the high-speed scanning process.

The ATC developed a video-based Kurzweil training CD for students with reading disabilities. This CD, which premiered to positive response at the California State University Northridge (CSUN) conference on Technology and Individuals with Disabilities, is made available at no cost via the Adaptive Technology Web site.

The ATC increased Braille support, added an alternative media specialist to meet increased needs of blind and low-vision students, began work on an expanded talking GIS map for the IU campus, and continued making presentations at disability conferences (including the national Association of Higher Education and Disability Conference). Seven adaptive applications are now delivered via server to all the workstations in the Information Commons and will be standard equipment in more locations in 2005. Staff co-taught more than 10 IUB classes on the importance of adaptive technology in providing access to information for individuals with disabilities. In response to the increased need for training, the Center created a visually based training module for use with reading assistance software. The ATC continues to share books through an agreement with Bookshare.org, a national repository of electronic books.

Students can now use Center workstations to convert their digital texts into MP3 files for access on the go — a boon for students who study during their commute. The Center has helped Bloomington-area schools incorporate adaptive technology into their programs, most notably through the use of software to assist students with dyslexia.

The Center opened a new location at IUPUI in November 2004 to serve IUPUI students, faculty, and staff who have such disabilities as mobility impairments, learning disabilities, low vision and blindness. The IUPUI ATC consists of two suites located in the 24-hour Student Technology Center on the first floor of the Informatics and Communications Technology Complex and is open seven days a week, 24 hours a day. Students have access to Kurzweil 3000 software that reads electronic text aloud so they can see it on a monitor while it is read. Dragon NaturallySpeaking helps those with mobility impairments create documents, send and receive e-mail, and use the Internet by voice. Users with low vision have access to ZoomText screen magnification software that enlarges by 16 times material on the monitor. ZoomText also includes a speech feature that reads aloud documents, names of desktop icons, and Web pages. Those who are blind can use JAWS, a screen reading software that voices whatever appears on the monitor, including controls, enabling users to negotiate the desktop without using a mouse. JAWS also supports Braille.

The IUPUI ATC also offers a selection of alternative keyboards and mouse devices for those with mobility impairments. In addition, high-speed scanners convert written materials (books, course packs, etc.) into electronic text that can then be read with adaptive software. Tactile graphics are provided for individuals who need graphical information in a form they can feel with their fingertips. Students may schedule appointments to use the ATC suites with a full-time UITS staff member, or request onsite training in using adaptive hardware and software.
Twenty-eight Residential Technology Centers are located throughout IUB campus housing. Several include Academic Support Centers jointly managed by Residential Programs and Services and UITS. A new Residential Technology Center opened in September 2004 in Ball Residence Hall at IUPUI. Residential Technology Centers at IUB and IUPUI include more than 300 workstations and Express E-mail Stations, and more than 30 high-speed laser printers. Residential IT Services (RITS) consultants staff the Residential Technology Centers on afternoons and weekends, providing application support to residents of campus housing, as well as free in-room computer consulting.

As college and universities around the country identify security for privately owned networked computers as their new primary challenge, Indiana University continues to provide leadership in the area of network security. IU has enhanced the tools that enable the more than 12,000 students to connect their personal computers to the IU network during a five-day period that precedes the start of Fall classes. The “Get Connected” kit students receive contains a CD that requires that they install Symantec AntiVirus (or another antivirus application) and critical updates and services packs for Windows XP and Internet Explorer before they connect their computers to the IU network. The “Get Connected” CD also contains spyware and adware detection and removal utilities, a printer locator utility, as well as the new IT Now client, which alerts users to critical outages even when e-mail services may not be available.

During Summer 2004, RITS introduced a new pre-paid long-distance calling card, available to all IU students. This offers a convenient and affordable option for making long-distance calls from campus housing residences, from other locations on campus, or from any phone worldwide. For this agreement IU negotiated extremely competitive rates for students, especially for calls to international destinations.
UITs began providing IT support for phone and data in IUPUI campus housing in Ball Residence Hall, IUPUI’s “traditional” dormitory, and in the new Campus Apartments on the River Walk, in Fall 2003. All IUPUI campus housing residents can now connect their personally owned computers to the IU Network via the data jacks in their rooms. Residents can also connect to the IU Network using wireless access in designated areas throughout campus housing. UITs provides information and recommendations for Ethernet and wireless cards in The Computer Guide, which is distributed to new students before Orientation and is also available online.

Beginning in Fall 2004, UITs and IUPUI Campus Housing joined forces to redesign the computer lab in Ball Residence Hall. The computer lab, or Residential Technology Center, is now equipped with new Dell computers, a high-speed laser printer, and many new software programs that support students’ academic goals. RITS consultants staff the Residential Technology Centers afternoons and evenings, providing software help and maintenance for computers and printers.

UITs continues to provide telephony services at IUPUI housing. Residents of Ball Hall and the Campus Apartments on the Riverwalk have free voice mail and access to the same telephony features available to students in privately owned apartments, including three-way calling, call forwarding, and caller ID, as well as direct-dial long distance. All IUPUI telephony services are completely paperless: users can order and pay for services and features via a secure Web interface and access phone bills using an interactive voice recognition system.

In 2004 UITs introduced a pre-paid calling card that students can use from any campus or non-campus telephone, offering a convenient, affordable long-distance calling with especially competitive international rates. UITs will continue to work with IUPUI residential planners to ensure that current and future housing develops as a premier living and learning community, demonstrating effective uses of technology.

Residential Technology Centers at IUB and IUPUI include more than 300 workstations and Express E-mail Stations, and more than 30 high-speed laser printers in campus housing. Workstations are configured identically to those found in the Student A new Residential Technology Center opened in September 2004 in Ball Residence Hall at IUPUI. Residential IT Services (RITS) consultants staff the Residential Technology Centers on afternoons and weekends, providing application support to residents of campus housing, as well as free in-room computer consulting.

For students on both campuses, IU provides information and recommendations for IT equipment and a “Get Connected” kit that enables them to quickly and easily connect their computers to the IU Network from their campus residences. It also contains critical antivirus applications to aid in safe computing practices. For more on campus housing IT resources, see the narrative under Actions 55 and 56.
Although IU does not require students to own computers (because of the potential impact on students’ personal expenses), computer ownership continues to rise on the core campuses. According the 2004 User Survey, 94.4% of students at IUB and 94.7% at IUPUI stated that they own or have access to a computer or PDA at home. These figures are believed to reflect on the incentives in place that encourage ownership.

Each year UITS provides extensive guidelines to all incoming students in the form of *The Computer Guide*, which contains current hardware and software recommendations, instructions for connecting to the IU network, and information on special offers on computers. Prospective students receive this guide before matriculating, enabling them to research purchase options before arriving on campus. During new student orientation sessions, UITS staff members advise students and their parents about IT resources. *The Computer Guide* is also available on line, from uits.iu.edu, accessible year round any time members of the IU community want to research hardware purchases, upgrades, and general information about computing at IU.

IU continues to leverage the buying power of the University by working with vendors to secure special pricing on high-quality computers and software, and by extending University pricing to students for their personal purchases.
Recommendation 9: The University should build upon and expand its digital library program, and develop the digital library infrastructure needed to support research, teaching and learning.

The Actions associated with this Recommendation address the development and implementation of an array of digital library services and initiatives, including digital library infrastructure (Action 60), access to electronic resources and electronic reserves (Actions 61, 62), lifecycle funding for existing digital library services (Action 63), digital archives and electronic records (Actions 64, 65), and digital library research (Action 59).

The IU Digital Library Program (DLP) is a collaborative effort of the Indiana University Libraries, the OVPIT, and the University research faculty with leadership from the School of Library and Information Science and the School of Informatics.
Digital Library Brown Bag Series. Beginning in Fall 2003, the Digital Library Program sponsored, with the School of Library and Information Science, a series of lunchtime brown bag presentations dealing with a variety of digital library projects, issues, and research. The Digital Library Brown Bag Series Archive is available, with presentation slides and other materials from the 17 programs in the 2003/2004 series. The program, which generated extremely positive feedback, will continue in 2004/2005. See http://www.dlib.indiana.edu/workshops/brownbags/

Variations2: Digital Music Library. The Indiana University Digital Music Library project aims to establish a digital music library testbed system containing music in a variety of formats, involving research and development in the areas of system architecture, metadata standards, component-based application architecture, and network services. This system will be used as a foundation for digital library research in the areas of instruction, usability, human-computer interaction, and intellectual property rights. This project is funded in part by a grant from the Digital Libraries Initiative – Phase 2 (DLI2) program, with support from the National Science Foundation and the National Endowment for the Humanities. In Fall 2004, the project released version 3 of the Variations2 system, which adds features to support custom audio playlists, annotation of musical scores, and access control based on course enrollment and location. See http://variations2.indiana.edu/

Building a Digital Library Education Program. In 2004 the Digital Library Program received a grant from the Institute for Museum and Library Services (IMLS) program Librarians for the 21st Century to create a digital library specialization for master’s and post-master’s library science students in the School of Library and Information Science (SLIS). The three-year project involves a four-way partnership with SLIS, the School of Library and Information Science at University of Illinois Urbana-Champaign, and the digital library program at UIUC. This project will fund curriculum research and development, a digital library education conference in each of the three years, and digital library internships and residencies in the digital library programs of both institutions. The data gathering phase of the project, now underway, will lead to the possible modification of existing courses and the development of new courses to be taught in Fall 2005. See http://lair.indiana.edu/research/dlib/

Text Encoding Initiative (TEI) Consortium. The Digital Library Program continues to play a leadership role in the Text Encoding Initiative Consortium. Program staff served on the Text Encoding Initiative (TEI)/National Endowment for the Humanities (NEH) Task Force on SGML/XML Migration, October, 2002-July, 2004. In October 2004, a staff member was elected to a two-year term on the TEI Council, a group of experts who guide the development of the TEI.

In 2004, the Digital Library Program continued to maintain and expand its technical infrastructure to support storage of and access to digital library collections. New IBM pSeries and xSeries development servers were installed for the Variations2 project, as well as a new production Apple Xserve to support audio streaming. New development and production environments were implemented for Java...
Web application and Oracle9i database servers, and a project plan was formulated to implement a digital library object repository and new image and text delivery services for IU.

The DLP continued to expand the number of collections available through its Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) Data Provider, which allows IU to easily share metadata for items in its digital library collections with other institutions running OAI-PMH Service Providers. Metadata records for texts from the Wright American Fiction and Victorian Women Writers projects were added to the Data Provider. Metadata records for IU’s digitized sheet music collections were harvested by the Sheet Music Consortium during Summer 2004; metadata were previously offered without links to digital content. See http://digital.library.ucla.edu/sheetmusic/

**ELECTRONIC INFORMATION RESOURCES**

**Action 61.** The University Libraries, with UITS, should provide students, faculty, and staff at all campuses with convenient and reliable access to a comprehensive and coordinated collection of electronic information resources, on the campuses and off.

The IU Libraries are in the process of implementing SIRSI’s Single Search product to allow users to search across multiple electronic database resources, to quickly find full text articles, or to further search within the database’s native interface. This service will also be implemented at the six regional campuses during Spring 2005. Bloomington launched a beta test of a general set of resources, plus a group of psychology resources to users in December. Based on feedback, focus group input, and new features in the software, enhancements will be implemented during Spring 2005. Technical staff are being trained in order to integrate Single Search functionality directly into the IUB Library Web site and Oncourse CL for all campuses.

**Action 62.** The University should develop within its digital library program an “electronic reserve” service so that faculty can assemble and make available content in all media and formats: text, image, audio, or video; published or unpublished; digitized representation or original digital artifact; etc.

**Video E-Reserves.** In Spring 2004 the Digital Library Program coordinated a pilot project to deliver streaming video to two classes at IU Bloomington through the IU Libraries E-Reserves system. The IUB Libraries Media/Reserves department provided contact with faculty for the project and UITS Digital Media Network Services provided video streaming hosting and consultation. DLP staff digitized and transcribed 12 hours of video for the Spring pilot and developed a Web interface and associated help and problem report files for accessing the video. Each video was streamed to users at three different bit rates in both MPEG-4 (via QuickTime) and RealVideo8 formats. Access logs and user surveys showed enough interest in the project for the team to offer an expanded pilot in Fall 2004 with more courses and video files. In Spring 2005 the two pilot tests will be evaluated as the feasibility of offering this service on an ongoing basis is explored.
VARIATIONS. VARIATIONS continues to provide access to sound recordings and a small number of musical score images to School of Music students and faculty in support of instructional and research needs. VARIATIONS delivered 184,649 sound file accesses between July 1, 2003 and June 30, 2004. To date, Music Library staff have digitized approximately 9,813 sound recordings and 384 scores. See http://www.dlib.indiana.edu/variations/

Library Electronic Text Resource Service (LETRS). LETRS continued to support the Digital Library Program’s online electronic text collections and collections hosted in the LETRS Humanities Computing Lab in the IUB Main Library. LETRS staff also provided support for the electronic text components of a number of DLP projects. LETRS consultants participated heavily in the development of the Film Literature Index (FLI) project, performing data editing and research to correct problems and deficiencies in the original data. LETRS consultants also performed XML/TEI markup on texts used to create a prototype of the Indiana Authors project, which was submitted for an IMLS grant. In the annual UITS User Survey, LETRS consistently ranks among the top one or two RAC units in user satisfaction, and in 2004 LETRS received a user satisfaction rate of 95%. See http://www.indiana.edu/~letrs/

Digital Media and Image Center (DMIC). 2004 was a year of continued growth for the DMIC, the Digital Library Program’s primary digitization facility. Staffing was increased, and the DMIC continued its commitment to high-quality imaging and quality control and served as a resource to IU librarians, faculty, and staff with the following activities:

- Updated digitization best practices document at http://www.dlib.indiana.edu/dmic/general/benchmarks.pdf
- Continually updated digitization and quality control procedures for ongoing projects
- Set up a Symantec Ghost server to streamline the deployment of software on new workstations
- Handled lifecycle upgrade of computers and scanning equipment
- Upgraded imaging and productivity software in the DMIC, including Photoshop CS and Microsoft Office 2003
- Purchased and set up replacement imaging equipment for the Fine Arts Slide Library
- Consulted on imaging issues with numerous IU departments, including the Lilly Library, the IU Art Museum, the Fine Arts Slide Library, University Archives, the Cook Music Library, the Liberia Collections Project, the Black Film Center Archive, and IU East Library. See http://www.dlib.indiana.edu/dmic/

DIDO Image Bank. DIDO (Digital Images Delivered Online) is a partnership between the Fine Arts Slide Library at IUB and the Digital Library Program that provides Web access to more than 40,000 art images to users on all IU campuses. In Spring 2004, the DLP released to the Slide Library an “Image Processing System” designed to record technical metadata about digitized images, enforce digitization specifications for the project, create derivative images for Web delivery, and archive master images to IU’s Massive Data Storage System (MDSS). This system has allowed the Slide Library to stop manually creating derivative images for the Web and burning TIFF images to CD Rom for storage, has improved the long-term sustainability of digitized images in the collection, and has increased image quality in the DIDO system. This system will be extended to other digitization projects for which the DLP manages digitized content, and used as a basis for further developing and standardizing DMIC digitization activities. See http://www.dlib.indiana.edu/collections/dido/
Charles Cushman Photograph Collection. An Institute for Museum and Library Services grant received in 2000 provided for digitizing the 14,500 Kodachrome slides of IU alumnus Charles Cushman from the IU Archives, developing standards for their digitization, and developing metadata practices for documentary slides. The site was launched on October 29, 2003, and improvements to searching and browsing were made in March 2004.

The completed site includes digitized versions of all images, two illustrated essays putting the images in photographic and urban history contexts, a timeline of the history of Mr. Cushman and the image collection, and additional contextual and technical information about the collection and the Web site. The site features several innovations, including faceted browsing on subject, location, date, and genre; and a search engine that uses the relationships between subject headings to retrieve more relevant results for users and to suggest related searches for further exploration. See http://www.dlib.indiana.edu/collections/cushman/

Film Literature Index Online (1976-2001). A July 2002 grant from the National Endowment for the Humanities for $259,343 provided for converting to electronic format 700,000 entries of an authoritative paper-based film and television literature index, 1976-2001. Working in partnership with the State University of New York - Albany, where the index is edited, IU has nearly completed the project. The index editors were unable to locate readable electronic files for six years during the period 1976-1988. Rekeying and XML encoding of these volumes was outsourced; these data have been parsed into the existing database. A Preview site was launched in November 2004, which has already generated positive response. Errors in the data that came from the paper index continue to be corrected and improvements are being made in response time for complex searches. The project should be completed by the end of January 2005. See http://www.dlib.indiana.edu/reference/fli/

Indiana University Sheet Music. With funding from the Library’s NEH Challenge Grant Endowment, sheet music is being digitized from two Lilly Library sheet music collections. Indiana University Sheet Music, launched in April 2004, provides access to metadata and some digital images from these collections. Users may search or browse records for more than 24,000 pieces in the Sam DeVincent Collection of American Sheet Music and the Starr Sheet Music Collection. Digital images are available for approximately 3,400 pieces of sheet music, with more to be added throughout the next three years (See IN Harmony below). See http://www.dlib.indiana.edu/collections/sheetmusic/

Ethnomusicological Video for Instruction and Analysis (EVIA) Digital Archive. The IU Archives of Traditional Music, in partnership with the University of Michigan, received a grant from the Andrew W. Mellon Foundation to develop a digital archive of ethnomusicology field recordings, including a library of content and tools for scholars and teachers to annotate video recordings and use them in teaching, beginning in 2002. The Digital Library Program is providing technical support for the project. In Summer 2004 the project team digitized approximately 80 hours of video collected in the field by ethnomusicologists and successfully developed and implemented a video segmentation and annotation tool. This tool was used by a group of ethnomusicologists who came to IU in Summer 2004 to annotate the videos they had contributed to the archive, and makes use of the METS XML standard with embedded MODS records to store information on video segments and annotations. See http://www.indiana.edu/~eviada/

The “Chymistry” of Sir Isaac Newton. In August 2003, the National Science Foundation awarded a grant to Prof. William Newman, Department of History and Philosophy of Science, to digitize and publish online the alchemical manuscripts of Sir Isaac Newton, including annotations tools for encoded text and page images of manuscripts. Summer 2004 marked the completion of the first year of this three-year project. Highlights include a seminar on Newton’s alchemy taught by History and Philosophy of Science faculty and Digital Library Program staff. As part of the seminar, graduate students transcribed and encoded an important Newton notebook of more than 200 pages, which were checked against the 250 transcribed and encoded pages. This comprises about a fourth of the 1,000 pages IU will digitize over the three-year project.
IN Harmony: Sheet Music from Indiana. An IMLS (National Leadership Grants — Library-Museum Partnership) grant for $343,000 provides for developing tools for libraries and museums to catalog their sheet music collections, digitize sheet music, and create a single Web site to provide online access to 10,000 pieces of digitized sheet music, about half from IU. This project involves a four-way partnership with the Indiana State Library, the Indiana State Museum, and the Indiana Historical Society. The grant period runs from October 1, 2004 through September 30, 2007. See http://www.dlib.indiana.edu/projects/inharmony/

IUPUI UNIVERSITY LIBRARY: DIGITAL LIBRARIES TEAM PROJECTS

The Central Indiana Online Historical Collection. A 2003 Central Indiana Community Foundation Library Fund grant to University Library provides for digitizing historical collections. In collaboration with the Indiana State Library and the Indianapolis Marion County Public Library, collections have been chosen based on condition and need for public access in an online environment. Collections digitized within the first year include The Indianapolis Sanborn Maps (1887, 1898, 1915), Baist Atlases (1916, 1927, 1941), and Indianapolis City Directories (1858-59, 1880, 1914-1920).

GIS Day Media Specialist Workshop. In July 2004 University Library hosted a workshop that assisted media specialists in planning National GIS Day activities for their teachers. The participants were introduced to Internet resources for global positioning systems (GPS) geographic information systems and mapping resources and trained to use a handheld GPS unit and map points around the IUPUI campus. Additional hands-on activities included using the data from the GPS units and mapping the data in a computer laboratory setting using WTH ThinkMap software. Funding for the workshop was provided thru a grant from the Central Indiana Community Foundation Library Fund.

SPECIAL COLLECTIONS DIGITAL PROJECTS

Use statistics for Philanthropy Resources Online (PRO) from January 2003 through June 2004 indicate nearly 48,000 hits and more than 11,000 page views during more than 7,300 visitor sessions, resulting from more than 3,300 unique visitors. More than 27,000 pages of digitized text are now available in PRO, with nearly 9,000 pages added during the last year.

Use statistics (FY 2003/04) for the Philanthropic Studies Index indicate nearly 20,000 hits and 13,000 page views during more than 5,300 visitor sessions, resulting from more than 2,500 unique visitors. These figures represent approximately a 100% increase over the previous year. In the same period, 400 new citations for journal articles were added to the database. In an effort to expand coverage provided by the Index, citations for 160 online working papers and 460 doctoral theses were also added.

Use statistics for the IUPUI Online Image Collection for FY 2003/04 indicates nearly 450,000 hits and 10,800 page views during 9,250 visitor sessions, resulting from nearly 3,000 unique visitors. The IUPUI Online Image Collection offers more than 5,000 images; 2,400 were added during the last fiscal year.

The Neil Matthew Online Image Collection is nearly completed. During FY2003/04, more than 1,000 images were added to the collection. This collection will be launched in early 2005 and will document the landscape and architecture from every county in Indiana.
Action 64. UITS, in partnership with the University Archives, Internal Audit, the Committee of Data Stewards, and others should develop a program to assure preservation of electronic institutional records.

Action 65. UITS, in partnership with the University Libraries, University Archives, and others should evaluate technologies and propose methods and standards to protect digital materials against media deterioration and technological obsolescence.

Indiana University Libraries completed work in a partnership with Stanford University, New York Public Library, and Emory University on the LOCKSS (Lots of Copies Keep Stuff Safe) project. LOCKSS is a system that allows libraries to safeguard their subscription Web journals. It was designed and is being implemented by Stanford University Libraries with funding from the National Science Foundation, Sun Microsystems, and the Andrew W. Mellon Foundation. LOCKSS provides tools that use local, library-controlled computers to safeguard readers’ long-term access to Web-based journals. LOCKSS is intended to demonstrate that it is safe for librarians to subscribe to journals’ Web editions and cancel the paper editions. See http://lockss.stanford.edu/
Recommendation 10: The University, with leadership from the OVPIT, must continue to develop policies and implement procedures that protect the security of IU’s information technology resources and institutional data, safeguard personal privacy, and respect intellectual property rights, while at the same time promoting two traditional university values associated with academic freedom: access to information and freedom of discourse.

The Actions associated with this Recommendation address issues of information technology policy and security, including the protection of information and security of IT resources (Action 66); authentication and access mechanisms (Action 67); and intellectual property (Action 68).
The Information Technology Policy Office (ITPO) develops and maintains policies on the appropriate use of IT by the Indiana University community, and administers education programs about common technology and security issues and concerns. The Office coordinates investigations of and responses to reports of abuse or inappropriate use of electronic information or information technology, interacting daily with, and on behalf of, students, faculty, and staff. The Office also works closely with University administration, judicial officers, counsel, and other IU agencies, as well as internal and external law enforcement and prosecutors. In addition the ITPO coordinates computer accounts management for centralized systems.

TECHNOLOGY POLICY ACTIVITY
During 2004, the ITPO continued facilitating progress on several technology policies that were previously distributed for comment. The strategy for the proposed security policy has changed owing to the introduction of the Gramm-Leach-Bliley Act, which governs the collection and disclosure of personal financial information and requires financial institutions to safeguard customer information, and the University’s mandate to publish a Security Program. A new draft policy on Security of IT Resources (IT-12) will outline who is responsible for securing what technology resources, and will mandate adherence to a published Security Program.

EDUCATIONAL MATERIALS
In response to the Recording Industry Association of America (RIAA) increasing enforcement of the Digital Millennium Copyright Act, the ITPO increased efforts to educate the University community about copyright related to file sharing. In particular, an online copyright tutorial and quiz were implemented for use with those implicated in copyright violations. A Web page compiling all educational material about file sharing for the IU community continues to be updated and kept current at http://filesharing.iu.edu/. (See Action 68 for further details.)

Increased attention to security awareness and policy education materials was focused primarily on Knowledge Base and UITS Online Support Environment tools. Over the year, ITPO worked closely with the KB editors to create many new articles and to revise dozens of existing articles. Duplication between the ITPO Web pages, the KB, and the OSE was reduced by ensuring that only one master copy was kept on any one topic. Other pages providing that information now pull that data live from the master copy. Novice end users are now directed to http://keepITsafe.iu.edu/ which is an alias for the OSE security and policy page, for basic security and policy educational materials. ITPO also printed up toothbrushes with “Don’t share your password either!” and the link to keepITsafe.iu.edu, for distribution at events and presentations.

Microsoft provided three free poster designs focusing on personal Internet firewalls, anti-virus software, and security updates. In cooperation with CPO, ITPO added a reference to the security and policy pages of the OSE to the posters, and printed and distributed large posters and smaller flyer-size posters across the University.

INCIDENT RESPONSE
Incident statistics continue to increase, primarily due to increased numbers of worms and viruses in the wild. Incident response staff streamlined procedures and kept up with the load, thanks to the transfer of one FTE to this function at the end of 2003. The Incident Response Coordinator designed and created a tool to manage compromised host reports received from the ITSO engineers, which also automatically identifies users associated with these hosts and notifies those users through e-mail. The tool can also automatically isolate those hosts from the network when directed to do so. This tool is being tested at the end of 2004 with full implementation planned for early 2005. With this tool in place, the University will be better prepared to mitigate the next big Internet worm or virus outbreak.
**ACTION 67.** UITS, with the Committee on Institutional Data and others in the University community, should develop security mechanisms that properly enact institutional policy. Implementation of these security mechanisms should include risk assessment, audit and controls, and education and awareness. UITS should focus special attention on providing reliable authentication and access management systems.

The primary role of the Information Technology Security Office (ITSO) is to provide proactive security analysis, development, education, and guidance related to Indiana University’s information assets and information technology environment. The overall objective is a safe and secure atmosphere for teaching and learning, research, service, and the conduct of University business. The Office works closely with the Information Technology Policy Office (ITPO), assisting in investigations of and response to reports of abuse or inappropriate use of information technology.

Units of the Office of the Vice President for IT and CIO continue to improve the security of IU’s computer systems. This year ITSO has deployed complex automated programs that analyze network traffic for real-time security threats, which has led to selective filtering of a variety of malicious communications. Many more such sensors are planned, including some to be deployed on regional campus networks.

UIT and ITSO partnered on many other proactive protective measures including development and distribution of a “Get Connected” CD, which students are required to apply before they are permitted to connect personal computers to the University network; creation and distribution of a security CD with various tools, programs, security patches, and infection removal tools; filtering of specific network communications to block the spread of infections; protecting central enterprise systems with formal firewalls; identifying and isolating, via hundreds of network scans, thousands of vulnerable or already-infected hosts, thereby saving tens of thousands of IU computers from infection; development of many, many online Knowledge Base articles about institutional and personal computer security issues; and researching firewalls placed at the University network borders. A project is underway to make locating and notifying users or technicians of misbehaving computers as easy and as fast as possible, so that these computers do not have an opportunity to affect University operations.

Department technicians outside UITS and ITSO now have more tools at their disposal, so can more easily manage systems securely and users have much more information available securing personal computers. Additional monies and staffing have been recently allocated to the effort to maintain IU’s excellent state of preparedness in the face of increasingly frequent and damaging threats.

Indiana University is regarded as a source of best practices for security in various areas of technology for higher education. IU was identified by Richard Clarke (former cybersecurity advisor to several US Presidents) as the “gold standard” in security operations. Indeed, many staff involved in security issues at IU are popular speakers and seminar leaders at national conferences and events.

IU continues to be active in national security efforts, with staff leading national efforts to improve security in higher education and in the national
cyberinfrastructure. The Chief IT Security and Policy Officer is a member of the EDUCAUSE/Internet2 Security Task Force executive committee and is Chair of the Task Force’s Security Policy and Legal Issues initiative. The Technical Director of the IU-based Research and Educational Networking Information Sharing and Analysis Center (REN-ISAC, below) is also a member of the Task Force, as well as a participant in the national ISAC Council and other broad efforts to improve security of high-speed networks. The Advanced Network Management Lab (of the IU Pervasive Technology Labs) is also involved in national efforts to develop products to assist in securing networks and computers, and conducts research in this area under contracts awarded by various federal government entities.

In 2004, CACR assisted the School of Informatics in hiring four new faculty/researchers in security, and collaborated on a successful Commitment to Excellence proposal to obtain funding to hire two additional faculty (one in wireless networking and one in information assurance law and policy) over the next two years. CACR also coordinated efforts to create a comprehensive curriculum in information and systems assurance, including a new Informatics undergraduate “cognate” and a pending graduate program in information security. CACR spearheaded two major ($5M and above) external grant proposals and began a corporate fundraising initiative. And the Center brought to the Indianapolis and Bloomington campuses a dozen nationally-renowned speakers in information assurance and security disciplines.

The IU Center for Applied Cybersecurity Research was formed to facilitate the sharing of security information among faculty, researchers, and practitioners. The Research and Educational Network Information Sharing and Analysis Center (REN-ISAC) based at IU provides real-time threat and warning information to organizations. Both are described below.

**CENTER FOR APPLIED CYBERSECURITY RESEARCH (CACR)**

In April 2003, Indiana University launched its Center for Applied Cybersecurity Research (CACR) with a $125,000 private gift and matching funds from the University. The Center serves as a focal point for cybersecurity research and teaching at Indiana University, as well as a meeting ground for cybersecurity scholars and practitioners from each campus.

The Center provides an environment where cybersecurity research and practice are intertwined, maximizing the speed with which new cyber-research is applied and new cyber-threats become the subject of research. It draws on IU’s research strength in computer science, informatics, accounting and information systems, criminal justice, law, organizational behavior, public policy, and other disciplines. CACR collaborates with federal and state governments, business, and other education institutions to improve the quality of information assurance practice, research, and teaching at IU and throughout the country.

With support from the University of Notre Dame, the Center also hosted the first annual Indiana Higher Education Cybersecurity Summit, held at IUPUI on March 26, 2004. This event was attended by more than 200 chief information officers, security professionals, auditors, lawyers, technicians, and others from universities and colleges across the State of Indiana. The featured speaker for the event was Richard Clarke, former Special Assistant to the US President for Global Affairs, US National Coordinator for Security and Counter-terrorism, and Special Advisor to the US President for Cyber Security.

**THE RESEARCH AND EDUCATION NETWORK INFORMATION SHARING ANALYSIS CENTER (REN-ISAC)**

The National Strategy to Secure Cyberspace, announced by President Bush in early 2003, calls for establishing “information sharing analysis centers” to facilitate communication, develop best practices, and disseminate security-related information. The Research and Education Network ISAC (REN-ISAC) operated by IU provides these services for organizations involved in higher education and research and education.

Throughout 2004, the REN-ISAC analyzed and provided many technical reports to the higher education community, describing specific security threats, and including recommended mitigation techniques. Network sensors subsequently detected a dramatic decrease in occurrence of the various malicious protocols. Toward the same goal, the REN-ISAC
The REN-ISAC has become part of the National Council of Sector ISACs, and participates in daily security briefing calls with Council members and US-CERT. In this way, the ISAC has a broader source of information about security threats, which can be analyzed and shared by the higher education community. The REN-ISAC has also done a great deal of work in creating a university and college security professionals registry, which will be populated with verified and trusted contacts on campuses across the US. In this way, the ISAC can communicate sensitive security information to appropriate specific individuals, and various campuses can communicate sensitive information to each other.

The University Information Technology Policy Office collaborates with the IUPUI Copyright Management Center on developing policies and programs that advance the use of information technology and information resources, especially in areas of teaching and research, while limiting the University’s liability exposure regarding intellectual property rights.

In response to the Recording Industry Association of America (RIAA) increasing enforcement of the Digital Millennium Copyright Act, IU heightened efforts to educate the University community about copyright related to file sharing. With the cooperation of the Dean of Students offices at the IUB and IUPUI campuses, and in consultation with University Counsel, a new process was put in place that requires those implicated in Digital Millennium Copyright Act notices to take an Oncourse-based copyright tutorial and pass a short quiz. Educational efforts on the theme “Are You Legal?” included posters in STCs, campus housing, and apartments; 14,000 flyers distributed to all who live in housing connected to the IU network; an ad on IU Cable TV; and numerous articles in student publications. A Web page compiling all educational material about file sharing for the IU community is kept current at http://www.filesharing.iu.edu/. Planned for early 2005 is a digital music and movie festival highlighting vendors of legal online music and movie services. The purpose of the “Digital Karma” event is to increase interest and awareness among Indiana University graduate and undergraduate students in using legitimate digital downloading and streaming technologies and services, and to decrease illegal and unethical file sharing behaviors.

The IUPUI Copyright Management Center (CMC) in conjunction with the University Information Technology Policy Office hired a temporary copyright coordinator to assist in facilitating the efficient dissemination of copyright educational resources via the CMC Web site at http://www.copyright.iupui.edu/, and to provide advice concerning the file sharing site at http://www.filesharing.iu.edu/.

The CMC continued its review of informational materials on the copyright information Web site to ensure that the information is current with University policies and recent trends in copyright laws. Web pages that were revised in 2004 include content on the following issues: Fair-use issues, course management systems, classroom handout common scenarios, documents, libraries and copyright, obtaining permission to use copyrighted works for educational use, and library copying and electronic reserves.

The CMC added new materials to the Web site covering such topics as classroom handouts and copyright, and posting materials on the Internet. Documents and educational resources in the Distance Education and Teach Act section have been merged to create one Web page titled “Copyright and Distance Education.”
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