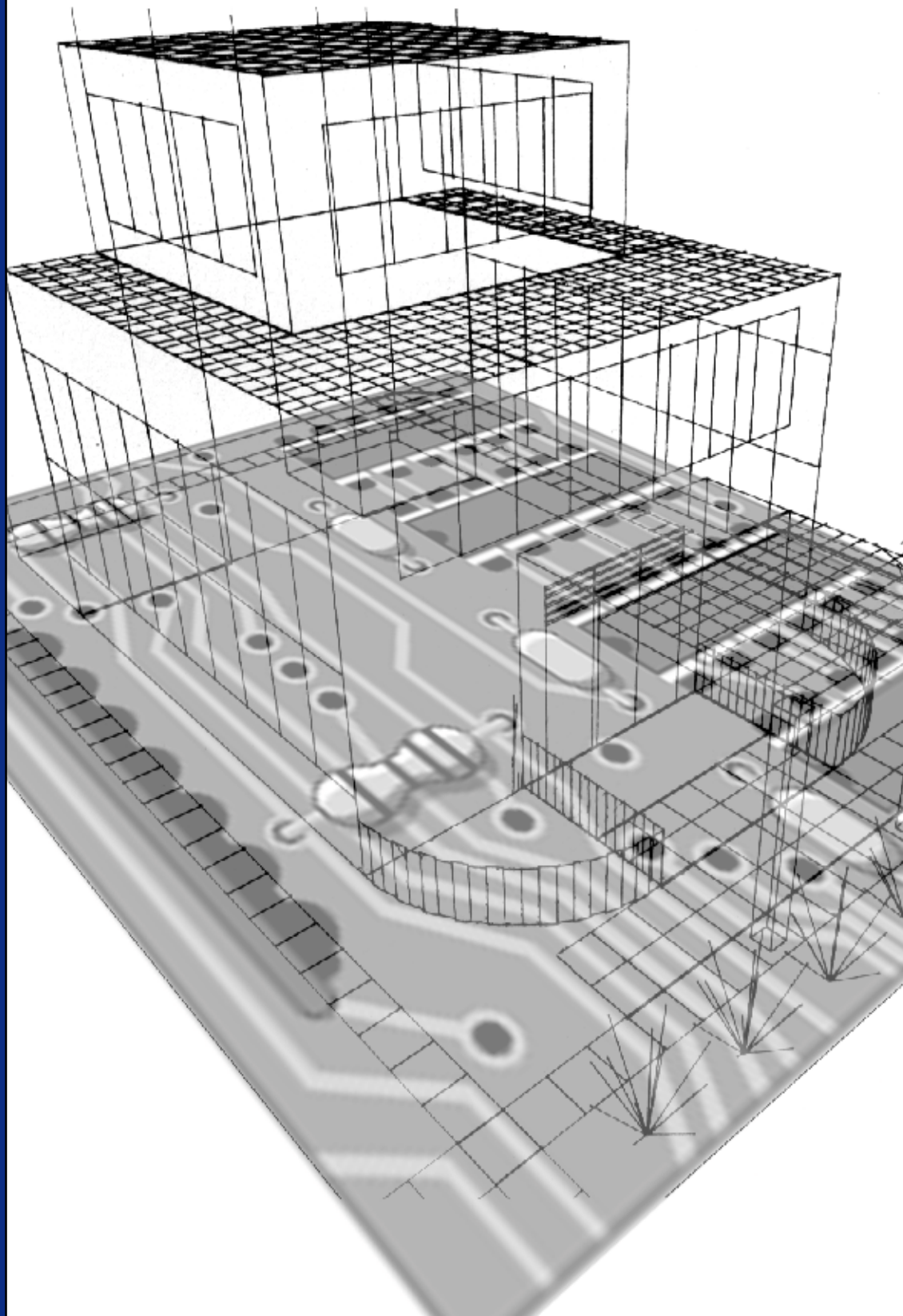
INDIANA UNIVERSITY

# Information Technology Strategic Plan

## *Architecture for the 21st Century*

May 1998



# Foreword

Dear Colleagues,

Information technology is today one of the most critical tools in higher education. It permeates every aspect of a University from the first contact a student has with its Web site through the myriad systems that manage and provide access to its information; to the desktop computer — now such a fundamental part of the daily life of nearly every faculty and staff member; the intricate web of fiber optic cables that link these computers together and connect them to the world of digital information; the supercomputers that carry out the massive computations that underpin simulation and modeling; and the wired classrooms, dormitories and student laboratories, which are now such fundamental components of the educational process.

But information technology, though critical, is still just a tool. It relies on people for its effective utilization, whether they be those who use these tools on a daily basis, those who instruct others how to use them, those who create or design new uses for these tools in teaching and research, or those that ensure they are maintained in good repair. And equally important is the need to upgrade tools and acquire new, more effective ones that save time, money and effort, all the time mindful of the need to constantly re-train people in their use and to re-conceptualize how best they can be used.

The Indiana University Information Technology Strategic Plan is the most comprehensive and far-reaching plan ever prepared for the development of information technology at IU. It provides an aggressive and bold, yet thoughtful and measured vision for how information technology should be developed, used and applied at Indiana University leading into the next millennium. It is sensitive to the fact that the University is a multi-campus institution with a formidable reputation in the arts, humanities, social sciences, basic sciences, and health sciences, but with an increasing emphasis on technology and applied science. It recognizes that eminence in the use and application of information technology requires the University to build more effective partnerships with other research institutions as well as with industry and government, both at the State and Federal levels. The plan is also realistic in that it appreciates the need to balance central direction in the development of some areas of information technology with the distributed responsibility of individuals and academic groups in other areas. And finally it recognizes the importance of effective access to the University's infrastructure and information assets from anywhere and at any time. For this underpins the transition of traditional higher education into distributed global education unfettered by boundaries of space or time.

This Strategic Plan has been prepared in response to a request from Indiana University President Myles Brand for a plan for the development of information technology at IU that will enable the University to become a leader in absolute terms in its use and application. This in turn is a vital part of his plan that IU "... move forward to the next level until it is recognized as one of the very best of the nation's universities."

The Strategic Plan completes a process commenced about fifteen months ago to overhaul information technology and the way it was structured at the University to better prepare IU to take the leadership position in information technology that President Brand envisions. This process included reorganizing the information technology organizations at IUB and IUPUI and consolidating them into UITS, reviewing and re-prioritizing UITS expenditures, carrying out the first University-wide security audit and reconstructing the entire University information technology committee structure. The Strategic Plan is the culmination of this process.

I would like to express my gratitude to the Chairman of the University Information Technology Committee, Mike Dunn, who has done a superb job in marshaling this whole process of preparing the Strategic Plan and giving leadership in a complex, often difficult task. My sincere thanks are also due to Jon Barwise, Russ Eberhart, Dennis Gannon and Jim Perin, the Chairs of the various University information technology taskforces, for the major contributions that they made. More than 100 people on the various committees and taskforces contributed to the development of the Strategic Plan and many other members of the University community provided comments. I am most grateful to all of them. Many staff in UITS and in the Office of the Vice President for Information Technology also contributed to the preparation of this plan and to all of them my thanks as well. I would like especially to thank Gerry Bernbom and also Karen Adams. The University is much in debt to all of those involved in the preparation of this Strategic Plan. It is a far-sighted document and I commend it very strongly to you.

Michael A. McRobbie
Vice President for Information Technology

May 1998

Michael McRobbie
Vice President for Information Technology
Indiana University

Dear Vice President McRobbie:

As Chair of the University Information Technology Committee, it is my privilege to present to you the Information Technology Strategic Plan. The plan is titled *Architecture for the 21st Century* to remind us all that information technology is becoming as important as more traditional infrastructure, and we must plan for its development on a regular basis, both technically and financially.

This plan results from an intensive planning process of about five months duration, involving over 100 faculty, staff, and students, who served either on the University Information Technology Committee, or on one of the four area Taskforces. We also gathered input from the general University community.

With so many people involved, it is impossible to thank them all. But I would like to single out the Taskforce chairs Jon Barwise, Russ Eberhart, Dennis Gannon, and Jim Perin, not just for their vital roles in chairing the Taskforces, but also for their role on the Drafting Committee. Two representatives from your office, Gerry Bernbom and Karen Adams, also served on that committee and provided critical support. Gerry deserves special note as he was responsible for much of the editorial work associated with this document.

I would also like to thank Bob Andree as head of the Computer Center Directors Committee for gathering input from the regional campuses. Your Associate Vice Presidents were extremely helpful, as were the secretaries to the Taskforces, and various other UITS staff. Finally I would like to thank Penny Studley for her cheerful and efficient work as secretary for the UITC.

Our Committee was charged with designing a comprehensive plan that would make IU a leader in the use and application of information technology. We did this without the constraints of a specific budget, so as to present a vision of what is needed to make Indiana University a leader (in absolute terms) in the use of information technology to support the traditional missions of teaching, research, and service. Two major themes emerged from our deliberations, both of which are essential for effectiveness in carrying out other parts of the plan. These two themes are life-cycle replacement funding and access (Recommendations E1 and E2, and corresponding Actions). They both have to do with the fact that we cannot expect faculty, staff, and students to become leaders in the use of information technology if they do not have reliable access to decent, well-supported equipment.

Of course both recommendations have major budgetary impact and will likely need to be implemented in a phased manner. And access must be considered in a constantly changing environment, with Internet service likely to develop into something like a utility within the next few years. The critical question is what we do in the interim to remove a significant barrier to computer use. A mixture of solutions seems the right answer.

There is one concern that relates to funding, but is not specifically mentioned in the plan, and which I now take the occasion to stress. This has to do with the special money from the State for information technology for this academic year and the next. It is essential that this be continued as base funding. Schools and other units are under great financial pressure these days, and are finding it increasingly difficult to fund the new investments in information technology that they must make.

Full implementation will call for increased levels of expenditures, both inside and outside of UITS. Indiana University, like most (perhaps all) universities, has not yet come to grips with the real cost of information technology — in people and equipment. We can achieve leadership by seriously addressing this problem, hopefully with cooperation from the State.

In closing, let me give thanks, on behalf of the Committee, for the support you and your staff have given to us in the development of this Strategic Plan.

Sincerely yours,

J. Michael Dunn
Chair, University Information Technology Committee
Oscar Ewing Professor of Philosophy
Professor of Computer Science

# Architecture for the 21st Century: An Information Technology Strategic Plan for Indiana University

## Table of Contents

**Members of the University Information Technology Committee**

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| Freund, Deborah | Vice Chancellor & Dean of Faculties | IUB |
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| Bailey, Darrell | Music | IUPUI |
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| Perin, Jim (Chair, UIS TF) | Assistant Vice President, Finance | IU |
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# A. Preface

*"The history of New College is the history of its buildings. They began as a magnificent conception, far exceeding any educational experiment which had gone before." A. R. Woolley, in the Clarendon Guide to Oxford*

*"We shape our buildings and afterwards, our buildings shape us." Winston Churchill*

*"We make our networks and our networks make us." William J. Mitchell*

If one could somehow travel back in time to Plato's "Academy" one would find a single teacher talking to his students in an olive grove. This was arguably the first European university. There was little in the way of infrastructure, not even walls.

Sometime in the early middle ages, significant infrastructure was added to the wandering scholars who managed to attract students around them. Anyone who has visited universities such as Oxford and Cambridge cannot help but be impressed by the large and substantial buildings, largely residence halls in today's terms, which clearly were built with the future in mind. It is amusing to note that Oxford's magnificent New College was founded in 1379. The Gothic colleges rival cathedrals, and as with cathedrals, their construction is awe-inspiring in its commitment, planning, labor, intelligence, and craftsmanship. Also quite remarkable are the castellated walls dividing the colleges from the rest of the world, even from the urban centers in which they developed.

At first American universities, particularly the private universities, tended to reflect their medieval paradigms, with walled compounds preserving class distinctions much as they did in the old world.

But American universities, particularly public universities, gradually changed in their architectural paradigms in support of their missions and their commitment to access for all. A visitor to a residential campus at an American public university is impressed by the large, open, sprawling physical plant, much of it built in the academic expansion that has occurred since WWII. To residence halls and a few classrooms and laboratories were added lecture halls, research facilities, language labs, libraries, administrative facilities, advising centers, museums, concert halls, athletic facilities, alumni centers, and a myriad of other facilities undreamed of by Plato. Modern urban campuses which have developed in the past several decades may be more compact, but their architecture still carries the message of openness and union with their communities.

A similar expansion of facilities is now taking place in universities, but it is far less visible. Much of it runs underground, through walls, sits on desktops, or is carried in brief cases. The most important part of it is literally invisible, except by the use of special instruments called monitors. But it is no less important for being so difficult to perceive. Of course what we are talking about is information, which in its digitized form consists of invisible electromagnetic bits. This same information can be printed (or even written) on paper, communicated verbally, etc. Many philosophers would in fact argue that information itself is an abstract notion with no physical parts.

Whether the basic units of information are incorporeal, or simply "very tiny," it is obvious that the physical realization of information has important consequences for the world in which we live. The way in which the tiny bits, whether in our computers or our own heads, have incredibly profound effects can be taken as an example of the so-called "Butterfly Effect" from Chaos Theory: small causes can have enormous and remote effects.

The effect on all of us may be summarized by a series of what have already become platitudes: we live in an information age, we are all enlisted (voluntarily or not) in an information revolution, more of us are becoming information/knowledge workers, we are entering an information-based economy, etc.

Our aim here is not to play at being futurists, but rather to point out the obvious. A university by its nature is concerned with information, its production and transmission, and the role of information in the conveyance and creation of knowledge.

Plato defined knowledge as warranted true belief, and distinguished it sharply from mere opinion. Later thinkers came to see "warrant" as having two aspects, rational justification and social authentication. Universities have a special role in the information economy, with their historic role of critically evaluating information with the aim of identifying structured information that can legitimately be called knowledge. Universities provide both rational justification and social authentication as a basis for knowledge. By

contrast, there is a lot of information on the World Wide Web, but it is far from clear how much of it constitutes knowledge.

Research, scholarship and the creative arts produce and organize information, and teaching transmits it. To teaching we add learning, understood in an active dimension, because a university-trained person must be an active participant in the processing and interpreting of information. Information is also collected and made available through such facilities as publications, databases, and libraries.

Just as Indiana University has by virtue of careful planning and stewardship built and maintained impressive physical plants (the campus at IUB has been ranked among the six most beautiful in America), we must make similarly wise investments in our information technology. We have a chance to catch up with, even surpass, historically better funded universities by timely and well-chosen investments in "e-infrastructure."

Information technology goes beyond computers. It includes the networks that connect them, electronic databases and other electromagnetic storage of data, and increasingly, with convergence of media, it includes all telecommunications: not just transmission of data, but also video, voice (and audio generally).

It is interesting to note that there is not a single item relating to the building of information technology infrastructure listed in the Historical Milestones in "Indiana University Facts 1997-98". It would be surprising if this were still to be true when the "Indiana University Facts 2000-2001" is published.

Just as "bricks and mortar" were essential to the architecture of the post-WWII university, "bits in order" are essential to the architecture of the university of the 21st Century. And unlike the old bricks and mortar, information technology does not build walls, it breaks them down. The World Wide Web opens the Indiana University to the world, and the world to Indiana University. It also connects each campus to the community that surrounds it.

This does not mean that information technology will replace the old bricks and mortar. We are not prophesying a "cyber university." At least in the foreseeable future the University still needs well-maintained buildings, and if anything we need more of them to house the space needs generated by information technology. This may or may not be a transitional period, but if it is a transitional period, it is certainly going to be a long one. The usefulness and appeal of a residential campus, of an urban-centered campus, or of community-oriented campuses, are not going to go away over night. But we must think of information technology in much the way we think of bricks and mortar: an absolutely essential part of the university infrastructure that must be built and maintained, with planned capital investments and provision for ongoing expenses.

If there is anything constant about information technology, it is change, even accelerating change. The pace and persistence of change calls for support even greater than might be suggested by the analogy of "bricks and mortar." Just as the need for space is not entirely displaced by information technology, neither is the University's need for people. As Professor Annette Kolodney writes, in *Failing the Future: A Dean Looks at Higher Education in the Twenty-first Century*,

> *"...accelerating technological innovation will transform all aspects of teaching and learning in ways that cannot yet be predicted. What is certain, however, even from the current successes with self-paced computer learning programs and video transmission to off-campus learning sites, is that there is no substitute for the inspiration, rigor, and focus of direct contact between a teacher and her students."*

This plan is predicated on the dual expectations that information technology has the potential to transform higher education, and that research, service, teaching and learning — that is, the vital activities of faculty and students — remain at the heart of this transformation.

# B. Background

Higher education, like the rest of society, is at the beginning of an upward curve in realizing the power of information technology. The Internet began in 1969 with four host computers. This number grew to about 200 in 1979, and to 80,000 in 1989. In about the next three years the number of computers reached 800,000, and in another three years reached 8 million. Since 1995, there have been 22 million computers added to the Internet, of which almost half were added in the last year alone. The amount of traffic on the Internet (email messages sent or Web-pages retrieved) is doubling in volume every one hundred days. The Web itself is estimated to have more than 320 million pages and it is projected that the number of Web sites will increase ten-fold in the next few years. Similar dramatic increases in use and functionality can be found in respect to personal computers, high-performance computers, telecommunications, digital media, information systems, and electronic transactions.

Dramatic technological change will reshape society and its institutions in the next ten to twenty years. The pace of this change is increasing and, as noted earlier, small causes can have great effects. For these reasons, there is urgency to the choices we make about information technology. The paths chosen in the next few years will be critical in setting a direction and trajectory for this institution in the decades that follow.

As we have argued in the Preface, since the essence of higher education is information and the creation and conveyance of knowledge, there is every reason to think that these changes will radically transform colleges and universities. This is unavoidable. But it does not mean that we have no control over our destiny. Indeed, to the contrary, it means that we must plan carefully so as to control events, and not be controlled by them.

These changes will cause a redefining of student, faculty, and staff roles, needs, and expectations, and are likely to cause profound shifts in university functions and structures. Universities that do not plan for the future will fall behind those that do. While IU has a record of information technology planning over the past decade (see Appendix B), the results of these plans have been mixed. In some cases recommendations were acted on, in other cases they were overtaken by events, while in still others there was no action at all.

What IU needs now is a comprehensive plan for information technology, backed by a commitment to action. The need for an IT plan is necessitated by several factors: the acceleration of technological advances, a university-wide planning effort (Strategic Directions) intended to make Indiana University "America's New Public University" (see Appendix C), and recent organizational changes, including the creation of the Office of the Vice President for Information Technology (OVPIT), and the formation of University Information Technology Services (UITS).

Most immediately this plan is a response to the challenge from President Myles Brand for Indiana University to become a leader, in absolute terms, in the use of information technology. This is essential not just for our standing among other universities in information technology, but, given the emerging centrality of information technology, it is essential to the fulfillment of President Brand's "Next Step" vision: "Indiana University must move forward now to the next level until it is recognized as one of the very best of the nation's universities."

It is well to note that Indiana University is embarking on this "Next Step" from a position of already having many comparative advantages, and we should seek to establish a position of technology leadership that is consistent with the institution's strengths. As a small sampling, these include:

- As a public university with a presence throughout the state, IU offers courses and degree programs to nearly 100,000 students on eight campuses and at two extension centers
- As a national leader in distributed education, IU records more than 25,000 student course enrollments annually, through courses offered by correspondence, or using video and Internet technologies.
- As a center of quality teaching and scholarship, IU has 37 nationally ranked undergraduate academic departments and 22 nationally ranked graduate programs.
- According to a recent study by Graham and Diamond, The Rise of America's Research Universities, IU is tied for eighth place nationally among public universities.
- As a premier research institution, IU has 75 research centers and institutes on the Bloomington campus; 10 more on the IUPUI campus apart from the School of Medicine; and 14 others at the School of Medicine.

- In support of teaching and research, the University has 57 libraries in the state representing one of the most extensive systems in the country, with a total of 8 million bound volumes and 17 million other cataloged items.
- As an example of IU's distinction, the School of Music in Bloomington has frequently ranked the best in the United States, and annually sponsors nearly 1,000 recitals, concerts and operas.

While the details are difficult to project, it seems clear that the University will observe and participate in the following changes:

- New ways to deliver instruction are now available, with the resulting ability to reach students in many ways other than the traditional classroom setting. An increasing number of students, faculty and staff will soon need to access information and learning materials while away from campus, and will use more mobile computers that accompany them to campus. Many will depend on the Internet and the Web as a primary communication link and user interface
- The economic viability of many institutions of higher education, including IU, will depend on fulfilling new needs and expectations of students for continuing professional development, lifelong learning, and for increased interaction in the instructional experience.
- The use of modern information systems to transform the business processes of the University to make them more effective and efficient which in turn will lead to institutional structural change.
- The ability of the computer to process and present information and simulations in radically new ways provides unique opportunities for the enhancement of learning.
- Changes in research tools and methodologies in many disciplines and professions have resulted from the spread of information technology throughout the disciplines.
- Radical new ways of writing and disseminating research findings, and related changes in social norms and values, (e.g., publishing on the Web) have important ramifications for faculty work patterns, staff support of faculty, and for our libraries.
- Changes in the patterns and methods of collaboration among scholars, across disciplines and in widely dispersed geographic locations, make new demands on communication and information technologies.
- Distributed education and new expectations of students require new methods of delivering student support services (remotely and/or asynchronously).
- New methods of communication among students, faculty, administration and staff bring vast potential but also raise complicated issues of access, security, and privacy.
- The widespread implementation of networks, personal computers, and other distributed technologies has given schools, departments, and individual users greater control of their own use of information technology; the result is an ongoing dialogue and negotiation of balance among various centralized and distributed IT services and providers.

To achieve a position of leadership, Indiana University must implement an effective strategic plan for the use of information technology in research and academic computing, teaching and learning, and administrative support. This plan must recognize the inevitability and ubiquity, but also the unpredictability, of the spreading use of information technology in higher education.

Information technology is in a state of rapid change. No one would have predicted where we are now five years ago, and there is no reason to suppose we can predict with certainty where technology will be in another five years. For this reason, flexibility and experimentation should guide every phase of information technology planning and implementation. Throughout this process, IU must stay light on its feet! Indeed, flexibility and experimentation are so important that these might well be guiding principles for this entire plan.

It is well to remember that as IU participates in all of these changes (and more), it does so from a position of relative strength. We start with a number of comparative advantages in information technology, including:

- IU ranked among Forbes' Top 20 Cyber Universities.
- IUB ranked by Yahoo! as eighth among the nation's "most wired campuses."
- UITS Knowledgebase ranked by Yahoo! as the BEST site on the Web for providing technical computing support.
- Internet2 charter membership, and partnerships in high-speed national and international networks,

including the vBNS (very high speed Backbone Network Service).

- Fiber optic campus networks on the IUB and IUPUI campuses.
- Unique pioneering Enterprise License Agreement with the Microsoft Corporation that provides Microsoft software to all faculty, staff and students at IU for office and home for the next four years.
- Leadership in high performance computing and advances in virtual reality technologies, with support from the University, private industry, and government agencies.
- Innovative administrative and student information systems, including awards for the Automated Course Exchange system (ACE), student academic advising system (STARNET), and Financial Data Retrieval System (FDRS).
- Pioneering digital library programs, including the Variations music library project and the Victorian Women Writers' Project (recognized by National Endowment for the Humanities as "best of the humanities on the Web").
- Strong academic programs that support information technology, including Computer Science at IUB, the School of Science and the School of Engineering and Technology at IUPUI, the university-wide School of Library and Information Science, programs in the Kelley School of Business and the School of Education, and the programs in Cognitive Science and Logic at IUB.

This plan is not just a plan for University Information Technology Services, but rather a strategic plan for information technology for all of Indiana University. Full implementation of this plan will need more than increased activity and funding for UITS. Much of the implementation will by necessity take place at the school and departmental level, calling for increased activity and funding there too. This fits the distributed nature of information, and is consonant with flexibility and experimentation. But as individual units make their own plans for information technology there should be an institutional expectation that these plans will be shared for review and comment with the UITC who, along with the Campus Computing Center Directors and the campus Information Technology Councils at IUB and IUPUI, can provide an important advisory and review function.

We recognize that this plan implies expenditures well beyond the historic norm, and that full implementation of this plan may be seen as competing with other University needs. The University should continue its efforts to increase revenue streams for information technology. Achieving fully the vision outlined in this plan may depend on increased state and federal funding, and on external partnerships, both national and international, with government, industry, and others in higher education which can help IU advance to a position of leadership in the application and use of information technology.

# C. Process Used in Developing This Plan

In January 1997 Dr. Michael McRobbie was appointed to the newly created post of Vice President for Information Technology (VPIT), with University-wide responsibilities for information technology. In September 1997, two previous technology organizations — University Computing Services at IUB and Integrated Technologies at IUPUI were consolidated to form the new University Information Technology Services (UITS) on both campuses.

In December, 1997, the VPIT implemented a new University-wide committee structure for information technology. The University Information Technology Committee (UITC) was constituted as an advisory committee whose mandate is to advise the VPIT on matters concerning information technology policy at Indiana University. The UITC is a University-wide committee, with the Computer Center Directors Committee and four specialist Taskforces reporting to it. These Taskforces correspond to the four Divisions in UITS and are advisory to the Associate Vice Presidents responsible for the Divisions. The four Divisions of UITS are:

- Teaching and Learning Information Technologies (the TLIT Division)
- Research and Academic Computing (the RAC Division)
- University Information Systems (the UIS Division)
- Telecommunications (the Telecom Division)

Campus-specific focus in this new committee structure is ensured through the IUB and IUPUI Campus IT Councils (which consist of appropriate subsets of IUB and IUPUI members of the UITC and are advisory to the two Campus IT Deans) and through the Computer Center Directors Committee (see Appendix A for membership of all these groups).

President Brand had requested that Vice President McRobbie initiate a process to develop a University IT Strategic Plan by Spring, 1998. Preparation of this Plan was the first charge the VPIT gave those committees. This process began by UITS senior management writing “white papers” for each of the four Divisions. These were used to initiate meetings of the four Taskforces, with the eventual result being reports containing recommendations for each of the four areas. In parallel with those meetings the UITC held meetings both to familiarize themselves with the white papers, to consider general strategies, and to give feedback to the Taskforces on draft versions of the reports. Both IT Councils also commented on drafts of the Plan. The VPIT and senior management of OVPIT and UITS commented on a number of drafts of the Plan as well. A drafting subcommittee was formed from the UITC, and the UITC had a series of meetings to discuss various drafts before approving this Plan.

Nearly 200 faculty, administrators, staff, and students participated in the various committees involved in this process. Web pages were established (http://www.indiana.edu/~uitc/) explaining the committee structure, listing the membership of all the committees, and soliciting input from the Indiana University community (see Appendix A). Articles appeared in the *Indiana Daily Student* and the *IU Home Pages* newspapers, also describing the process and inviting comment. Further input was solicited through memo and email communication with faculty and staff on the campuses. We believe that the recommendations and actions that originated through this participatory process were well debated and should have widespread support throughout the Indiana University community.

As befits as dynamic an area as information technology, it is intended that the UITC (aided by the four Taskforces) should have advisory oversight concerning the implementation of this plan, revising and modifying it as necessary for IU to “stay light on its feet.”

## D. The Goal for Information Technology at IU

President Myles Brand in his 1997 speech, "State of the University: The Next Step," set a challenge for Indiana University to "take the next step in institutional academic excellence and move into the very top tier of the nation's public universities."

As is argued in this Plan, the creation of new knowledge and sharing of information are defining features of a university, and so the goal of excellence in the use of information technology is an essential ingredient in achieving academic excellence.

The vision put forward in this Plan is one in which our advances in information technology help to achieve this overall vision of academic excellence for Indiana University. Information technology will be one strategy among others that must be pursued by IU, but is one that must be pursued with commitment if we are to "move into the very top tier."

The goal of this Plan is for Indiana University to rise to a position of absolute leadership among institutions of public higher education in the creative use and application of information technology.

This goal focuses in particular on the design, development, and application of information technology in support of teaching and learning, research, service, and the conduct of University business.

Toward the realization of this goal, there are set forth in this Plan a number of general recommendations (Section E), followed by a series of more detailed proposed actions (Section F). The timeline of this Plan is intended to cover the next five years (that is the period July 1998 to June 2003). These recommendations and actions are presented in a way to convey many of the interrelationships that exist among them, but no priority is intended or implied by the sequence and organization of these items. The Plan concludes (Section G) with a strategy of cooperation, essential to fulfillment of the recommendations and actions. For the convenience of the reader, Appendix D contains a summary of the recommendations and actions.

# E. General Recommendations

IU's strengths, challenges, and needs require an effective overall strategy that covers the four main areas of information technology: Teaching and Learning, Research and Academic Computing, University Information Systems, and Telecommunications. These are in effect the bricks in our architecture, and this metaphor reminds us that at the same time this strategy must focus on the common structure that these areas share: Sound Fiscal Planning; Access to Network Resources; Institutional Commitment; Support for Student Computing; Digital Libraries and the Scholarly Record; Security, Privacy, and Intellectual Property. We discuss these all, in the process motivating and stating recommendations, which have an over-arching character. Later on in the plan (Section F) we will state more specific proposed actions that follow from these recommendations.

## E.1 Solid Foundation of IT Infrastructure & Sound Fiscal Planning

Information technology is now a fundamental of higher education, internationally and on the campuses of Indiana University. Given the key role of information technology in research, teaching and service, it is no longer responsible to budget for it in an ad hoc manner and to fund it on a crisis basis. Planning for the full cost of technology, including on-going replacement and support, must be built into the budgeting of all units on all campuses. This applies to everything from desktop computers, to classroom technology, to central and distributed systems.

A related issue, which also has fiscal implications, is the University's ability to recruit and retain the technical staff needed to support information technology, in the departments, on the campuses, and in UITS. It is critical to recognize that the information technology function depends upon the skills of technical staff, and that those skills are in demand in both the Indiana regional employment market and nationally where there are an estimated 200,000 vacancies for information technologists.

**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.*

It should be the policy of Indiana University to build life-cycle replacement into its planning at every level of information technology investment (personal, departmental, and central systems, and network hardware and software). It should also be the policy of Indiana University to budget a standard amount per year, per FTE to support life-cycle replacement of faculty and staff computers, and to cover the cost of local support. These policies should be implemented in phases, to account for budgetary realities and constraints, but this phased implementation should begin immediately, in recognition of the seriousness of this need. Further, IU should review the compensation levels for technology staff in all departments and on all campuses, to help assure that technical support is available at the levels needed by faculty, students and staff.

## E.2 Access to Network Resources

Leadership in the use of information technology at IU depends on providing students, faculty, and staff with outstanding access to this technology. The nature of academic work will require faculty and staff to have reliable and high-speed access to the network, on campus and off; from the office, at home, or in clinical settings; while traveling; or wherever they may be working. The transformation of teaching and learning and advances in distributed education will call for network access in classrooms and throughout campus, in residence halls and homes, or wherever students, faculty and staff may work and study.

**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!")*

The five-year goal should be to make the electronic borders between home, community, work place and campus invisible, and at little or no additional cost over current telephone technology. The need for reliable access to network services should guide the development of network services and the mechanisms to fund them; funding mechanisms should not be the primary determinant of what network services are made available. In pursuing this goal we must keep watch on advances in the telecommunications industry that may make remote network access a ubiquitous and competitively priced commodity. Along with access to the network itself, the University should develop and implement technologies (e.g., mass storage, metadata) that will allow students, faculty and staff to store, search for, and easily retrieve information using the network.

## E.3 Institutional Commitment: Faculty and Staff Engagement

Innovative applications of information technology are those which change in some significant way the research methodologies or learning strategies or service models within a given discipline. Disciplines are always open to such transformations, of course, but the information revolution has the potential to change the very way research, teaching, and service are conducted. Such innovative and transforming efforts should be implicitly and explicitly recognized as valued contributions to scholarship and pedagogy at each IU campus, to the various disciplines, and to the University at large. This in turn requires removing disincentives and putting in place a program of incentives to encourage and reward faculty and staff innovation in the use and application of information technology for teaching, research and service.

In particular for faculty, these incentives should include recognition of the transforming role of information technology in statements of policy concerning promotion and tenure. Recognition and reward should be given, not for the simple "use" of information technology in teaching and research, but to acknowledge, as creative activity or creative pedagogy, the transformation of research or teaching within a discipline through information technology.

**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.*

In particular the Deans in each school should ask their faculty policy committees to review tenure and promotion guidelines to see whether they do discourage the innovative use and application of information technology, and refine these guidelines as necessary in a manner consistent with the mission and standards of excellence of the school. Similar attention should be paid to criteria for annual merit reviews for both faculty and staff. As developed and adopted by faculty policy committees, these changes should be reflected in the Faculty Handbook and Academic Guides.

The current systems of faculty fellowships and staff development grants should be reviewed with the idea of expanding them to promote design, development, or innovative application of information technology to instruction, research, or creative activity.

Ways must be found to move faculty and staff along the ever increasing learning curve associated with mastering and keeping up to date with the information technologies relevant to their work. Experimentation should be tried with discipline-specific and peer education, with appropriate UITS staff involving departmental support staff and/or technologically aware faculty in a department (or cluster of departments) to develop appropriate training for faculty and staff. Evidence from Virginia Tech, the University of Iowa, the University of Delaware, and from recent efforts within IU, demonstrates that well-supported training efforts are appreciated by faculty and serve to raise the level of awareness and effective use of technology. The key is adequate funding to support the effort.

## E.4 Teaching and Learning: Content, Access, Distributed Education

Teaching and learning are central to the mission of a university, and information is of central concern to teaching and learning. It is no surprise then that the revolution in information technology is changing the very ways in which teaching and learning are conceptualized by enhancing student access, removing obstacles of time or place, and increasing the level of interaction in learning. Information technology is also the defining characteristic of what is now referred to as "distributed education," meaning, technology-supported learning, provided both on and off-campus, and based on both synchronous and asynchronous communication.

To become a leader in information technology, Indiana University must become a leader in the innovative application of technology to teaching and learning, both for use on its campuses to improve the education that its students receive, and also for external use to share and promote the University's best to new learners.

Achieving this goal of technology leadership in teaching and learning will depend upon advances toward several of the goals outlined in this plan, most especially in the areas of Access to Network Resources, Engaging Faculty and Staff, Support for Student Computing, and building a sound IT Infrastructure.

**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 use of information technology will facilitate and enhance teaching and learning by:

- improving access to the teaching resources of Indiana University,
- eliminating or reducing constraints due to time, place, method of instruction, or format of traditional university calendars,
- supporting and promoting the preparation of quality instructional content for use with information technology,
- fostering greater teacher/student interaction and promoting active student engagement,
- supporting more varieties of instructional formats,
- increasing access to information resources through the library and WWW,
- providing "help desk" services to support asynchronous learning, and
- creating a seamless environment for the development of a genuine distributed learning community for both students and faculty.

## E.5 Research: Computation, Communication, Collaboration

Revolutionary changes in information technology have set the stage for social and economic transformations. These changes, brought about by the convergence of computational and communication technologies, have created entire new industries. Information technology now allows problems to be solved in new ways and human communities to be thought about in a new light. All researchers work in intellectual communities and increasingly one of the most important uses of information technology in research will be to support their collaboration. It is essential that all researchers have access to at least a common base of collaborative technology such as Web access and email and, in addition, that more advanced collaboration technologies are introduced and systematically deployed at Indiana University.

High performance computing has been an area of distinction for IU, and one that can only be maintained through continued attention and support. The University's participation in many national and international research partnerships will depend upon its capabilities in high performance computation and communications. Advances in computing and communication have created increased demands for data storage and management. And underpinning all of this is the need to provide researchers with good software tools and good support services.

**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.*

## E.6 Information Systems: Managing IU's Information Assets

Information technology has become a key component of managing and operating the University's business systems. These systems are no longer back office operations. Ten or fifteen years ago a systems designer could meet face-to-face with every potential user of a new information system. Today the University's information systems are seen and used by tens of thousands of students who access these systems through the Web and thousands more staff and faculty in departments at IU. They are an essential component of the administrative and business affairs of the University in support of teaching, learning, research, and service.

Information itself is a strategic organizational asset for the University and must be carefully managed, and managing the information resources of an institution the size of Indiana University is a huge undertaking. The University Information Systems (UIS) Division of UITS is responsible for the development and deployment of many of the University's business information systems. Although the goal of the institution's information systems is to make it easy for the end-user to execute day to day tasks, the technologies behind these require highly skilled staff for development and maintenance.

However for many years now there has been no overall institutional strategic plan for the implementation and on-going development of the University's central information systems. Systems have been proposed, developed and funded in a basically ad-hoc manner without any overall central prioritization, coordination and planning essential for multi-million dollar, multi-year projects involving scarce and highly sought-after human and financial resources. Consequently the University is becoming over-extended in its ability to continue to develop new information systems.

University-wide prioritization, coordination, oversight and planning are needed for the development and implementation of information systems. Standards are needed for software tools, development methodologies, project management, and computing platforms in order to achieve cost savings and make the best use of resources that are available. Leadership is needed in the implementation of enterprise-wide information systems to help continue the transformation of the administrative units of the University, and to support the goals set forth in other areas of this plan for teaching, research, service and support for student learning.

Although University-wide coordination, planning, and standards will lead to more efficient and effective use of resources, without significant new resources it will not be possible to sustain the development and implementation of the various information systems presently underway and at the same time begin implementation of new information systems.

Having said this, a top information systems priority is a new Student Information System. Such a system will contribute to the University's goals for recruitment and retention. It will enable students to move through the administrative processes required at IU with ease and absence of bureaucracy. Students should not need to understand how the University is organized in order to do this, but should be able to access these services from one virtual environment. Non-traditional students should be able to enroll in, pay for, and begin to take classes immediately. Students today expect this level of service, and soon will be dismayed if it does not exist and does not work flawlessly, on demand, from any place at any time. Staff in University departments must have access to the data created by these systems in order to make informed and intelligent management decisions. Faculty and students need to be able to access student and course information for planning and advising. The University's advances in distributed education will only increase the demands placed upon these systems.

**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.*

## E.7 Telecommunications: Applications, Infrastructure, Convergence

Telecommunications is one of the most important and fundamental technologies in the last decade of this century. It promises to be even more so in the next. It is revolutionizing commerce, industry, education, science and society.

Telecommunications at Indiana University consists of two components: its voice, video and data intra- and inter-campus networks and services, and the connections from this infrastructure to national and international telecommunications networks and services. In a very real sense telecommunications is the "cement" that binds the University together and which binds it to the national and international research community in all academic areas.

Indiana University also has nationally recognized expertise and organizational strengths and skills in the configuration and management of communication networks. These strengths and skills are extremely valuable assets in a particularly competitive part of the highly competitive information technology marketplace.

As such this infrastructure, physical and human, represents a fundamental strategic asset for Indiana University. Harnessed properly, it can make a major contribution to Indiana University's quest for leadership in information technology. Thus it is vital that the University keep control over its telecommunications infrastructure so it can most effectively manage it to maximize its contribution to achieving the University's fundamental goals.

A particularly important challenge for the University is the management of the convergence of traditionally separate technologies of voice, video and data. The dramatic new technology developments in this area promise great savings to the University if harnessed in a timely and effective way. They also promise major new services to the University in a fully converged digital world, as well as new interdisciplinary field of scholarship (e.g., the proposed School of New Media at IUPUI).

**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.*

## E.8 Support for Student Computing

Advances in information technology in areas of teaching, learning, and academic research will depend upon the quality of support provided for student use of computing. In most cases, and this will only increase, students come to campus with an acceptance and understanding of information technology that pushes the institution, through its faculty and staff, to respond. While some faculty and staff may still need to be enlisted in the information revolution, students everywhere are already agents for change. The challenge is to make sure that students graduate from Indiana University having had the advantages and opportunities they need to explore information technology, especially as it relates to their chosen studies.

UITS already has a good record in support for student computing, with computing clusters, support centers, "Jump Start" classes, wiring to many residence halls, etc. IU should continue these efforts and prepare to support students for their increased use of computing and other forms of information technology.

**RECOMMENDATION 8**: *IU must provide the information technology tools, infrastructure and support services so that students may 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.*

## E.9 Digital Libraries and the Scholarly Record

The transformation of teaching and learning through the use of information technology also entails the transformation of scholarly literature and learning resources through the widespread implementation of electronic journals, online databases, digital libraries, and other networked information services. Academic research is integrally involved with access to information and the creation of the scholarly record. While it is tempting to view the Web as the new paradigm for knowledge acquisition and distribution, this volatile collection of community culture was never designed to be the next evolution in research resources.

There is a science to the management and mining of information, and the library is the heart of this enterprise. The nexus of the next revolution will not be based on Web technology alone, it will be based on tools that integrate intelligent knowledge acquisition systems with the ingenuity of the individual scholar, teacher, or learner who has access to a well catalogued, distributed, national digital library. In this process there will develop a new role for the academic librarian as information agent and information broker, working across many traditional boundaries of organizations and scholarly disciplines, providing a service to faculty and students by connecting them with the information resources they need for research, teaching and learning. The professional expertise of librarians in the IU Libraries and of faculty in the School of Library and Information Science will be invaluable in this transformation.

**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.*

## E.10 Security, Privacy, Intellectual Property

Security and privacy are important issues for IU to address in achieving a position of information technology leadership. Computing and network technologies have the ability to make local information available worldwide, and to access locally information from almost anywhere in the world. It is essential in this environment to both promote access to information and freedom of discourse, while ensuring personal privacy and protecting the intellectual property rights of individuals and other rights-holders. During 1997 the VPIT carried out a comprehensive University information technology security audit, the first of its kind ever done at IU. At the direction of the President the VPIT is presently implementing the recommendations of this audit.

The security of information and information technology is a university-wide concern, requiring a university-wide response: institutional vision and commitment, clear and forceful policies, appropriate plans and procedures, and ongoing programs of education and awareness. The OVPIT must take a continuing active role in leading and coordinating this university-wide initiative; the President and leadership at the highest levels of the institution will need to engage and support these efforts.

**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.*

# F. Proposed actions

## F.1 Solid Foundation of IT Infrastructure & Sound Fiscal Planning

Information technology has become fundamental to teaching, research, and service at Indiana University and throughout higher education. It is no longer responsible to budget for it in an ad hoc manner or to fund it on a crisis basis. Planning for the full cost of technology, including ongoing replacement and support, must be built into the budgeting of all units on all campuses. This applies to everything from desktop computers, to classroom technology, to central and distributed systems.

The University should take as guiding principles for funding information technology services:

- to use central funding to raise the baseline as high as necessary for widespread access to computing and communication technology, and support services;
- to use central funding for exemplary or innovative applications that advance the state of practice in teaching and research at IU;
- to thoroughly explore collaboration, partnership, and joint funding of information technology initiatives that serve targeted needs (e.g., to match central IT funding with support from the individual departments, schools and campuses, or to supplement IU resources with funds from external agencies).

### *Life-Cycle Replacement Planning*

Success at using information technology requires not just a one-time investment but constant updating of hardware, software, methods, and support models.

**ACTION 1**: *The University should build life-cycle 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 life-cycle replacement model to use where needed in conjunction with its investments in information technology. Implementation should begin immediately, with full funding of life-cycle replacement phased in over a fixed number of years.*

A phased implementation of this action is proposed, to acknowledge budgetary realities and constraints. This model should incorporate plans not only for replacement of today's technical capabilities, but for the ongoing increase in computational power and communication bandwidth.

### *Faculty and Staff Base Support*

In the near future, if not already, information technology will be just as vital to the attraction, support, and retention of top faculty and staff as are traditional considerations like competitive salaries, fringe benefits, offices, research and teaching support, telephones, and parking spaces. At present, though, it is treated on a very ad hoc basis. The University could provide real leadership in higher education by adopting the following proposal.

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

As an EXAMPLE ONLY, an allocation of approximately 2500-5000 dollars per year, per faculty and staff member could provide for a three-year replacement cycle of desktop computer hardware, provide some support for software purchases, and help underwrite the cost of local support in most academic departments. This amount does not cover the full cost of support, in particular it does not cover the expense now paid for by UITS in providing central support and training for local support providers, but it should assist schools and departments in providing their own component of local support. Neither is this a new expense; in one way or another, individuals, departments, and campuses are paying the cost of local support and the cost of ongoing equipment replacement or upgrade, or they are suffering the consequences of not replacing or supporting their investments in information technology. In order to meet this goal, many units would need access to new resources.

These actions address issues of access and future replacement funding. However they do not address the problem of modernizing the University's existing stock of computers so that researchers and academics as well as staff and students across the whole University all have machines that are Web and multimedia capable and hence capable of supporting a base level of activity.

There are still significant numbers of machines throughout the University that are not Web capable and these should be replaced as soon as possible. This is also essential if full value is to be realized from the Microsoft Enterprise License Agreement. This agreement provides, and will continue to provide, the most current release of Microsoft software and operating systems for all faculty, staff and students. However as of the date of this Strategic Plan, an Intel Pentium class machine or its equivalent is required to most effectively run the most current release of Microsoft software (and software from many other companies). Thus it should be the University's aim to raise its current inventory of computers to this level, and through life-cycle replacement planning, to keep these computers at an appropriate technology level.

**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.*

### *Information Technology Staff and Skills at IU*

It is critical to recognize that the information technology function depends upon the skills of technical staff, and that those skills are in demand in both the national and Indiana regional employment market. As a result, it is important for IU to provide a high quality of institutional life to the IT staff (in UITS and in departments), for this is part of what will attract them to IU, and keep them at IU, and not seeking opportunities in the private sector. IU must also remain marginally competitive with regard to compensation, as significant salary discrepancies cannot be easily overcome with quality of workplace benefits alone.

**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.*

Total compensation calculation should include such IU benefits as extensive paid time off (PTO) and retirement benefits (TIAA-CREF), as these compensation elements are usually not as good in the private sector.

## F.2 Access to Network Resources

Access is one of the critical success factors for IU to become a leader in the use of information technology. Traditionally, access to the network from off-campus has been constrained by the number of phone-lines and modems available. New technologies will replace those of today, but the fundamental concerns will remain: that students, faculty and staff have around-the-clock and remote access to the University's network resources.

### *Access for Students, Faculty and Staff*

The nature of academic work — teaching, research, and service to the institution — will require faculty and staff to have reliable access at appropriate bandwidths to the network from the office, at home, in hospitals and clinics or from other locations remote from the campus, and while traveling. Student access to computing and networked information resources and services is the key for the transformation of teaching and learning through technology. Students must be able to engage in learning, not only in the classroom, but also from other locations on campus, from their homes, in their residence halls, or at their workplaces. Clinical students and others need access to the network while learning in the field, which may require access from multiple locations in a single day. For urban and regional campuses, network access is needed to reach learners where they seek to learn. On every campus, network access is becoming a minimum expectation of students, and is critical to IU's ability to compete.

**ACTION 5**: *The University should provide students, faculty and staff with reliable access to computing, data storage, information and network services, on the campuses and off.*

Access should be available at a much-improved rate of successful connection (Stated in terms of today's technology, "No busy signals!"), and at appropriate bandwidths. Access should be available for network-connected computers and personally owned portable computers, and should include support for mobile computing. Improved access is needed to electronic resources, such as a core of online textbooks and journals, and links from indexes to these resources for better retrieval (see Section F.9). Access is also needed to University information resources such as may be maintained in large-scale massive data storage systems (see Section F.5).

## F.3 Institutional Commitment: Faculty and Staff Engagement

Information technology is having a transforming effect on higher education. The ability of a university to fulfill its fundamental missions of teaching and research is increasingly dependent upon information technology. Academic leadership will increasingly require leadership in information technology. In order to achieve this goal, Indiana University, its departments, and its individual faculty and staff members must become agents for change, actively engaged in the design, development, and innovative application of information technology in teaching and research. And, in many instances, this will involve work that crosses traditional disciplinary boundaries.

### *Faculty and Staff Engagement*

Creative applications of technology are those which change in some significant way the research methodologies, learning strategies, and service practices within a given discipline. Disciplines are always open to such transformations, of course, but the information revolution has the potential to change the very way research, teaching, and service are conducted. Such creative and transforming efforts should be implicitly and explicitly recognized as valued contributions to scholarship and pedagogy at each IU campus, to the various disciplines, and to the University at large. This in turn requires removing disincentives and putting in place a program of incentives to encourage and reward faculty innovation in the use and application of information technology in the transformation of higher education.

These incentives should include:

- recognition of value in statements of policy concerning promotion and tenure; and
- encouragement, in the form of faculty fellowships and staff development grants to support the design, development, and innovative application of information technology in the teaching, research, and service missions of the University.

Recognition and rewards are given for excellence in teaching, research, and service. It is not being advocated that rewards be given for the simple "use" of information technology in these activities, but rather that recognition be given to acknowledge the achievement of excellence in teaching, research or service within a discipline through information technology.

### *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.*

Specifically:

- the tenure and promotion process should recognize, as a form of creative activity, outstanding faculty contributions to the design, development, and innovative application of information technology in research, in scholarship, and in the arts;
- the tenure and promotion process should recognize, as accomplishments in creative pedagogy, outstanding faculty contributions to the design, development, and innovative application of information technology in teaching and learning; and
- the tenure and promotion process should recognize outstanding faculty contributions to the design, development, and innovative application of information technology that advance the state of practice in the category of service.

The faculty councils and Deans of Faculties can aid in this process, helping to standardize and codify these changes. The successful inclusion of these factors in the tenure and promotion guidelines of the IUPUI campus may serve other units as a model of this recognition.

### *Fellowships and Development Grants*

Faculty are generally focused on their students and their disciplines, and not the innovative uses of information technology in their teaching and research. Staff are similarly focused on their assigned tasks. The design, development, and application of information technology competes for time, and the current reward structure of the University generally penalizes, rather than rewards, the investment of time in creative uses

of information technology. Also, there are often disincentives for interdisciplinary work, which is entailed in these information technology developments. There is an issue of short-term personal advantage versus long-term institutional pay-off, and the proper balance is needed to provide time and rewards for explorations of information technology.

**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.*

Other programs of development grants, equipment grants, or other incentives which may serve as models or examples include the Faculty Instructional Development program at Virginia Tech, the program in IU's School of Nursing, or the recent Computers in the Classroom project in COAS.

### *Staff and Faculty Support*

Technical support staff are essential to the successful diffusion of information technology throughout the University. The prime purpose of the UITS Leveraged Support Model is to increase the availability of local technical support in the schools and departments. A serious problem exists throughout the University in providing enough support to individual departments to help them maintain their computing resources. Very little support is available from the schools and departments and many of these local facilities are not managed very well. Not only is this a serious economic problem for the University, it is also a serious security concern. While the Local Support Provider system is good, more training is needed for both faculty and staff. Further, as noted in Section F.1, many units would need new resources to properly support their information technology needs.

**ACTION 8**: *Schools across the University should be encouraged to provide more resources for maintenance and training for departmental 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.).*

It is equally important that central IT support staff be accessible to users, that they work in conditions conducive to productivity and service (the working conditions for UITS staff at IUPUI are especially in need of attention), and that all staff have access to the ongoing training they need.

**ACTION 9**: *Specific action should be taken to locate improved workspaces for UITS staff at IUPUI, and to bring UITS staff at IUB onto campus, thus making them more accessible.*

And more generally, as a guiding principle, UITS should locate technical and support staff in office locations that are accessible to the campus faculty, students and staff, and are conducive to productive work, in order to help the University leverage its investment in information technology and in UITS. It is important too that all University staff who work in the area of information technology receive the training and education they need to stay current in this field and provide effective service.

**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.*

Such education should be subsidized institutionally and made available at no charge to departmental IT staff. Where possible, UITS should seek out partnerships with leading technology vendors to bring professional education, testing, and certification to IU IT support staff.

## F.4 Teaching and Learning: Content, Access, Distributed Education

The first computers brought to Indiana University were used for scientific computation and for administrative systems. Higher education in general, and IU in particular, have a long history and impressive track record in the use of information technology to support academic research and information systems. On the other hand, technology for teaching and learning is still in the early stages of development, both here at IU and at colleges and universities across the country. The recommendations following seek to capitalize on this opportunity to advance IU into a position of leadership in the innovative application of information technology for teaching and learning.

The central importance of this to the University was recognized in the formation of a Teaching and Learning Information Technology (TLIT) Division in UITS as part of the VPIT's reorganization of information technology at Indiana University.

### *Content Development*

The Report to President Clinton on the Use of Technology to Strengthen K-12 Education in the United States pointedly observes that "There is widespread agreement that one of the principal factors now limiting the extensive and effective use of technology within American schools is the relative dearth of high-quality computer software and digital content designed specifically for that purpose." While this comment was aimed at the K-12 area, especially the secondary schools, it applies at least as much in higher education. If IU is to be a leader in the use of information technology in higher education, it must be a leader in helping to overcome this obstacle.

Indiana University and its faculty offer many courses and several degree programs that currently make use of basic information technologies for communication, presentation, or information access. There are a smaller number of courses and programs in which a closer coordination of content and technology has substantively altered the educational experience. And there are many courses that might benefit from information technology, but in which faculty may not have had the chance to explore that possibility.

It is important that where high-quality content material already exists, faculty have easy access to it. It is also important that where content does not currently exist, but there is faculty interest and expertise, such material is developed and put in place that is suited to the intellectual content and learning objectives of a given course. And at the same time, it is important that all faculty have access to a baseline of communication and presentation technologies, which are becoming so commonplace as to be considered standards. The Microsoft Enterprise License Agreement will make a significant contribution toward satisfying this need.

The goals for teaching and learning information technology should include:

- To improve the standard level of baseline support for the use of teaching and learning technology available to all faculty.
- To continue to provide, and increase the number of opportunities for faculty to explore the potential applications of information technology to their own teaching.
- To promote the introduction of teaching and learning technology to courses and disciplines that may not have previously had access to information technology.
- To support the application of teaching and learning technology in cases where course content is especially suited to, or may be substantially enhanced by, the use of information technology.

One of the impediments to the use of information technology in teaching and learning is the scarcity of good IT-based course materials. The traditional textbook model for the development of such materials just does not work. What is needed is the academic leadership paired with sound technical assistance of varying degrees. Faculty need a broad range of support to help them find or develop tools for their courses. They simply cannot do it alone, but no one else can do it for them without their help.

IU has two units that have served it well in this regard, the Teaching and Learning Technology Lab at IUB and the Center for Teaching & Learning at IUPUI.

**ACTION 11**: *The Teaching and Learning Technology Lab and the Center for Teaching & Learning should be expanded, and new services developed where needed, to offer a standard level teaching support services for all faculty at IUB, IUPUI, and the regional campuses.*

This includes help in finding existing courseware, and help in using WWW, Web tools, and other routine instructional tools. This help should be available in a variety of formats, including online help, a Teaching & Learning Knowledge Base, short courses, consultation, including on-site or in-office consultation.

**ACTION 12**: *To support course tools development and initiatives in distributed education, UITS (through its Advanced Information Technology Laboratory) should evaluate Web-based and other network-based learning environments and offer faculty a comprehensive set of options to easily create, edit, revise and maintain online course material.*

**ACTION 13**: *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.*

This more intensive support would be offered by a partnership of instructional design, faculty development, and technology support units of IU. Cost/benefit calculation and other review of merit should guide selection (e.g., project feasibility, educational benefits, market potential, reputation of individual or unit, estimated cost and cost sharing, etc.). Multiple long-term projects may be in progress at any one time, where a long-term project is one that takes anywhere from a person-month to several person-years to complete.

These intensive development projects will produce instructional material of value to the individual creators and to the University. Policies and guidelines need to be developed that protect the interests of all parties and facilitate cooperative agreements.

**ACTION 14**: *The University should provide overall guidelines and direct support to help facilitate relationships with publishers for the commercial development and marketing of technology-based instructional materials.*

Guidelines should address issues of intellectual property ownership, incentives and fair compensation, recognition of accomplishment, and others. These guidelines should build on the University's May, 1997 Intellectual Property Policy (http://www.indiana.edu/~rugs/respol/intprop.html), and should take into account technological support provided by departments and/or schools to facilitate such innovative learning products.

One example of intensive course development or focused investment might be in science courses for non-majors, specifically the development of simulation-based laboratory courses that can provide non-majors with the learning experiences of the laboratory but at a lower cost to the teaching department. Similar examples employing simulation and visualization may emerge in such areas as the performing arts, health sciences, or others.

**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.*

## *Basic Skills Courses*

Education in basic skills provides a concrete example of how teaching and learning can be advanced through the application of information technology. Each year Indiana University enrolls several thousand new students who are simply not ready to take standard college level courses, especially in English and mathematics. Retention of and success for these students is unlikely unless IU prepares them to take the course or courses required for their degree program. There are now a number of computer-based commercial systems in use at other universities, which claim to have great success at efficiently solving this problem. A similar opportunity exists in foreign language instruction, for students who arrive at IU with various levels of language competency.

**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.*

In particular, the University should fund the IUB and IUPUI Departments of Mathematics to allow them to implement pilot programs to determine whether these systems could be used successfully in classes throughout IU, and perhaps in high schools and middle schools throughout the state. This program should over time expand to include basic skills in foreign languages or other disciplines. UITS should assist in the study and evaluation of these systems. These initiatives can provide IU with a proving ground for the new technologies of distributed education.

## *Distributed Education*

Information technology, especially network technologies like the Internet and WWW, have begun to blur the distinction between classroom based education and distance education, with "distributed education" encompassing both. The same array of teaching and learning technologies should be available for local or remote learners - in campus classrooms or residence halls, at students' homes, or in the workplace - to be chosen as appropriate to the instructional needs, and not constrained by location. New academic programs developed as a result of IU's distributed education initiatives offer opportunities to experiment with new organizational models for supporting teaching and learning technology.

The report of the President's Advisory Committee on Distance Education and the newly announced position of Associate Vice President for Distributed Education will provide a focal point for these efforts, in particular encouraging and managing new initiatives and coordinating distributed education activities to facilitate

creativity and avoid duplication. New distributed education initiatives that focus on reaching University alumni are among the proposals advanced in the report of this Advisory Committee. The TLIT Division of UITS will be an important partner in these initiatives, providing technology support to distributed education, and helping to define the organizational arrangements needed to advance the goals of distributed education. In turn, the Distributed Education program and the School of Continuing Studies will provide the TLIT Division with a proving ground for innovative uses of technology in instruction.

In several disciplines (for example, in the School of Education, and in Medicine, Nursing, and other health professions), in the School of Continuing Studies, and through the Community Learning Network at IUPUI, there are already thriving programs of distributed education, making use of asynchronous delivery of instruction, or conducting classes and training in multiple remote locations. Many of these programs entail complex arrangements (involving faculty, students, and staff in multiple teaching locations, with interrelated schedules), all of which could best be addressed through coordinated efforts, rather than ad hoc or one-off efforts.

**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.*

**ACTION 18**: *UITS should ensure an available and reliable infrastructure of networks, servers, storage, and applications for the support of online courses and other new learning experiences.*

Distributed education reflects new expectations on the part of students who will want to conduct business with the University from remote locations, and at the times of their choosing. This is addressed by actions proposed in the section on University Information Systems (Section F.6), and by the following.

**ACTION 19**: *UITS should initiate changes to university information systems that improve the quality of instruction, service to students, or manageability of the distributed education program itself.*

### Support Models and Technology for Instruction

UITS has developed a model for general computing support, called the Leveraged Support Model (LSM), which shares support responsibilities among central technology staff, staff on the campuses and in the departments, and online support resources (e.g., online help via the Knowledge Base). The LSM has been quite successful in moving support into the departments and units where it is needed and can be deployed most effectively. (See Section F.3.) However, the LSM can only work if the leveraged units have the willingness and the resources to pick up the costs of the program as it proves successful. Some units do not have these resources.

**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.*

This model allows for the aggregation of the University's technology resources through contributions of central and distributed support, and should encourage the type of partnerships that this report recommends. Key to the success of this proposed action will be adequate funding of both the central and distributed components of the support model.

### Classroom Technology

While much has been done to improve the access to technology in IU's classrooms, much remains to be done. On some campuses or among some faculty the small number of IT-enabled classrooms available make it difficult or impossible for faculty to even gain access to the technology that might enhance their instruction. This problem is made worse by overall limits on the amount of teaching space available. For some years there have been discussions at IUB and IUPUI of the need for new classroom buildings, and for facilities that incorporate technology for instruction. Examples of such state-of-the-art facilities include the Media Union at University of Michigan, and the Edward J. DeBartolo Hall at Notre Dame.

While new teaching facilities would help address the problems identified, this solution would take time. UITS has participated with others in plans for classroom renovation on the IUB and IUPUI campuses. Some, but not all, of these renovation plans have been allocated funding, but in general no funds have been allocated for the information technology component of upgrading these classrooms.

**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, life-cycle 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.*

To implement this latter proposal, UITS should continue to support campus planning efforts for improved access to information technology in classrooms, and should be represented in all future building and renovation plans. UITS and the Electronics department need to significantly strengthen their working relationship concerning classroom technology planning and support on the IUB campus. UITS and other campus support units should collaborate with the campus registrars to assure optimal use of information resources within classrooms.

### *Training and Development for Faculty and Staff*

As Indiana University develops the resources to provide IT-enhanced instruction to its students, some attention should be given to leveraging these resources for the benefit of all university employees. Similar technologies and methods that improve the learning experience for students will support the training and development needs of staff and faculty.

**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.*

### *Evaluation and Assessment*

As it makes ongoing decisions about a diverse array of information technology applications, the University should also assess what it is doing, what others are doing, and how it could do things better. Current programs of assessment and evaluation can be built-upon, or new programs might be supported, toward the goal of assuring that decisions for teaching and learning technologies are fact-based and fundamentally sound. Proven findings of such programs can be fed back to campus planning processes for more wide-spread implementation.

At the same time, the University must be responsive to a diverse array of influences, not all of which may be immediately tracked through assessment and research: innovations in technology, changes in government regulations, shifts in the higher education market place, and so forth.

Assessing technology-mediated teaching and learning should examine a range of measures, including student and faculty outcomes, as well as cost and effectiveness. Above all, technology must serve the needs of pedagogy, and for this reason assessment of teaching and learning with technology intimately involves instructional design. The intent of these proposals is to provide leadership and to engage partners in a continual assessment of teaching and the learning environment.

**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.*

Members of this group should represent the range of constituencies with a stake in teaching and learning technologies. Their role will be to advise those who actually undertake assessment projects. For example, assessment of learning outcomes should be the responsibility of the faculty, the Schools, and the Deans of the Faculties. Technology evaluation, usability, and service satisfaction, on the other hand, should be the responsibility of UITS.

**ACTION 25**: *Faculty who participate in university-funded programs which 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.*

Programs of faculty support for innovative uses of technology are proposed elsewhere in this document, in the context of institutional commitment (Recommendation 3). A final report and evaluation of the project, produced by the faculty member, would be a part of all such programs.

**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.*

Applied pedagogical research should be closely coordinated with technology research and development provided by the TLIT Division, the Advanced Information Technology Laboratory, and other related groups.

## F.5 Research: Computation, Communication, Collaboration

The revolutionary changes in information technology in the last decades of the twentieth century have set the stage for numerous, profound social and economic transformations of culture. These changes, brought about by the confluence of computational and communication technologies, have created entire new industries. Information systems now allow problems to be solved in new ways and human communities to be thought about in a new light. Intellectual life is no less affected. Research in all areas of science and engineering has been transformed by information processing power. Scientific computation has risen to be a peer with theoretical and experimental analysis in most science disciplines. Also, the impact on design, art, music and journalism of new technologies has created new academic programs like the proposed School of New Media at IUPUI. Similarly, the transformation of the American workplace into an information economy has had a profound effect on many Schools within the University.

Indiana University has academic research areas that involve research in information technology itself, it has other research areas that deeply involve information technology as a tool in research, and it has some areas where the full impact of information technology has yet to be felt. Access to modern information technology is not uniform across Indiana University. The use of computer and networking technology that is commonplace in some departments and laboratories is out of reach to many others. Any plan that seeks to raise the level of support for the integration of new information technologies into research should seek to raise this level broadly, across many disciplines. Different disciplines place different demands upon information technology, but all should have access to technology support appropriate to their research needs.

The goals for research and academic computing should include:

- improve the standard level of base-line support for the use of information technology across all disciplines;
- provide the infrastructure needed by those disciplines that are already heavily invested in information technology and need to keep up and expand;
- encourage the exploration of new technology in disciplines where the cutting edge of research is intimately tied to advances in computing;
- promote the introduction of new technology in disciplines which would greatly benefit from it, but which may have previously not had access to, or made use of, information technology.

Key to the success of these technologies will be the kind of support provided by staff from the Research and Academic Computing (RAC) Division and the Advanced Information Technology Laboratory (AITL) at UITS.

### *Collaborative Technology*

All researchers work in intellectual communities and communities of practice; a fundamental feature of this work is collaboration, across disciplines within a single institution, and on a global scale within these widely distributed communities. Increasingly one of the most important uses of information technology in research will be to support worldwide distributed collaboration.

There are many important and fundamental changes that can be enabled by an increase in our ability to communicate. Research that involves groups that are distributed across our many campuses can work together in ways they cannot now. For example, new interdisciplinary teams can be formed. Researchers at the School of Medicine will be better able to work in collaborative teams with colleagues in biology, information science, psychology, chemistry and other disciplines in ways that have, until now, been impractical. The very nature of research collaboration can and will change.

It is important to note that this collaboration technology can reach well beyond the boundaries of the University. The Kelley School of Business is already involved in extensive electronic collaboration with corporate partners that share data as part of joint research ventures. In Indianapolis, the proposed Research and Future Parks are ideal places where both private industry and the public could interact with research from across all of IU by means of collaboration technology.

At present, the Web is the most dramatic example of collaborative technology, but there are others less visible such as news groups and email, now essentials of academic life. However all this provides only a basic very primitive approximation of the highly interactive activity that characterizes collaboration. True distributed collaboration will involve technologies that provide the ability to share and edit documents across vast distances, to be able to see and talk to collaborators on the other side of the earth and to interactively explore data and simulation based on remote servers. And beyond these technologies lie virtual "collaboratories" of whole distributed communities of researchers working together on common projects.

Given this vision, it is essential to ensure that all researchers have access to at least a common base of collaborative technology such as Web access and email. In Sections F.1 and F.2 it is argued that information technology is fundamental to the academic work of faculty and students, and that funding to enable and support access to this technology should be provided in the budget base. The Microsoft Enterprise License Agreement provides all faculty, students and staff access to the current versions of several software products such as Visual Studio that make up this common base.

In addition, there are collaboration technologies that are standard tools in the private sector and other research institutions that have yet to be systematically deployed at Indiana University. For example, feature-rich email systems like Microsoft's Exchange, distributed notes software, desktop and small group videoconferencing, multi-user virtual environments, and shared file systems and servers.

**ACTION 27**: *UITS should launch an aggressive program to systematically evaluate and deploy across the University state-of-the-art tools and infrastructure that can support collaboration within the University, nationally and globally.*

Beyond these technologies lie a further group of advanced technologies that will support even more realistic and complex collaboration. These include virtual reality, teleimmersion, haptic devices, wearable computers and so on.

IU has already joined the ranks of a select group of research organizations that are exploring these next generation distributed collaboration technologies. Working with the University of Illinois at Chicago, Argonne National Laboratory and others, IU is exploring the use of fully immersive 3-D VR environments such as CAVEs and ImmersaDesks at IUB and IUPUI. These immersive technologies use the NSF's very high speed Backbone Network Service (vBNS) network to interconnect the VR devices at these sites to allow participants at remote sites to "join" a local group in a seamless exploration of virtual environments that can be tailored to the task at hand. Another example of an advanced collaborative environment is the Department of Chemistry's StereoView Room.

**ACTION 28**: *UITS should explore and deploy advanced and experimental collaborative technologies within the University's production information technology environment, first as prototypes and then if successful, more broadly.*

One aspect of this challenge over the next five years might be to transform a researcher's office into a virtual "collaboratory." This might initially take the form of several, digitally supported, collaboration studios or laboratories conveniently located across the campuses. Each might be modified to enhance the interactions of its most frequent users. These small satellite clusters would facilitate the collaboration of five or six persons engaged in team research or creative activities.

### *Computational Resources*

Indiana University has had a long tradition of centrally supporting numerically and non-numerically intensive computation that is beyond the resources of any one department or school to support. IU's current high performance computing resources are comparable to the best in the CIC. The University has a world class SGI/Cray system and a substantial IBM resource that may be improved very soon with support from IBM. IU is weak in the area of clustered NT systems, but efforts are underway to improve this. However such resources are in constant need of upgrading if IU is to maintain a leadership position in this field.

**ACTION 29**: *In order to maintain its position of leadership in the constantly changing field of high performance computing, the University should plan to continuously upgrade and replace its high-performance computing facilities to keep them at a level that satisfies the increasing demand for computational power.*

High performance computing also plays an important role in the use of advanced data gathering technologies, such as the use of remote instruments or instruments that produce large amounts of primary research data. The use of these instruments, and the data obtained thereby, are making new demands for research computational power.

### Visualization and Information Discovery

Many of the techniques developed in the high performance computing and communications community are expanding in usefulness to the broader academic research community. In many disciplines software packages in visualization, simulation, data mining and data streaming, are emerging where at least in principle, the more the computing power is scaled up the better, quicker and more insightful are the results that can be obtained.

**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.*

Advanced simulation and virtual reality technologies (of which the CAVE and ImmersaDesk are examples) can play a crucial role in the visualization, representation and discovery of information.

### Computational Grid

The ability to build up and interconnect these resources is crucial because the individual researcher ideally does not want to know where his or her computing power is coming from, only that it is available on demand and in sufficient quantity. This in turn suggests the need for a "computational grid" (an analogy with the power grid, in which the resource is shared, distributed, and re-routed among a widely-dispersed group of users) where computing power is available as a utility.

It is critical to understand that the development of a computational grid is not the blue-sky idea of computer scientists. Rather there is a major national effort going into solving the problems to establish such a grid. The NSF has effectively put most of its High Performance Computing and Communications (HPPC) Centers budget ($70 million yearly) into this. The establishment of a national computational grid is the explicit central aim of the new National Computational Science Alliance (NCSA) consortium and a major aim of the National Partnership for Advanced Computational Infrastructure (NPACI) consortium that developed out of the San Diego Supercomputer Center. The total budgets of these two efforts probably total around $150 million per year. Through the efforts of faculty in the Computer Science Department at IUB and staff in UITS, IU participates in the work in this area being done at NCSA.

Today, the network ties desktop and high performance computing resources together. However, in many ways workstations remain isolated from each other with separate file systems and, with the exception of email and Web browsers, few applications are "network aware." This network of resources can ultimately be integrated together to form a seamless computational grid. Additional components of a computational grid would include:

- A uniform file system that spans the entire university network.
- A computational environment where software can be configured to run on a supercomputer as easily as on a laptop. Users see the grid as the resource and are not concerned with how the software is executed.
- Mass storage systems that are a transparent extension of normal local file archives.
- Specialized software resources, such as geographical information systems, can be made available to a wider group of researchers with less duplication and easier maintenance.

The IU network (IUnet) provides interconnection among university computers, and the university provides marginal access to this network from off campus. However, through the national initiatives mentioned above, this network will evolve into an entity that is as ubiquitous as the phone and power grid. Researchers will have access to private and shared information space and processing resources wherever they are located.

**ACTION 31**: *The University should plan to evolve its high performance computing and communications infrastructure so it has the features to be compatible with and can participate in the emerging national computational grid.*

### Massive Data Storage

Advances in the application of high performance computing to research have been accompanied by massive increases in the amount of data gathered and stored from even a single experiment. For example, researchers in Geology will be collecting earthquake data from 1000 state-of-the-art seismic stations in California. This huge project will yield remarkable new results on how earthquakes work and how seismic waves

propagate in the earth. Data streams from this array of sensors should be configured to automatically deposit information into a mass storage system that would be part of our grid of computational resources. Astronomy, high energy Physics, and other disciplines are creating similar demands for data storage. This problem is not unique to research computing. The University's administrative information systems also call for high-volume and long-term storage of institutional data (see Section F.6). The University's digital library initiatives will make similar demands for long-term, high-volume storage of data (see Section F.9).

**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.*

It will be critical, too, for users to be able to search for, locate, and retrieve information that is kept in this massive data storage system. Concurrent with implementation of the hardware and software, there should be attention given to the cataloging and description of information that is placed in the mass storage system, and the development of both policies and technologies to help the institution manage these information assets.

### *Research Software Support*

Database systems are becoming much more widely used in research and scholarship. More support needs to be provided for these systems. Additionally there is an increasing demand for support of software for text markup, text analysis, and text manipulation. Included in this category are software products for manipulating and representing texts in foreign languages and alphabets. Text-oriented software is available in some locations (e.g., Library Electronic Text Resource Service at IUB), but is not generally available to scholars on all campuses of the university. There is also a continued demand for support of software for statistical and mathematical analysis. Here too, software and support are available in some locations (e.g., the Stat/Math Center at IUB), but are not generally available on all campuses of the University.

**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.*

### *Research Initiatives in Information Technology*

The emphasis of this plan has been on the creative design, development and application of information technology. These depend upon fundamental advances in information technology research. IU is fortunate to have academic programs engaged in information technology research. Among them are Computer Science at IUB, the School of Science and Engineering at IUPUI, the university-wide School of Library and Information Science, various programs in the Kelley School of Business and the School of Education, and the programs in Cognitive Science and Logic at IUB. It is important that IU support faculty involved in research in information technology itself, and research that pushes the limits of today's information technology, both of which are by their nature often speculative and expensive.

But IU cannot accomplish all of these tasks in support of the research faculty with resources provided solely through State support. Fortunately there are new federal programs that have recently been put in place that should be a component of the University's planning. The National Science Foundation has released an agency-wide initiative (Knowledge and Distributed Intelligence) that addresses many of these concerns. This and many other leading-edge research initiatives involving information technology call for interdisciplinary collaboration. The University should make every effort to take advantage of opportunities such as this and to extract maximum leverage out of its substantial investment in UITS and information technology infrastructure more generally.

**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.*

## F.6 Information Systems: Managing IU's Information Assets

Information technology has been used for administrative systems at IU since the mid-sixties. Over the years these systems have evolved from being used by a small group of operational units to serving a global audience made up of tens or hundreds of thousands of users who are conducting business with, or seeking information about, IU. The function of transforming the business processes of the University requires

sophisticated state-of-the-art information systems. The University Information Systems (UIS) Division of UITS is responsible for the development and deployment of many of these systems.

While it is a goal of IU's information systems to make it easy for the end-user to execute day to day tasks, the technologies behind these systems are complex and depend upon a highly skilled staff. These systems are developed through a defined life cycle, from requirements analysis and system design, through programming and user testing, to implementation and ongoing maintenance. Systems development activities have over the years resulted in a variety of disparate software, some built and some purchased, on a wide variety of different computer hardware platforms, all of which must operate together.

For many years now there has been no over all institutional strategic plan for the implementation and ongoing development of the University's central information systems. Systems have been proposed, developed and funded in a basically ad-hoc manner without any overall central prioritization, coordination and planning essential for multi-million dollar, multi-year projects involving scarce and highly sought-after human and financial resources.

Consequently the University is becoming over-extended in its ability to continue to develop new information systems. It is presently implementing a new Library Information System, a new Human Resources Management System and a new Facilities System. It continues significant development of the Financial Information System and is planning for a new Student Information System and a new Purchasing System.

An overall structure of coordination, prioritization and planning for information systems development is needed so that the University can (i) determine priorities as to the allocation of scarce human and financial resources between these projects, (ii) plan for the systematic and integrated development of these systems, (iii) decide between the conflicting demands of the end users of the various systems, and (iv) present a coordinated, unified face to users within the University and externally, especially to software and hardware vendors.

**ACTION 35**: *The Office of the Vice President for Information Technology should establish an effective mechanism for overall prioritization, coordination and oversight of planning for the development and life-cycle replacement of University information systems.*

In all of this of course it is critical that end-users and functional units remain appropriately involved in the specification and development of these systems.

OVPIT through the UIS Division should also communicate widely the technologies that it uses, supports and which it recommends to schools and departments for use in their own information systems. These standards for computer hardware, software tools, development methodologies, and project management practices can help achieve both cost savings and better integration among systems.

Greater University-wide prioritization, coordination and planning for new information systems will contribute to the achievement of some of the actions recommended in this section through the more efficient and effective use of resources. However it must be stressed that without new resources it will not be possible to sustain the various information systems projects presently underway and at the same time begin the new information systems and other developments called for in the remainder of this section. By comparison, most CIC institutions are better staffed in this area (including institutions with fewer campuses and smaller enrollments), and a number of them are directing significant new resources to systems development, spending upwards of $40M on implementations of human resources, financial, and student systems.

## *Student Information System*

The most important information systems at IU are in the student area, serving the needs of nearly 100,000 students each semester. The current systems were developed in the early 1980s and enhanced over the years. For many years these systems met many student needs for service, but today several of the systems are in urgent need of replacement, especially the financial aid and admissions systems. Having an effective Student Information System in these areas is essential for achieving the University's goals for recruitment and retention. An integrated Web environment needs to be developed to allow access to all information needed by students in the conduct of their day-to-day interactions with the University. Additionally, the University's advances in distributed education will place new demands on information systems to provide services for students who may visit campus less frequently, to allow for alternatives to the standard fifteen-week semester, or to accommodate other changes that are not yet envisioned.

**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 student and is adaptable to future changes.*

### Common Interface

Users can be categorized into three groups. There are back office users in the operational units doing transaction processing on a daily basis and understanding more of the complexities of the systems and data. There are students, faculty and staff who need only occasional, casual access to the information. And, somewhere in between these two groups, are the service providers in various schools, departments, and programs who need to use a diverse set of information systems. These last two groups need and will benefit most from consistent and integrated access to the applications, data, and systems.

**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.*

This common interface environment should be implemented across all commonly used desktop computing platforms and operating systems.

### Architecture

Technical and information architecture, technology standards, and enterprise business plans are critical to long-term success and stability of information systems. These ensure that central and distributed computing systems can operate together and that disparate data sources can be combined, analyzed and reported. Future developments or acquisitions will require a multi-tiered architecture that supports the development of components as a requirement for facilitating change and performance. In this architecture the presentation, business logic and data are separate entities. This facilitates business, data, and technology changes while minimizing the impact and cost to the institution. There should also be greater investment in network application products (e.g., Winframe and Hydra), to support the demands for existing, large workstation-based applications. A central server would execute these applications and enable the use of lower performance workstations, avoid problems of application distribution and minimize network bandwidth demands.

**ACTION 38**: *UITS should enhance its current information and IT architectures to include the use of "thin client" technologies, and employ multi-tiered architectures in future software development.*

IU's information systems architecture will depend, too, on development and support of a production-quality UNIX computing environment and on the use of software component technologies for systems development.

### Information Delivery/Access to Institutional Data

The UIS Division needs to deliver information to faculty, students and staff by providing access to the data they need to fulfill their roles at the University. Concerns about security and privacy should be balanced with the needs of the institution to function effectively. Planning for a consolidated information delivery environment should be undertaken in full consultation with all interested parties. This environment should enable users to access information without needing to understand the complexities of the technologies involved. Behind the scenes is a complex array of tool sets, platforms, operating systems, security schemes and data stores. Users should be able to analyze trends, manipulate data in various ways and make better-informed decisions affecting teaching, learning, and research.

**ACTION 39**: *UITS should develop a consolidated information delivery environment, leveraging technologies already in use and expanding on these 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.*

### Data Administration

As is noted in Section F.10 of this plan, the security of University information and the protection of IT resources depend upon having appropriate policies. Further, sound guidance and leadership regarding the organization and management of institutional data are needed if the University is to operate efficiently and effectively. OVPIT through the UIS Division should reconvene the Committee on Institutional Data (CID) to address policy issues regarding the organization, management, access and availability of institutional data. Along with the Committee of Data Stewards, the CID should be linked to the UIS Taskforce to address data administration and management issues.

**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.*

Through this process, the CID and Data Stewards can help promote the collection and maintenance of comparable data in standard formats from across the campuses. The CID and Data Stewards can also play key roles in developing university-wide information technology policies (as outlined in Section F.10).

### *Year 2000*

The UIS Division is leading Year 2000 readiness for IU. It must ensure that all mission-critical institutional information systems will work correctly at the turn of the century. It should also continue its work with research, facilities, medical and departmental users to heighten their awareness and offer assistance for Year 2000 planning.

**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.*

### *Disaster Recovery*

In the event of a major disaster, UITS must be prepared for recovery of critical services housed at the WCC data center. Plans are in progress to set up disaster recovery control centers and conduct rehearsals of disastrous events. Funding will determine to what level and in what time frame recovery will be possible. Plans should provide capability both for system recovery and for business continuity.

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

Disaster recovery planning and the assessment of risks and priorities should include both centrally-managed systems and distributed systems maintained on the campuses or in various departments.

### *Massive Storage*

IT operations at IU are faced with the ineffective use of magnetic tape capacity and excessive time spent by machine room operators handling tapes. A new massive storage system should enable virtual tape libraries and disk arrays between servers and tape stores to cache data sets and stack them as virtual tape volumes, replacing the thousands of tapes supporting university information. There is almost one terabyte of data in all the University's institutional data stores, and the need for new data types such as document images, graphics, sound and video will strain the resources of the current environment even more. This initiative should, over time, result in the ability to redeploy resources to other areas of need.

**ACTION 43**: *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.*

Massive storage for data from IU's information systems should be consistent with technology that will be implemented as part of IU's research computing and computational grid (see Section F.5).

### *Usability Laboratory/User-Centered Design*

Usability of information systems from the users' perspective in meeting their requirements is key to their success. A goal for all of the University's information systems is that technologies should be selected or developed which are appropriate to the needs of their various users and suitable to the business need that is being addressed. To achieve this end, there should be a commitment made to user-centered design, employing usability studies and bringing an explicit focus on end-user needs and requirements to the design of all university information systems.

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

To assist in this effort, the UIS Division has built up expertise in usability studies and user-centered design, and has developed and equipped a modern Usability Laboratory.

### Advanced Information Technology Lab

The UIS Division, with appropriate staff from the Advanced Information Technology Laboratory (AITL), provides focus and attention on new technologies that can provide innovative solutions for the business needs of the customers. Current activities include the establishment of a database lab to assess current popular database technologies such as IBM's Universal Data Base and Microsoft's SQL Server, and evaluate product support for non-traditional data types such as images, voice, video and spatial data. The UIS Division and AITL are also investigating component technology such as message brokers and transaction processing servers to support Web-development environments and application integration. Emerging development standards such as Java should be tested and migrated to mainstream use by technical staff where appropriate. Electronic commerce technologies such as Cybercash for Web financial transactions, authorization services, and development processes should be researched, as should knowledge management and decision analysis software that enable intelligent forecasting, scenario analyses, and risk management. The Lab will rotate staff on a periodic basis to enable better technology transfer. Since the Lab was populated with some staff who were formerly paid through chargeback, funding is problematic, and the search for alternate funding alternatives is a priority.

**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.*

## F.7 Telecommunications: Applications, Infrastructure, Convergence

Telecommunications consists of the web of fiber, cables, wireless transceivers and satellites that spans the globe, and the myriad diverse services that run on this infrastructure, from the Internet through cellular phone networks to global business systems. Advances in these technologies have become almost routine, but are revolutionary in their impact. We are in the midst of a telecommunications revolution that many claim has barely begun.

Telecommunications infrastructure at Indiana University consists of two components: its voice, video and data intra and inter-campus networks and services, and the connections from this infrastructure to the national and international telecommunications networks and services. In a very real sense telecommunications is the "glue" that binds the University together and which binds it to the national and international research community in all academic areas.

Indiana University also has nationally recognized expertise and organizational strengths and skills in the configuration and management of communication networks. These strengths and skills are extremely valuable assets in a particularly competitive part of the highly competitive information technology marketplace.

As such this infrastructure, physical and human, represents a fundamental strategic asset for Indiana University. Harnessed properly, it can make a major contribution to Indiana University's quest for leadership in information technology. Thus it is vital that the University keep control over its telecommunications infrastructure so it can most effectively manage it to maximize its contribution to achieving the University's fundamental goals.

Telecommunications is also a major cost to the University. It represents nearly half of the overall budget of UITS and is also a substantial cost for the regional campuses. Together with the University's information systems, it is the area where the University makes its largest single long-term investments in information technology.

The central importance of this area to the University was recognized in the formation of a Telecommunications Division in UITS as part of the VPIT's reorganization of information technology at Indiana University. A national search is presently underway for an Associate Vice President for Telecommunications. Similarly, a component of the UITS Advanced Information Technology Laboratory is devoted to the testing and trialling of advanced network technologies.

### Convergence

The critical problem that lies in front of Indiana University in this area over the next five years will be managing the convergence of data, telephone and video services into one basic integrated digital transmission infrastructure using the Internet Protocol (IP), presently mainly used for data.

The dramatic new technology developments in this area, e.g., cheap telephony over IP, convergence of present analog video standards into a single standard based on IP, promise great savings to the University if

harnessed in a timely and effective way. They also promise major new services to the University in a fully converged digital world.

One of the key management problems will be to judge the right pace at which to move to a digital, all IP telecommunications environment. To go too soon is to put the reliability of basic services such as telephone at risk. To go too slow risks locking the University into expensive and obsolete technology. This is particularly pertinent given the pending expiration of the contracts on the telephony switches at IUB and IUPUI.

**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 trialling of new "converged" technologies.*

### Funding

One of IU's real strengths in telecommunications lies in the excellent data networks on the IUB and IUPUI campuses. However the situation is less satisfactory on and between the regional campuses. Further the funding situation for some of these networks is unsatisfactory. It is especially true of telecommunications, as with information technology infrastructure in general, that funding cannot be provided for such a fundamental area in an ad hoc or on crisis basis. A telecommunications infrastructure needs to be planned for over a long period, long term financial commitments need to be made and multi-year plans need to be in place to increase the capacity of services (e.g. at the moment bandwidth in the case of data; lines in the case of telephony) in anticipation of continuous vigorous growth. Telecommunications services, which affect nearly every person in the University on a daily basis, cannot be held hostage to resource disputes.

**ACTION 47**: *The University as a whole and the campuses individually should establish base funding for the life-cycle replacement and ongoing development of telecommunications services and infrastructure.*

### Inter-campus Networks and Commodity Internet Connections

The intercampus telecommunications networks (the IUnet data network and the VIC video network) are a critical part of the glue that binds IU's geographically distinct campuses together into one University and allows teaching and learning resources to be shared across the whole University. As such they are vital to the future of distributed education within IU. Thus it is a vital component of IU's identity as a single University.

Planning and resource allocation for the future of these networks has been less vigorous and coherent than what is required. There have been problems with redundancy and reliability of connectivity and the continuance of the VIC network needs to be ensured. The impact on the networks of new initiatives within the University, e.g. a full-scale deployment of Microsoft Exchange, multi-campus massive data storage infrastructure and increasing use of telepresence technology, need to be planned for.

These issues also need to be planned for with reference to the University's commodity Internet connections. The capacity of these needs to be scaled up in anticipation of demand. Full path-diverse routing, hence ensuring redundancy of commodity Internet connectivity, needs to be implemented.

**ACTION 48**: *A five year plan for the University's intercampus networks and commodity Internet connectivity should be immediately developed, funded and implemented.*

### Standards

In the past, IU campuses have developed their telecommunications infrastructure relatively independently of each other. A consequence of this has been incompatibilities and waste. This situation is no longer tolerable especially since there is no longer a wide range of alternatives.

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

This will help ensure that network services can be offered at a high quality and acceptable cost, and that individual and departmental decisions about telecommunication technologies do not impede interconnection or the reliable delivery of network services.

### Advanced Applications and Networking

Indiana University is already a vigorous participant in many of the new generation national networking initiatives and has made a major commitment to continue this participation. It is a founding member of

Internet2 and expects to be an early participant in the newly-announced Internet2 Abilene network, possibly through the development of a gigaPoP based at IUPUI connected in turn to an Abilene core node in Indianapolis. IU was awarded a grant under the NSF's Connection Program in March, 1997, for a connection to the NSF's very High Speed Backbone Network Service (vBNS). This connection was established early in 1998 and is now operational. This connection is established via a connection to the Metropolitan Research and Education Network (MREN) in Chicago which IU has also joined. A plethora of new funding for advanced network research and infrastructure will be announced during 1998 under the Clinton administration's Next Generation Internet (NGI) Initiative. IU has submitted a proposal to the NSF under it's High Performance International Internet Services (HPIIS) Program for the construction of a high performance connection between the US and the Asia/Pacific. This has been favorably reviewed. If finally approved, funding will commence about mid-year.

In planning for these advanced networks and the applications that will utilize them, two goals need to be borne in mind:

(i) responsiveness to the production application requirements which focus on networks as a means to deliver service and content;

(ii) introduction of new technologies to support new applications.

There is the potential for tension between these two forces. In particular the introduction of new technologies should not interfere with production applications. Ideally it should improve them or at least not impact them. One way of addressing this problem is through a network architecture that provides one network for production applications and another for research applications and new networking technologies (e.g. Argonne National Laboratory's Morphnet architecture). This also provides a way of addressing quality of service issues for network applications.

**ACTION 50**: *The University should consider implementing a network architecture that separately supports production and advanced network applications.*

### *Wireless Networks*

Wireless networking is rapidly reaching maturity and its deployment at universities has the potential for radically changing the way they do business. Potentially most significant is that no longer will students and faculty be bound by needing to connect to a fixed network connection in order to access network resources. Wireless networking frees them from the tyranny of place and allows them to work anywhere on campus with a notebook computer and a simple wireless modem.

However the technical problems involved in a widespread deployment of a wireless network are very substantial and will have to be fully overcome before a full-scale production wireless network is deployed. One way of introducing this technology would be via a trial with a School (e.g. the IU School of Dentistry or the Kelley School of Business) that wants to aggressively utilize this technology.

**ACTION 51**: *Implementation should begin for a university-wide wireless network, initially through a trial with a School.*

### *Multimedia and Streaming Media*

The network will be required increasingly to support applications characterized by rich content and multiple media — image, text, hypertext, audio, video, VR — with interactions ranging from active information seeking, to intelligent agents as information seeking intermediaries, to "push" and broadcast models of information distribution. Special support will also be required for streaming media such as video and audio to ensure both quality of service and to provide the large amounts of scaleable hierarchical storage that will be required. The Variations project is a particularly good example of a trial venture in this area. Quality of service standards are still emerging and IU should work closely with industry partners and application developers to determine the best strategy for its support.

**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.*

Quality of service standards are still emerging and IU should work closely with industry partners and application developers to determine the best strategy to support these standards.

## F.8 Support for Student Computing

The goal of technology leadership, and especially leadership in technology for research, teaching and learning, will require that Indiana University also maintain a leadership position in support for student computing. This does not simply mean building more computer clusters. Indeed, we envisage that the trend of students ownership of computers will increase, and the challenge will be to support these computers. For at least the short-run we should continue to equip and staff computer clusters, and indeed in some instances to enhance them so that they have the degree of functionality that students require for their studies.

### *Student Technology Support*

As students gain access to IU computing and network resources from virtually any location, support and assistance become essential. Currently, a base level of support for students is provided by UITS in Student Technology Centers on the IUB and IUPUI campuses. Some schools and departments provide student technology support that is designed to complement curriculum and programs, especially at the graduate level. On the other hand, ownership of undergraduate student support that exceeds the base level support provided in UITS student technology centers is not so clearly defined.

**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 which do not provide such specialized support.*

### *Access in Student Residence Halls*

Indiana University has begun a program to revitalize the residence halls on the Bloomington campus and to develop housing on the IUPUI campus.

Students living in residence halls at Bloomington have to use a different computing environment than is provided in Student Technology Centers on the campus. This is a source of great frustration and one example of the failures of collaboration that we cannot afford. Arrangements should be explored for UITS to become more involved in managing information technology services in the Halls of Residence, to better deliver a seamless student computing environment.

**ACTION 55**: *UITS should work with the Halls of Residence and Residence Life, at IUB and IUPUI, to provide students with a seamlessly integrated computing environment, available on campus, in the residence halls, including academic support centers, or from remote locations.*

IU has a long commitment to running a residence hall system that is more than just a place to live. To that end, each residence hall at IUB has a branch of the main library, at least one classroom space, and an office for academic advisors. As academic support programs have increased there has been a corresponding increase in students' grades and retention rate. Placing teaching and learning technologies in the residence halls would support the University's efforts to retain students.

As the IUPUI campus and other IU campuses embark upon the design and construction of student residence halls, it will seek to benefit from lessons learned in other settings as well as meet new needs that are defined.

**ACTION 56**: *Housing on the IUPUI campus should be planned carefully with involvement of UITS and others, to ensure that it is developed as a premier living and learning community, making effective use of technology for student learning.*

**ACTION 57**: *UITS, in partnership with the Halls of Residence and Residence Life, should develop a program to provide teaching and learning technology and support services in one or more selected residence halls, as one part of an on-campus pilot in distributed learning.*

For example, one residence hall floor (e.g., in Briscoe Quad at IUB) might be selected to experiment with new teaching and learning technologies and services. The students who choose to live on this floor might agree to take one or two classes together using distributed education technologies and methods (e.g., interactive video, network-connected computers) in a technology-equipped site on the floor. This site could also be used for the distribution of other academic initiatives to the other residents of the building.

### *Student Ownership of Computers*

As the use of information technology becomes more pervasive in the learning process, many students will come to campus equipped with computers, and students who engage in learning from home or the work-place will increasingly have the computing capability to access university resources from off campus. Student ownership of computers is becoming increasingly common, with some universities requiring all entering students to own a computer.

**ACTION 58**: *IU should consider a program of incentives to increase student ownership of computers, including some combination of direct financial assistance, negotiation of institutional discounts for student purchases, on-campus sales and support, and encouragement from the highest levels of the University. IU should further evaluate programs that would require computer ownership for all students.*

This Plan recommends actions to encourage and support student ownership of computers but stops short of recommending that computers be required for all. IU should continue to pay close attention to this question, and reconsider it on a regular basis. The Plan also recognizes that many students may have access to computers they do not own (e.g., at home or in their place of work).

Students enrolled in some of IU's graduate and professional programs are already required to own a computer. As the curricula in various disciplines call for it, student ownership of computers will become more widespread and will increasingly be required. Actions taken now should, in addition to encouraging student use and ownership, prepare the infrastructure and support services that will be required when every IU student owns a computer.

Most immediately, in recognition of this trend toward student ownership, and to accelerate its progress, the University should provide:

- the on-campus infrastructure for connecting student-owned computers to campus networks;
- the remote-access capability for connecting to campus networks from off campus;
- the support services needed by students who are using personally-owned computers; and
- guidelines to help students select an appropriate computer for use at IU.

## F.9 Digital Libraries and the Scholarly Record

Indiana University is well positioned to take a leadership role in the area of digital libraries. The University Libraries and UITS are engaged in a far-reaching analysis of potential targets. And IU has several unique resources that stand as clear demonstrations of IU's ability to be a leader in digital libraries. These include the "Variations" project, a digital audio library in the IU School of Music; LETRS (Library Electronic Text Resource Service), which supports access to electronic scholarly texts, primarily in the humanities; and the IUPUI Library, which incorporates information technology into the architectural design of the building itself. The proposed actions in this Section seek to advance the role of digital libraries as part of the teaching and research mission of the University.

### *Digital Library Development*

There are many fundamental information science and technology problems that must be addressed in the development of digital libraries. For example, where are digital collections stored and how is the pertinent portion of the digital artifact delivered to the user? How are intellectual property rights managed, and access controlled and authenticated, while still making scholarly resources widely available to faculty and their students? What easy-to-use interface will enable the indexing, mark-up, and maintenance of large personal collections of scholarly material? What strategies will optimize the relationship between central collections, distributed resources, bandwidth, network congestion and local storage? How will individual institutions, like IU and its peers, participate in development of a national digital library?

Addressing these questions has been taken up as the research agenda by a number of universities, research libraries, professional associations, US government agencies, corporations, and national and international consortia. For example, the NSF, in partnership with the NEH, DARPA, NASA, the Library of Congress and others, has announced a second phase to its Digital Library Initiative and is seeking proposals that will advance the state of knowledge and practice in digital libraries.

**ACTION 59**: *The University should develop a program of digital library research, and engage in national initiatives, to address the issues of user services, creation and management of digital collections, the federation of distributed digital libraries, and the design of digital library systems.*

Critical to the long-term success of this effort will be a coordinated approach to building a digital library infrastructure that will support teaching, learning and research.

**ACTION 60**: *The University should develop a digital library infrastructure that will provide a common technical and organizational base for new and ongoing digital library programs.*

This infrastructure should address three dimensions of a successful digital library:

- digital technology (massive storage, network access, intelligent agents, etc.);
- digital content (creation, acquisition, subscription); and
- human and organizational resources to support the use of scholarly material in electronic form (reference, collection development, cataloging, indexing and abstracting, etc.).

### *Access to Electronic Resources*

The various IU libraries currently acquire a large number of subscriptions to online full-text and index resources from commercial sources. The task of providing access to the resources in its existing 57 libraries is enormous, involving the complexity of multiple publishers and licensing agents, diverse license terms, and various applications and interpretations of intellectual property and copyright laws. Current efforts include access to the Web version of the online catalog, licensed access to scholarly journals, and Web versions of the library reserve rooms.

**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.*

In improving access to electronic library resources, special attention should be given to:

- Make commercial digital resources more widely available to students, faculty and staff, with special emphasis on access in the workplace and home.
- Digitize items from existing collections and from faculty files.
- Promote the creation of original digital resources (electronic journals, research papers, etc.), including audio and video materials.
- Build the technology infrastructure to support the full life-cycle of digital content.
- Develop or expand library services to support the scholarly use of digital materials and networked information resources.
- Provide remote access to electronic library resources and services, in support of distributed education initiatives.
- Develop policies and agreements, and implement technology, that will improve access to digital resources while respecting the legitimate limits dictated by concerns of intellectual property.

### *Electronic Reserves*

There is great value in enabling a scholar, researcher, or instructor to assemble a large indexed collection of high resolution digital artifacts (2D and 3D images, documents, film and video clips, audio recordings) and make them available to themselves and to a wider audience for particular periods of time. This is a simple extension of the reservation shelf in a good library but enables many to efficiently access rare or limited editions.

**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.*

### *Digital Collections*

The development of collections in digital form — digital text, image, audio and video — and the provision of network access to these collections will be a key component of IU's digital library program. The Variations Project (digital audio) and the Victorian Women Writers Project (electronic text) are two prime examples of such innovation in digital libraries. The University has many other unique collections (e.g., in the Lilly Library, the Archives of Traditional Music, etc.) that can become part of both the local and national academic research digital libraries. Work on building these new digital collections should be encouraged by providing funding levels that will insure a successful completion of the project and sustained maintenance of the collection and provision of access. This is a problem that transcends the boundaries of UITS, but it is of great importance to the future of the university.

**ACTION 63**: *The University should establish sound funding for existing digital library initiatives (including Variations, LETRS, IMDS, others), and should provide support for other digital library projects of merit that are advanced in the years ahead.*

### *Digital Archives and Electronic Records*

Increased use of digital media and increased reliance on digital content raises concerns about whether information stored digitally will be available when needed at some time far in the future. Two key issues in the realm of digital libraries and electronic records are preservation of and continued access to digital content. The first issue of concern is establishing policies, procedures, and common practices for determining what digital content to preserve (and for how long), and what to dispose of (and when).

**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.*

These units should establish retention and disposition schedules for the University's institutional databases and electronic records, and evaluate the liabilities involved in electronic record retention. A second issue of concern is the possibility that the actual digital media on which information is stored will deteriorate over time or be made obsolete by changes in technology.

**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.*

These units should consider development of a "digital archival laboratory" which may aid in the preservation or recovery of digital content that is in danger of permanent loss.

## F.10 Security, Privacy, Intellectual Property

In 1997 the VPIT carried out a comprehensive University information technology security audit, the first of its kind ever done at IU. At the direction of the President the VPIT is presently implementing the recommendations of this audit, with actions in areas of Information Technology Policy and Information Technology Security. An important set of related issues has arisen in planning for digital libraries at IU, having to do with copyright and intellectual property.

### *Information Technology Policy*

The security of information and of IT resources depends upon having appropriate policies. The quality or any security system can only be evaluated in terms of how well it satisfies the requirements for protection, privacy, and so forth that are defined in IT policies.

**ACTION 66**: *The University should develop clear and forceful policies to address the management and protection of information and the security of IT resources.*

These policies will depend upon the clear articulation of institutional values, and an understanding of how the institution will make judgments when its values are in conflict. For example, individuals have a right to personal privacy, while the institution has a need to keep some records of individuals' activities, and to

protect itself against some actions of individuals. Or, members of a university community enjoy the right to speak freely, but also may reasonably expect protection from threats, harassment, and other abuses. A key step in the formulation of policy will be the development of a shared vision of information, and information technology based on the beliefs and values of the University community: academic freedom, collegiality, openness, etc.

Because the development of information policies can bring the University face-to-face with fundamental issues about its values, the process will require broad support from throughout the institution and will call for leadership at the highest levels of the University. Because the implementation of information policies involves an ongoing process of interpretation and oversight, it will need a sustained commitment of leadership, attention, staff, and resources.

## *Information Technology Security*

Specific mechanisms are needed to assure IT security and the protection of privacy. Some details will depend in part upon the development of policy, but some aspects of security mechanisms are required for any policy to be effectively implemented. These include:

- Risk assessment: to determine the need for protection, to specify mechanisms of protection, and to help prioritize choices of protection.
- Audit and controls: to verify that policy is being followed and to determine if mechanisms are working and correctly deployed.
- Education and awareness: to ensure that parties are aware of their responsibilities and to help engage everyone involved in managing and using information and IT resources as part of the University's security plan.

A specific issue of security, one that is an obstacle to the development and use of networked information resources, concerns mechanisms of authentication, authorization and access management for digital content. This problem affects research and education institutions throughout the world in their development of digital libraries and their negotiations in the electronic publishing marketplace.

**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.*

Depending upon the copyright and intellectual property rights being dealt with, this access management mechanism may need to be one that includes ways to selectively authorize access for individuals or groups to fairly specific items in a digital collection, and for specified periods of time. The development of access management mechanisms should support and be supported by the University's understanding of copyright restrictions and exceptions.

## *Intellectual Property*

One of the most demanding issues facing the broad deployment of networked information resources, not only here at IU but worldwide, is the potential barrier raised by concern for intellectual property rights. The University is fortunate to have available the support of the Copyright Management Center (CMC), located on the IUPUI campus. As part of its mission, the CMC is "pursuing novel policies and programs that illuminate the complex interrelationships of intellectual property laws and emerging technologies."

**ACTION 68**: *UITS should collaborate with the 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.*

As stated previously, policy is the guiding force to the implementation of security mechanisms. It is important that developments of mechanisms for authentication, authorization and access management proceed hand-in-hand with developments of policy regarding copyright and intellectual property rights.

## G. Conclusion: The Importance of Cooperation

Because this is a strategic plan for information technology at Indiana University, its scope has not been limited to those actions that can be undertaken by OVPIT or by UITS. As has been indicated, information technology is having a transforming influence on the University as whole, and is not restricted to just those agencies that have traditionally been responsible for information technology. Further, by its nature information technology is distributed. As a practical matter, this plan does not presume that full funding of recommendations and actions proposed here will come from the central IT organization, or from any single source. To this end, we discuss a strategy of cooperation as a means of pulling together the diverse organizational interests and institutional resources needed to achieve the vision presented here for information technology at Indiana University.

Meeting the goal of this plan will require cooperation between virtually all units of the University. Effective cooperation between different units within the University is intrinsically a difficult matter. While there are usually good intentions and good will, these are not enough. Also needed are clear cut statements of mission and, where these overlap, clearly articulated ways to cooperate at their intersection. This planning exercise has uncovered a number of areas where information technology has exacerbated stresses on the organization, stresses that have not always been met in an optimal way. But to achieve the overall goal of becoming one of the leading public universities IU must find ways to overcome these difficulties. On the positive side, this planning exercise has also uncovered a number of excellent partnerships of the type deemed necessary. These are acknowledged throughout this report, and the continuation and development of such partnerships is critical to IU's success.

In light of advances being made in distributed systems, the University should seek a balance between centralized IT services and distributed IT services in the various departments, schools and campuses. In many cases, partnership between central and distributed IT services can be the most effective means of providing an information systems solution.

Partnerships are also essential with commercial organizations as they provide access to the latest technology and expertise, quite often at advantageous pricing. The University through OVPIT and the Purchasing Department should continue to use the leverage of the substantial amount it spends on information technology to leverage commercial partnerships as it has done with Microsoft and Cisco. As well partnerships with other research and teaching organizations nationally and internationally provice excellent opportunities for participation in innovative technology developments of University-wide value.

Many of the specific recommendations in this plan are for the formation of various kinds of partnerships. Achieving the needed degree of cooperation and collaboration between various units of the university will take good will on all parts and strong leadership by example by the heads of all units.

The most important aspect of cooperation has to do with our faculty and staff. They must become willingly engaged in the creative application of information technology to their work. Achieving the overall goal of this plan — university leadership in information technology — will require much more than innovations in technology.

In order for information technology to have a transforming effect on teaching and scholarship, IU will need to recruit, retain, reward and support faculty and staff who are innovators in the use of information technology for teaching and research, and recognize the value of IT in the development of academic programs.

Key to the transformation of teaching and scholarship through the application of information technology is support at every level: hardware, software, training, and access to human expertise. The University's development of computer networks calls for development of human and institutional networks. Support is fundamentally a cooperative effort. Major investment is required not just in UITS, but in every school and department.

This plan has outlined ten recommendations and 68 specific actions that should guide the University's investment, so that IU will become a leader in absolute terms in the development and use of information technology. The achievements of Indiana University in the next millennium will be measured in large part by the architecture of its information technology. The next five years will be critical in setting the foundation stones for this architecture.

# Appendix A: Committee Structure, Membership, and Process

## University Information Technology Committee Strategic Plan (UITC)

**URL: http://www.indiana.edu/~uitc/**

The University Information Technology Committee (UITC) is the newly constituted University-wide advisory committee whose mandate is to advise the Vice President for Information Technology, Dr. Michael A. McRobbie, on matters concerning information technology policy at Indiana University. J. Michael Dunn, Oscar Ewing Professor of Philosophy and Professor of Computer Science at IUB, is chair of the UITC.

Four specialist taskforces and the Computer Center Directors committee report to the UITC.

Teaching and Learning Information Technologies Taskforce
Jon Barwise (Chair), College Professor of Mathematics, Computer Science, and Philosophy at IUB

Telecommunications Taskforce
Russell Eberhart (Chair), Professor of Engineering at IUPUI

University Information Systems Taskforce
James Perin (Chair), Assistant Vice President for Finance

Research and Academic Computing Taskforce
Dennis Gannon (Chair), Professor of Computer Science at IUB

These taskforces correspond to the four divisions in University Information Technology Services and are advisory to the Associate Vice Presidents responsible for them.

Campus-specific focus in this new committee structure is ensured through the IUB and IUPUI Campus IT Councils, which are advisory to the two Campus IT Deans.

The first task of these new committees is the preparation of the University IT Strategic Plan to be presented by Vice President McRobbie to President Myles Brand in May 1998.

## University Information Technology Strategic Plan

**URL: http://www.indiana.edu/~uitc/stratplan.html**

Information technology (IT) is vital to the University and will become ever more so in the future. The appointment of Indiana University's first Vice President for Information Technology, Dr. Michael A. McRobbie, allows University-wide planning for IT to be carried out for the first time.

A new University-wide IT Committee structure has been established that provides a unified and uniform way of involving faculty, staff and students from all eight campuses in major policy decisions affecting the development of IT at Indiana University.

The first task of the new committees in this structure is the preparation of the University Information Technology Strategic Plan to be presented by Vice President McRobbie to President Myles Brand in May 1998. A major aim of this Plan is to develop a strategy to achieve the President's goal of making IU a leader in the use and application of information technology in absolute terms.

This is a very important task as it will have a central role in determining the development of information technology at IU for the foreseeable future. Thus it is vital that the whole University community have an opportunity to participate in this strategic planning process by contributing their opinions about what IU's priorities should be in IT.

The UITC and its taskforces welcome views, comments and suggestions from any member of the University about priorities for the future development of IT at IU that will best support the University's missions of excellence in teaching, learning and research. Please send your views to uitc@indiana.edu before March 10, 1998.

## Members of the University Information Technology Committee

| | | |
|---|---|---|
| Dunn, Michael (Chair) | Philosophy, CSCI | IUB |
| Cronin, Blaise | Dean, SLIS | IUB |
| Davidson, Ernie | Chemistry | IUB |
| Freund, Deborah | Vice Chancellor & Dean of Faculties | IUB |
| Huffman, John | Chemistry | IUB |
| Miller, Theodore | SPEA | IUB |
| Thorin, Suzanne | Dean, Libraries | IUB |
| Orensten, David | UG Student | IUB |
| Bailey, Darrell | Music | IUPUI |
| Boschman, Erwin | Dean, Faculty Development | IUPUI |
| Jay, Steven | Medicine | IUPUI |
| McBride, Angela | Dean, Nursing | IUPUI |
| Plater, William | Executive Vice Chancellor & Dean of Faculties | IUPUI |
| Rothe, Carl | Medicine | IUPUI |
| Mand, Larry | Integrated Technology | IUSE |

**Taskforce/CCD Chairs**

| | | |
|---|---|---|
| Barwise, Jon (Chair, TLIT TF) | Math, CSCI, Philosophy | IUB |
| Perin, Jim (Chair, UIS TF) | Assistant Vice President, Finance | IU |
| Eberhart, Russell (Chair, Telecom TF) | Assoc. Dean, Research School of Eng & Tech | IUPUI |
| Gannon, Dennis (Chair, RAC TF) | Chair, CSCI | IUB |
| Andree, Bob (Chair, CCD) | Director, Computer Services | IUN |

**OVPIT Attendees**

| | | |
|---|---|---|
| McRobbie, Michael | Vice President | IU |
| Elmore, Garland | Associate Vice President, OVPIT | IU |
| Peebles, Chris | Associate Vice President, OVPIT | IU |
| Holland, Norma | Associate Vice President, OVPIT | IU |
| Antolovic', Laurie | Finance Officer, OVPIT | IU |
| Studley, Penny (UITC secretary) | UITS | IUB |

## Teaching & Learning Information Technologies Taskforce

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| Barwise, Jon (Chair) | Math, Philosophy, CSCI | IUB |
| Bristow, Ann | Libraries | IUB |
| Cunningham, Donald | Education | IUB |
| Duffy, Tom | Education | IUB |
| Dunning, Jeremy | Interim Dean, SCS | IUB |
| Fenske, David | Music, Libraries | IUB |
| Jacobs, Bruce | Director, Res. Programs & Services | IUB |
| Maki, Dan | Mathematics | IUB |
| Soni, Ash | Business | IUB |
| Smith, Ray | ISS & Writing Program | IUB |
| Chiagouris, Steve | UG Student | IUB |
| Billings, Diane | Nursing | IUPUI |
| deCaprariis, Pascal | Geology | IUPUI |
| Fern, Jay | Music | IUPUI |
| Garetto, Lawrence | Dentistry | IUPUI |
| Hernandez, Emily | Allied Health | IUPUI |
| Morgan, James | Medicine | IUPUI |
| Novak, Gregor | Physics | IUPUI |
| Overhage, Marc | Medicine | IUPUI |
| Rogers, Richard | Business | IUPUI |
| Lindeman, Art | FMS | IU |
| Aune, Kirk | OIT | IUSB |

**OVPIT/UITS Attendees**

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| Elmore, Garland | Associate Vice President, OVPIT | IU |
| Hoff, Beth | Director, UITS | IUPUI |
| Voss, Brian | Director, UITS | IUB |
| Chang, Anita (administrative assistant) | UITS | IUB |

## Telecommunications Taskforce

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| Eberhart, Russell (Chair) | Assoc. Dean, Research, SE&T | IUPUI |
| Agostino, Don | Director, Radio/TV | IUB |
| Bramley, Randall | CSCI | IUB |
| Busey, Tom | Psychology | IUB |
| Dunn, Jon | Music | IUB |
| Henderson, Robert | CSCI | IUB |
| Hughes, Sarah Jane | Law | IUB |
| Kling, Rob | SLIS | IUB |
| Patterson, James | Business | IUB |
| Kirkley, Jamie | GRAD Student - IST | IUB |
| Boehm, Thomas | Dentistry | IUPUI |
| Brown, Carol | Business | IUPUI |
| Ho, Thomas | Chair, Computer Technology | IUPUI |
| McDonald, Clement | Medicine | IUPUI |
| Price, Timothy | Eng & Technology | IUPUI |
| Springston, Jeff | Journalism | IUPUI |
| Warner, Amy | Director, Special Media Project | IUPUI |
| Yoakam, Michael | Distance Learning | IUPUI |
| Zwirn, Enid | Nursing | IUPUI |
| Klein, Thomas | Director, Computer Services | IUSE |
| Osgood, Thomas | Director, Computer Services | IUE |
| Sciame-Giesecke, Susan | Speech | IUK |

**OVPIT/UITS Attendees**

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|---|---|---|
| Peebles, Chris | Associate Vice President, OVPIT | IU |
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| Levanon, Jacob | Acting Director, UITS | IUB |
| McLaughlin, Lee (administrative assistant) | UITS | IUPUI |

## University Information Systems Taskforce

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| Perin, Jim (Chair) | Assistant VP, Finance | IU |
| Hossler, Don | Vice Chancellor Enrollment Services | IUB |
| Pugh, Gerald | Registrar | IUB |
| Ripley, Edward | Geology | IUB |
| Rubin, Barry | SPEA | IUB |
| Thompson, Maynard | Vice Chancellor & Dean, Budgetary Affairs | IUB |
| Kelker, Craig | UG Student | IUB |
| Borden, Vic | Director, IMIR | IUPUI |
| Crist, Alan | Director, Admissions | IUPUI |
| Griffin, Linda | Medicine | IUPUI |
| Grove, Mark | Registrar | IUPUI |
| Keeley, Chris | Director, Human Resources | IUPUI |
| Martin, Robert | Vice Chancellor, Admin. & Finance | IUPUI |
| Schneider, William | History | IUPUI |
| Tompkins, Philip | Libraries | IUPUI |
| DeStefano, Guy | Director, Purchasing | IU |
| Heck, Andy | Director, HRM | IU |
| Hunt, Linda | Director, Finance & Operations | IU |
| Thomas, Barry | Director, Management Advisory Services | IU |
| Walsh, Barry | FMS | IU |
| Bonhomme, Raymond | Vice Chancellor, Admin. and Finance | IUK |
| Moran, Bob | University Library | IUN |
| Shan, Feng | Library | IUSB |

**OVPIT/UITS Attendees**

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|---|---|---|
| Holland, Norma | Associate Vice President, OVPIT | IU |
| Hoff, Beth | Acting Director, UITS | IUPUI |
| Taylor, David (administrative assistant) | UITS | IUB |

## Research & Academic Computing Taskforce

| | | |
|---|---|---|
| Gannon, Dennis (Chair) | Chair, CSCI | IUB |
| Albert, Jeffrey | Psychology, Assoc Dean of RUGS | IUB |
| Burke, Raymond | Business | IUB |
| Gottleib, Steve | Physics | IUB |
| Hanson, Gail | Physics | IUB |
| Haven, Betty | HPER | IUB |
| Pavlis, Gary | Geology | IUB |
| Shakespeare, Rob | Theatre and Drama | IUB |
| Smith, Brian | Cognitive Science | IUB |
| Bimbo, Katalin | GRAD Student | IUB |
| Buckwalter, Kenneth | Radiology, School of Medicine | IUPUI |
| Chin, Raymond | CIS | IUPUI |
| Palakal, Matthew | CSCI | IUPUI |
| Rosentraub, Mark | Assoc. Dean, SPEA | IUPUI |
| Sutton, Robert | Modern Languages and Cultures | IUPUI |
| Wilson, Kathryn | Science | IUPUI |
| Merritt, Doris | Research and Sponsored Programs | IU |
| Baden, William | Computer Services, Anthropology | IPFW |
| Hollingsworth, Joseph | CSCI | IUSE |

**OVPIT/UITS Attendees**

| | | |
|---|---|---|
| Peebles, Chris | Associate Vice President, OVPIT | IU |
| Stewart, Craig | Acting Director, UITS | IUB |
| Decker, Mary (administrative assistant) | UITS | IUB |

## Computer Center Directors

| | |
|---|---|
| Bob Andree | IUNW |
| Kirk Aune | IUSB |
| Ron Cigna | IPFW |
| Beth Hoff | IUPUI |
| Norma Holland | IUB |
| Arif Khan,Acting Director | IUK |
| Tom Klein | IUS |
| Tom Osgood | IUE |

## Campus IT Councils

The Campus IT Councils have been established to ensure that campus-specific focus in IT matters is maintained on the Bloomington and IUPUI campuses. These Councils aggregate all the Bloomington and IUPUI members of the University Information Technology Committee and taskforces in the new University-wide IT Committee structure. The mandate of these Councils will be to advise the IUB and IUPUI Deans on matters concerning campus-specific IT policy.

**IU Bloomington**

| | | |
|---|---|---|
| Agostino, Don | Director, R/TV | TELE |
| Alberts, Jeffrey | Psychology, Assoc. Dean RUGS | RAC |
| Barwise, Jon | Math, Philosophy, CSCI | TLIT, UITC |
| Bimbo, Katalin | GRAD Student | RAC |
| Bramley, Randall | CSCI | TELE |
| Bristow, Ann | Libraries | TLIT |
| Burke, Raymond | Business | RAC |
| Busey, Tom | Psychology | TELE |
| Chiagouris, Steve | UG Student | TLIT |

| | | |
|---|---|---|
| Cronin, Blaise | Dean, SLIS | UITC |
| Cunningham, Donald | Education | TLIT |
| Davidson, Ernie | Chemistry | UITC |
| Duffy, Tom | Education | TLIT |
| Dunn, Jon | Music | TELE |
| Dunn, Michael | Philosophy, CSCI | UITC |
| Fenske, David | Music, Libraries | TLIT |
| Freund, Deborah | Vice Chancellor and Dean of Faculties | UITC |
| Gannon, Dennis | Chair, CSCI | RAC , UITC |
| Gottlieb, Steve | Physics | RAC |
| Hanson, Gail | Physics | RAC |
| Haven, Betty | HPER | RAC |
| Henderson, Robert | CSCI | TELE |
| Hossler, Don | Vice Chancellor, Enrollment Services | UIS |
| Huffman, John | Chemistry | UITC |
| Hughes, Sarah Jane | Law | TELE |
| Hunt, Linda | Director, Finance & Operations | UIS |
| Jacobs, Bruce | Director, Res. Programs & Services | TLIT |
| Kelker, Craig | UG Student | UIS |
| Kirkley, Jamie | GRAD Student, IST | TELE |
| Kling, Rob | SLIS | TELE |
| Maki, Dan | Mathematics | TLIT |
| Miller, Theodore | SPEA | UITC |
| Orensten, David | UG Student | UITC |
| Patterson, James | Business | TELE |
| Pavlis, Gary | Geology | RAC |
| Pugh, Gerald | Registrar | UIS |
| Ripley, Edward | Geology | UIS |
| Rubin, Barry | SPEA | UIS |
| Shakespeare, Rob | Theatre and Drama | RAC |
| Smith, Brian | Cognitive Science | RAC |
| Smith, Ray | ISS & Writing Program | TLIT |
| Soni, Ash | Business | TLIT |
| Thompson, Maynard | Vice Chancellor and Dean, Budgetary Affairs | UIS |
| Thorin, Suzanne | Dean, Libraries | UITC |

**IUPUI**

| | | |
|---|---|---|
| Bailey, Darrell | Music | UITC |
| Billings, Diane | Nursing | TLIT |
| Boehm, Thomas | Dentistry | TELE |
| Borden, Vic | Director, IMIR | UIS |
| Boschman, Erwin | Dean, Faculty Development | UITC |
| Brown, Carol | Business | TELE |
| Buckwalter, Kenneth | Radiology, School of Medicine | RAC |
| Chin, Raymond | CIS | RAC |
| Crist, Alan | Director, Admissions | UIS |
| deCaprariis, Pascal | Geology | TLIT |
| Dunning, Jeremy | Interim Dean, SCS | TLIT |
| Eberhart, Russell | Assoc. Dean, Research, SE&T | TELE |
| Fern, Jay | Music | TLIT |
| Garetto, Lawrence | Dentistry | TLIT |
| Griffin, Linda | Medicine | UIS |
| Grove, Mark | Registrar | UIS |
| Hernandez, Emily | Allied Health | TLIT |
| Ho, Thomas | Chair, Computer Technology | TELE |
| Jay, Steven | Medicine | UITC |
| Keeley, Chris | Director, Human Resources | UIS |
| Martin, Robert | Vice Chancellor, Admin. & Finance | UIS |
| McBride, Angela | Dean, Nursing | UITC |
| McDonald, Clement | Medicine | TELE |

| | | |
|---|---|---|
| Merritt, Doris | Research and Sponsored Programs | RAC |
| Morgan, James | Medicine | TLIT |
| Novak, Gregor | Physics | TLIT |
| Orr, Scott | CSCI | TELE |
| Overhage, Marc | Medicine | TLIT |
| Palakal, Matthew | CSCI | RAC |
| Perin, Jim | Assistant Vice President, Finance | UIS, UITC |
| Plater, William | Executive Vice Chancellor and Dean of Faculties | UITC |
| Price, Timothy | Eng & Technology | TELE |
| Rogers, Richard | Business | TLIT |
| Rosentraub, Mark | Assoc. Dean, SPEA | RAC |
| Rothe, Carl | Medicine | UITC |
| Schneider, William | History | UIS |
| Springson, Jeff | Journalism | TELE |
| Sutton, Robert | Modern Languages and Cultures | RAC |
| Tompkins, Philip | Libraries | UIS |
| Warner, Amy | Director, Special Media Project | TELE |
| Wilson, Kathryn | Science | RAC |
| Yoakam, Michael | Distance Learning | TELE |
| Zwirn, Enid | Nursing | TELE |

# Appendix B: Bibliography (Includes Relevant Previous Planning Documents)

1994-95 Application Area Plan: Database, Spreadsheet, And GIS. Final report of the DataBase Support Group Advisory Committee. (George Alter, chair.) February 14, 1994.

1998 Planning and Budget Review. Communications and Planning Office, University Information Technology Services (Christine Fitzpatrick, Manager, IUPUI Operations.) February 4, 1998.

ACPC External Relations Subcommittee Interim Report. (Donald E. Robinson, James G. Williams, co-chairs. April 24 1997).

City of Bits: Space, Place, and the Infobahn. William J. Mitchell. MIT Press, Cambridge, Mass. 1995

Clarendon Guide to Oxford. A. R. Woolley. Oxford University Press, London. 1972.

Classroom Instructional Technologies At IUB: 1994-1999 - CITAC Report To Kenneth R. R. Gros Louis. Final report of the Classroom Technologies Committee. (Gary E. Wittlich, chair.) September 30, 1994.

Developing And Supporting Classroom Technologies At IUB. Report of the Classroom Technologies Committee. (Gary E. Wittlich, chair.) June 9, 1997.

Distributed Education and Indiana University: Strategic Pathways and Windows of Opportunity. Final Report of the President's Advisory Committee on Distance Education. (Blaise Cronin, chair.) November 1997.

Failing the Future: A Dean Looks at Higher Education in the Twenty-first Century. Annette Kolodney. Duke University Press. 1988.

Future Directions for Computing At Indiana University (aka The Gannon Report). Dennis Gannon. December 23, 1986.

Update on Future Directions For Computing At Indiana University (aka The Gannon Report). Dennis Gannon. October 12, 1989.

Future Directions For Computing In The Administrative Environment At Indiana University (aka The Sullivan Report). Administrative Computing Advisory Committee Report. (Paul Sullivan, chair.) June 29, 1989.

Future Directions For Computing In The Humanities At Indiana University, 1992-1997. Five-year plan of the ACPC Computing in the Humanities Subcommittee. (Robert A. Shakespeare, chair.) January 1991.

Future Directions For Computing In The Physical, Biological, And Medical Sciences At Indiana University, 1992-1997. Five-Year plan of the ACPC Computing in the Physical, Biological and Medical Sciences Subcommittee. (Daniel Maki, chair.) January 1991.

Future Directions For Computing In The Social Sciences At Indiana University, 1992-1997. Five year plan of the ACPC Computing in the Social Sciences Subcommittee. (Joanne Peng, chair.) January 1991.

Future Directions For Instructional Computing At Indiana University, 1992-1997. Five-Year Plan of the Academic Computing Policy Committee's Instructional Computing Subcommittee. (Thomas Duffy, chair.) January 1991

Future Directions In Academic Information Systems At Indiana University, 1994-1999. Five-year plan of the ACPC Academic Information Systems Subcommittee. (Debora Shaw, chair.) April 15, 1994.

High Performance Computing And UCS: A Plan For The 90s. ACPC Planning Committee. (Dennis Gannon, chair.) March 29, 1992.

Hobbes' Internet Timeline v.3.3. Robert Hobbes' Zakon. Internet Evangelist, The MITRE Corporation. http://www.isoc.org/guest/zakon/Internet/History/HIT.html#Growth

Hypermedia '93 - Faculty Work In The 21st Century: Time, Tools, and Talent. William M. Plater, Dean of the Faculties, IUPUI. 1993.

Indiana University Strategic Directions: Becoming America's New Public University. (Myles Brand, President of Indiana University.) January 1996.

Indiana University-Wide Information Technology Strategic Planning Document. Computer Center Directors Contribution (Regional Campus Input). February 27, 1998.

IU Information 2000: A University Plan. Final Report of the Information Resources Council. (Christopher S. Peebles, chair.) October 11, 1993.

IUPUI University Library Information Systems Plan Project: Systems Integration Master Plan: Realizing the Vision. Ameritech Information Systems, January 31, 1990.

IUPUI Library Information System Project Plan. IMB Consulting Services. June 24, 1992.

IUPUI/IBM Library Information Systems Project: Functionally Clustered Requirements. October 16, 1992.

IUPUI/IBM Library Information System Project: Gateway/Workstation/Multi-Media Detail Design Phase Report. June 4,1993.

Planning for Learning, Equipping Our Learning Environments. IUPUI Committee on Classroom Use. (Erwin Boschmann, chair.) Spring, 1997.

Report Of The Connectivity And Access, ACPC Subcommittee. (Henk Haitjema and Larry N. Thibos, co-chairs.) April 25 1997.

Report to the President on the Use of Technology to Strengthen K-12 Education in the United States. President's Committee of Advisors on Science and Technology, Panel on Educational Technology, (David E. Shaw, Chair). March 1997.

Special Computing And Information Technology: 1995 Recommendations For The Future. ACPC Special Computing and Information Technology Subcommittee. (Robert A. Shakespeare, Chair.) April 28, 1995.

State of the University: The Next Step. ( Myles Brand, President of Indiana University.) September 9, 1997.

A Strategy For Improving Educational Programs At IUPUI. William M. Plater, Dean of the Faculties, IUPUI. November 1997.

Note: Several publications of the National Academy of Science have outlined critical issues and research areas in information technology. Many of these reports are available on the Web at *http://www.nap.edu/readingroom/*. A few recent reports of particular interest include:

More Than Screen Deep: Toward Every-Citizen Interfaces to the Nation's Information Infrastructure. Computer Science and Telecommunications Board; Commission on Physical Sciences, Mathematics, and Applications; National Research Council. National Academy Press. Washington, D.C. 1997.

National Collaboratories: Applying Information Technology for Scientific Research. Computer Science and Telecommunications Board; Commission on Physical Sciences, Mathematics, and Applications; National Research Council. National Academy Press. Washington, D.C. 1993.

The Unpredictable Certainty: Information Infrastructure Through 2000. NII 2000 Steering Committee; Computer Science and Telecommunications Board; Commission on Physical Sciences, Mathematics, and Applications; National Research Council. National Academy Press. Washington, D.C. 1996.

# Appendix C: Strategic Directions Charter

In the Fall 1997 State of the University address, President Myles Brand highlighted the many ways Indiana University "has reformed and refined itself in accordance with our Strategic Directions Charter." He noted that significant progress has been made in defining IU as America's New Public University, and he issued the challenge to take the next step and "move to the front of the line of public, research-intensive universities."

During the past two years, the Strategic Directions Charter has set the framework for the University's future, outlining key directions and steps for IU as a public university and major research institution. The Strategic Directions Charter, which is expected to stimulate achievement at IU far into the future, has served as a guide for achieving academic excellence and realizing the possibilities for change. Likewise, the vision put forward in this Strategic Plan for Information Technology is intended to set a framework for advances in the use of information technology. The goal is to harness the power to transform that is inherent in information technology resources and use these resources to further achieve academic excellence for Indiana University.

The Strategic Directions Charter contains 30 recommendations that have been grouped into three broad areas: the Community of Learning, Responsibilities of Excellence, and Accountability and Best Practices. This Strategic Plan features ten recommendations that will contribute to the successful implementation of the Charter's recommendations. The following summary is intended to provide a snapshot of the ways in which the recommendations for information technology align with and will advance the recommendations of the Strategic Directions Charter.

## I. Community of Learning

Teaching and learning opportunities are available for thousands of students across the University's eight campuses. Student learning, the improvement of teaching, the refinement of traditional teaching methods, the use of new technologies of learning, increased access to the University's programs and courses are areas of challenge and innovation in the community of learning.

Information technology resources and services continue to take on greater significance within the community of learning. Recommendations for the application of IT resources to meet the challenges include:

- Teaching and Learning: Content, Access, Distributed Education (E4) IU should assume a position of worldwide leadership in the use of IT to facilitate and enhance teaching and learning.
- Support for Student Computing (E8) IU must provide the IT tools, infrastructure and support services so that students may effectively engage in learning and research, appropriate to their various academic disciplines.
- Digital Libraries and the Scholarly Record (E9) IU should build upon and expand its digital library program, and develop the digital library infrastructure needed to support research, teaching and learning.

Proposed actions in each of these areas are intended to revolutionize the ways in which teaching and learning are conceptualized, improve the education that IU students receive, share and promote the University's best to new learners, and transform scholarly literature and learning resources.

## II. Responsibilities of Excellence

Indiana University is committed to the ideals of public higher education and there are obligations to fulfill as a result of that commitment. Making selective investments in programs and schools of distinction, promoting standards of excellence, strengthening partnerships and increasing research collaboration are all critical to maintaining a tradition of excellence.

Information technology resources, primarily high performance computing and communication provide a means for local and global interaction, regional and international collaboration, and extensive application of new research paradigms. Recommendations relevant to this category include:

- Access to Network Resources (E2) The University should provide students, faculty and staff with reliable access to computing and network services, on the campuses and off.

- Research: Computation, Communication, Collaboration (E5) The University should continue its commitment to high performance computing and computation, and should provide broad support for basic collaboration technologies and begin implementing more advanced technologies. Telecommunications: Applications, Infrastructure, Convergence (E7) The University should accelerate planning for a converged telecommunications infrastructure. Specific attention must be given to improving the state of the intercampus 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.

Proposed actions for these recommendations are intended to provide network access on the campuses and off, fully converged digital services for the University community, and a common base of collaborative technologies. In addition, high performance computing is an area of distinction for IU and it must be maintained through continued attention and support to facilitate further participation in national and international research partnerships.

## III. Accountability and Best Practices

Indiana University strives to ensure that accountability and best practices are characteristic of the management and organization of the enterprise. High achievement, personal commitment, innovation, and responsiveness to new conditions are essential for responsible stewardship of IU's human and financial resources.

Numerous applications of IT resources will enhance accountability and best practices in managing the University's resources. Relevant recommendations include:

- Solid Foundation of IT Infrastructure and Sound Fiscal Planning (E1) 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.
- Institutional Commitment: Faculty and Staff Engagement (E3) 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.
- Information Systems: Managing IU's Information Assets (E6) University-wide prioritization, coordination, oversight and planning are required in the implementation and development of institutional information systems.
- Security, Privacy and Intellectual Property (E10) The University 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 access to information and freedom of discourse.

Proposed actions in these areas encourage life-cycle replacement planning for all IT resources, competitive compensation levels for qualified IT professionals, policies and programs that facilitate the application of IT for teaching and research, successful management of institutional data and exemplary security procedures and policies.

The successful implementation of the Charter's recommendations and those of the IT Strategic Plan will be dependent on the efforts of the whole University. Ultimately, however, these document provide complementary frameworks for realizing Indiana University's goals to become America's New Public University and an absolute leader in information technology.

# Appendix D: Summary of Recommendations and Actions

## E.1 Solid Foundation of IT Infrastructure & Sound Fiscal Planning

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 life-cycle 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 life-cycle replacement model to use where needed in conjunction with its investments in information technology. Implementation should begin immediately, with full funding of life-cycle replacement phased in over a fixed number of years.

ACTION 2: The University should budget a standard amount per year, per FTE to support life-cycle 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.

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.

## E.2 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!")

ACTION 5: The University should provide students, faculty and staff with reliable access to computing, data storage, information and network services, on the campuses and off.

## E.3 Institutional Commitment: Faculty and Staff Engagement

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.

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.

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 8: Schools across the University should be encouraged to provide more resources for maintenance and training for departmental 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 9: Specific action should be taken to locate improved workspaces for UITS staff at IUPUI, and to bring UITS staff at IUB onto campus and thus more accessible.

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.

## E.4 Teaching and Learning: Content, Access, Distributed Education

RECOMMENDATION 4: Indiana University should assume a position of worldwide leadership in the use of information technology to facilitate and enhance teaching and learning.

ACTION 11: The Teaching and Learning Technology Lab and the Center for Teaching & Learning should be expanded, and new services developed where needed, to offer a standard level teaching support services for all faculty at IUB, IUPUI, and the regional campuses.

ACTION 12: To support course tools development and initiatives in distributed education, UITS (through its Advanced Information Technology Laboratory) should evaluate Web-based and other network-based learning environments and offer faculty a comprehensive set of options to easily create, edit, revise and maintain online course material.

ACTION 13: 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 14: The University should provide overall guidelines and direct support to help facilitate relationships with publishers for the commercial development and marketing of technology-based instructional materials.

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.

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 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 their complex requirements.

ACTION 18: UITS should ensure an available and reliable infrastructure of networks, servers, storage, and applications for the support of online courses and other new learning experiences.

ACTION 19: UITS should initiate changes to university information systems that improve the quality of instruction, service to students, or manageability of the distributed education program itself.

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 more generally.

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, life-cycle 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 on classroom technology design, and coordination of classroom technology use.

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.

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 which 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.

## E.5 Research: Computation, Communication, Collaboration

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.

ACTION 27: UITS should launch an aggressive program to systematically evaluate and deploy across the University state-of-the-art tools and infrastructure that can support collaboration within the University, nationally and globally.

ACTION 28: UITS should explore and deploy advanced and experimental collaborative technologies within the University's production information technology environment, first as prototypes and then if successful, more broadly.

ACTION 29: In order to maintain its position of leadership in the constantly changing field of high performance computing, the University should plan to continuously upgrade and replace its high-performance computing facilities to keep them at a level that satisfies the increasing demand for computational power.

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 31: The University should plan to evolve its high performance computing and communications infrastructure so it has the features to be compatible with and can participate in the emerging national computational grid.

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 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.

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.

## E.6 Information Systems: Managing IU's Information Assets

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.

ACTION 35: The Office of the Vice President for Information Technology should establish an effective mechanism for overall prioritization, coordination and oversight of planning for the development and life-cycle replacement of University information systems.

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 student and is adaptable to future changes.

ACTION 37: UITS, working with the users of IU's administrative systems, should develop a common interface environment that will suppor the efficient and effective accomplishment of the day-to-day administrative tasks of the University.

ACTION 38: UITS should enhance its current information and IT architectures to include the use of "thin client" technologies, and employ multi-tiered architectures in future software development.

ACTION 39: UITS should develop a consolidated information delivery environment, leveraging technologies already in use and expanding on these 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.

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.

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.

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

ACTION 43: 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.

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.

## E.7 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 trialling of new "converged" technologies.

ACTION 47: The University as a whole and the campuses individually should establish base funding for the life-cycle replacement and ongoing development of telecommunications services and infrastructure.

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.

ACTION 50: The University should consider implementing a network architecture that supports separately production and advanced network applications.

ACTION 51: Implementation should begin for a university-wide wireless network, initially through a trial with a School.

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.

## E.8 Support for Student Computing

RECOMMENDATION 8: IU must provide the information technology tools, infrastructure and support services so that students may 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.

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 which do not provide such specialized support.

ACTION 55: UITS should work with the Halls of Residence and Residence Life, at IUB and IUPUI, to provide students with a seamlessly integrated computing environment, available on campus, in the residence halls, including academic support centers, or from remote locations.

ACTION 56: Housing on the IUPUI campus should be planned carefully with involvement of UITS and others, to ensure that it is developed as a premier living and learning community, making effective use of technology for student learning.

ACTION 57: UITS, in partnership with Halls of Residence and Residence Life, should develop a program to provide teaching and learning technology and support services in one or more selected residence halls, as one part of an on-campus pilot in distributed learning.

ACTION 58: IU should consider a program of incentives to increase student ownership of computers, including some combination of direct financial assistance, negotiation of institutional discounts for student purchases, on-campus sales and support, and encouragement from the highest levels of the University. IU should further evaluate programs that would require computer ownership for all students.

## E.9 Digital Libraries and the Scholarly Record

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.

ACTION 59: The University should develop a program of digital library research, and engage in national initiatives, to address the issues of innovative user services, creation and management of digital collections, the federation of distributed digital libraries, and the design of digital library systems.

ACTION 60: The University should develop a digital library infrastructure that will provide a common technical and organizational base for new and ongoing digital library programs.

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.

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.

ACTION 63: The University should establish sound funding for existing digital library initiatives (including Variations, LETRS, IMDS, others), and should provide support for other digital library projects of merit that are advanced in the years ahead.

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.

## E.10 Security, Privacy, Intellectual Property

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.

ACTION 66: The University should develop clear and forceful policies to address the management and protection of information and the security of IT resources.

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 that are standards-based and widely accepted.

ACTION 68: UITS should collaborate with the 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.