PROPOSAL FOR NEXT-GENERATION EOS
College of Engineering, North Carolina State University

1. Introduction

In 1990, engineering students selected "Eos," Greek goddess of the dawn, as the name for the new computing environment for engineering education that was being set up in the college. Built on technologies from the MIT Athena Project, Eos and Athena have been yoked on a common path of development that still continues today. From its beginning, Eos was taught to freshmen in *E115: Introduction to Computing Environments*, on UNIX®[*] in the 1990s, Linux®[†] since 2000, and on laptops in the Student-Owned Computing (SOC) pilot program since 2001.

The recent NCSU initiative to produce the SACS *Quality Enhancement Plan for Learning in a Technology-Rich Environment* has encouraged the college to plan for its own academic computing future and to redefine Eos. ***Eos now names the computing services and software that the College of Engineering shares across departments and curricula. It is the foundational technology on which departments build and then diversify their educational and research computing.*** The following is a strategic proposal to expand Eos beyond lab-based computing to support students and faculty on mobile computers via remote-access technologies.

2. Role of the College of Engineering Computer Committee

The College of Engineering Computer Committee, composed of faculty representatives from all departments and staff from ITECS, advises the Dean in the use of resources to support academic computing for undergraduate and graduate students. The Computer Committee is currently designing a next-generation Eos that includes both lab and mobile platforms via wired and wireless connectivity. Two subcommittees have been organized to address **student-owned computers**, which 98% of incoming freshmen have, and **discipline-specific software**, required by departments to fulfill their academic mission. The work of these subcommittees has provided the basis for this proposal and will guide the Computer Committee's planning for next-generation Eos.

3. Need for a New Computing Model

Our UNIX-only model of the past decade has given way to a multi-platform Eos (see table on page 7). This diversity, demanded by users, has been difficult to develop and support within our current lab-centric model.

The Eos model is characterized by delivering a complete locked-down environment to a clean computer, including all pertinent application software and custom user configurations. The highly customized setup to "Eos-ize" lab computers does not scale well outside the labs. In the case of the Microsoft® Windows®[‡] setup, it does not even scale well within labs, with

[*] UNIX is a registered trademark of The Open Group in the United States and other countries.
[†] Linux is a registered trademark of Linus Torvalds.
[‡] Microsoft and Windows are registered trademarks of Microsoft Corporation.

workstations requiring constant attention and support. Windows was designed with home and office computing in mind, not labs, and cannot be forced into the Eos mold easily.

Scaling Linux has been easier, but it has a narrower user base and suite of applications. Sun Solaris®[§] has offered the most tractable platform for both student labs and faculty offices, but only on campus on high-end workstations. In short, current Eos does not effectively support:

- student-owned computers
- distance education students
- non-Solaris-based faculty computing in their offices
- computing in the classroom
- department-specific computing labs

4. Overview of New Model

In first-generation Eos, workstations for each of the three supported platforms were identically configured, and everything on the system was available to everyone. However, the location was limited to Eos labs. Over time, these labs have become islands in a sea of other networked computers that also need access to resources. Next-generation Eos shifts the focus to these other computers, redefines lab computing, and rebuilds its infrastructure around remote-access services (RAS). It also serves populations of users who have been left out of college computing heretofore (see list above).

4.1 Owned Computers

Most students and faculty have their own computers and use them 24/7 from their homes and offices. For doing work, their first choice is to use these "owned" computers rather than an Eos workstation. The College of Engineering has been running a very successful pilot laptop program in student-owned computing for three years (**http://www.eos.ncsu.edu/soc/**). The SOC pilot program has given ITECS and the college experience with:

- integrating student-owned laptop computers in courses.
- working with vendors to license software and specify hardware for student-owned computers.
- setting up wireless access in engineering buildings.
- preparing E115 instructors to adapt content for students with laptops.

At the same time, ITECS and the college have had to develop more services to support the growth in distance education. This development has given us additional experience with:

- delivering services and software by remote access.
- improving security for distance access.
- developing web applications to replace many command-line tools.
- documenting services for the distance user coming in from a variety of platforms.

[§] Sun Solaris is a registered trademark of Sun Microsystems, Inc. in the United States and other countries.

At the COE Dean's Retreat in summer 2003, deans, department heads, and directors agreed to broaden our college computing infrastructure to deliver software and services to "owned" computers, i.e., student-owned computers and university-owned faculty computers. In fall 2004, the student-owned computing pilot will continue with a parallel pilot in faculty laptop computing. Forty faculty will work in the new Eos model on laptops provided to them on a grant from the Dean (see **Attachment A: Proposal for Instructional Laptop Computers for COE Faculty**). If the pilot is successful, the Computer Committee hopes to see a commitment of resources that will result in a regular refresh of faculty instructional laptops every three years.

4.2 Remote-Access Services

To provide services and applications to faculty- and student-owned computers, ITECS has:

- set up servers for Solaris and Linux remote-access services (remote.eos.ncsu.edu, remote-linux.eos.ncsu.edu) and secure terminal and ftp services (PuTTY, WinSCP, F-Secure).
- licensed the X-Win32 Windows-based X-Server to run Solaris and Linux applications back to Windows clients.
- written the Wolfcall Windows Kerberos/AFS authentication application to access the AFS campus file system.
- developed web applications to replace many command-line tools.

User demand is highest for third-party software, mostly for Windows applications, followed by Solaris and Linux. As a result, work has begun to build the infrastructure needed to deliver Windows applications to users via remote access.

With the release of UNIX-based Mac OS X,®[**] faculty have also asked for Mac applications to be added to the mix. To add this or any other platform in our current infrastructure would require more resources than we can afford. However, in the new model, the workstation is no longer considered part of the infrastructure that has to be fully integrated. Rather, it is a thin client that can run any current OS on a wide range of computers, both desktop and laptop. For this reason, Mac OS X is being introduced in both student and faculty pilots in 2004.

If development continues in this direction, future users will simply connect to desired applications and services, installing only what they need to facilitate access. Remote-access services are the means by which most applications will be delivered, from downloading a licensed copy of an application that has been purchased on a group discount plan, to connecting to a dedicated computer that can run an application natively (e.g., a virtual computing lab).

4.3 Targeted Eos Labs

Eos labs will continue to be part of the college landscape. They will range from traditional hard-wired locales to recombinant wireless clusters that change size, location, and purpose. Fixed-location labs will still be needed for complex specialty software, high-end graphics and CAD, high-performance computing, and interfacing with physical equipment or tools. Other labs can

[**] Mac OS is a registered trademark of Apple Computer, Inc.

be spontaneously created in classrooms, open spaces, and common areas by students working wirelessly on mobile devices.

Targeted Eos labs will not run everything the college supports, as Eos labs have in the past, but mainly what students need in their majors. These labs, like the wireless lab and classroom clusters, will rely heavily, though not exclusively, on remote-access services. The current "one size fits all" environment will transition to custom labs, which are better tailored to department needs but still unified by a common infrastructure.

4.4 Infrastructure

A robust infrastructure and enterprise resources will support this architecture, including networking, shared file system, license servers, user storage and backup, email, web services and applications, course and content management, enterprise printing, security, etc. Infrastructure has always been and will continue to be a major part of Eos development efforts. It is the foundation that "glues" owned computing, remote access, and targeted labs together. The phrase, "Wherever you go, there you are," which has been used to describe the Eos environment since its beginning, is even more descriptive of next-generation Eos. More people from more locations will be able to access the immense resources that have been amassed over the system's lifetime.

4.5 Education, Communication and Information

Finally, and most importantly, are education, communication, and information. E115 will need to be revised to be an introduction of students to their own computers and how to use them to interface with the Eos infrastructure and get to the resources they need. Other computing topics, such as networking and safe computing practices, also need to be added to the E115 curriculum. Faculty will likewise need instruction and support so that they can successfully integrate computing into their classes to further the educational experience of students through technology. Organized venues of communication and training will help students, faculty, and staff access the full array of campus resources and become adept users of the system and their own computers.

5. Migration Plan

Transitioning between models, while requiring a great deal of preparation and many changes, should not be disruptive to the user community. The shift to the new model will be evolutionary, not revolutionary. Eos labs will be maintained and upgraded to keep educational computing stable, but new investments in lab-centric infrastructure will gradually taper off. The following changes are anticipated to initiate the transition and make it as seamless as possible.

5.1 Change in Student Computing

The most significant change will be in the principal student platform, which no longer will be an Eos lab computer but a student-owned computer. However, since October 31, 2001, when the Computer Committee voted to "strongly recommend that students own or have access to a personal computer," students have been advised that lab computing would not be able to provide

all the computing they need and that individually owned machines could give them an educational advantage.

By 2006, the college will expect (but not require) all incoming undergraduate students to have a laptop that meets college specifications. Expectations for graduate students will be decided in the 2004-05 academic year after the Computer Committee has gathered additional information from the student and faculty pilots. The committee will also encourage graduate students and departments to participate in the discussions that address the computing needs of these students.

The laptops that students bring will need to run a current operating system, e.g., Windows (2000, XP), Linux (Red Hat®[††] Fedora or Enterprise), or Mac (OS X). Hardware manufacturers can vary because of the open platform model we have adopted. The college will continue to pursue advantageous educational pricing for students from both hardware and software vendors.

The freshman year remains the best time to get students oriented to the college computing environment because of E115, E101, and other resources targeted to first-year students. Fall 2004 begins our fourth year of the SOC pilot laptop program with 300 incoming students. Twelve sections of E115 will be taught with the revised E115 curriculum that focuses on students taking personal responsibility for their own computers and learning how to interface with the Eos infrastructure.

2005 will bring in an additional 500 new students with laptops, bringing to nearly 1100 the total number of students with SOC laptops and E115 instruction in how to use them. In that year, the focus will turn to getting E115 instructors ready to teach all sections of E115 on laptops in fall 2006. CSC instructors and ITECS staff already have course planning under way for the upcoming 2004 semester. What is learned from the pilot sections this year will prepare us for the training of instructors in 2005.

For the next two years, 2004-2006, current Eos labs will be maintained to ease transition and provide continuity. Documentation, support, and instruction in their use will continue as long as needed. However, Windows labs in particular will be put in "maintenance mode" with no significant new growth or change. Targeted labs will be phased in as infrastructure develops to support them. ITECS currently maintains 22 Eos labs with 653 (49%) of the computing seats in the college. The departments maintain the other 693 (51%) computing seats in 48 classroom and lab clusters (see table on page 7). The number and nature of all of these labs will change gradually but significantly over the next two years.

5.2 Change in Faculty Computing

A grant for 40 faculty laptops in fall 2004 will begin the transition of faculty to the Eos 2 model. The focus will be on computing in the major disciplines using these computers to enhance teaching. The full plan in Attachment A looks ahead to the future when all faculty can participate in next-generation computing using "owned" computers and remote-access services to access the same software and tools as their students. The table at the end of the document

[††] Red Hat is a registered trademark of Red Hat, Inc.

anticipates an additional 60 faculty laptops in 2005 and 90 in 2006 to begin a program of routine computer replacement every three years for 280 faculty.

Faculty will likewise need instruction and support so they can take advantage of system resources and be prepared for the frequent changes that are inevitable in enterprise computing. When current Eos was UNIX only, faculty and students shared a common environment and applications, which made it fairly easy for faculty to integrate computing and course content. With the diversification of Eos, that capability eroded. Next-generation Eos will need to keep faculty and student computing harnessed together and rely on user education to coordinate academic computing across the college. The upcoming summer 2004 introduces the first faculty workshops to launch this educational effort.

5.3 Delivery of Applications

Applications can be provided in a number of ways. When unit prices are low--in the range of a textbook--students may be expected to purchase their own copies of software. In some cases, software is included with the textbook at no extra charge. However, most software will be delivered to students by remote access from the college with licenses paid for from fees. Linux and Solaris applications, plus special utilities, have already been delivered this way, and work has begun on serving Windows applications. Applications might also be delivered directly from the vendor via a subscription service or some other method. In all of these scenarios, concerted effort needs to be made to keep the cost of software as low as possible for students.

Transitioning applications to the new model will be done application by application with careful testing and review of each. All applications are currently under review to identify (1) core applications needed by all engineering students, and (2) discipline-specific software needed by departments to fulfill their academic mission. The Computer Committee has assembled college and department software requirements as well as lists of software identified as essential and discipline-specific. **Attachment B: Discipline-Specific Software Subcommittee 2003-04 Academic Year Report** will help guide software planning for Eos 2.

6. Conclusion

Eos needs to be re-structured in order to (1) continue providing platform diversity, (2) deliver to faculty the same computing environment that their students are using, and (3) introduce mobile and remote-access services into academic computing. The transition from our current model to Eos 2 is already under way but will not be widely noticed until the labs begin to change. Faculty and students will first see more and more resources available to them remotely. If restructuring is successful, Eos's immense resources of application software, enterprise file system and tools, secure development environments, and high-end computing will be available to labs, classrooms, and individuals, regardless of their location.

COE Computing 1990-2007: Eos and ETF-Funded Labs and Student and Faculty Laptop Programs													
Eos Labs: General-purpose Labs Funded from College Eos Fees													
	1990-95	***1996***	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***
UNIX OS	**Ultrix**	**Sun Solaris 2.5.1**			**2.6**		**7**		**8**		TBD		
Seats	200-500	515	522	463	361	215	208	195	184	183	~183	RAS/Targeted	
WindowsOS				**NT 4.0**			**Windows 2000**				TBD		
Seats				68	239	268	296	288	274	274	~274	RAS/Targeted	
Linux OS						**RH 6.2**	**7.1**	**7.3**	**9**	**RHEL**		TBD	
Seats						182	182	170	190	190	~190	RAS/Targeted	
Total Seats	200-500[*]	**515**[*]	**522**[*]	**531**	**600**	**665**	**686**	**653**	**648**	**647**	**~647**	RAS/Targeted[†]	
Department Labs: Discipline-specific Labs Funded from NCSU ETF Fees													
UNIX						19	63	62	91			RAS/Targeted	
Windows						94	380	434	471			RAS/Targeted	
Linux							47	102	119			RAS/Targeted	
Mac							9	9	12			RAS/Targeted	
Unspecified						303							
Total Seats	NA	NA	NA	NA	NA	**416**	**499**	**607**	**693**			RAS/Targeted[†]	
Student-Owned Computing (SOC) Laptop Program													
WindowsOS							**Win2000**	**XP Professional**			TBD		
Linux OS							**RH 7.1**	**7.3**	**9**	**Fedora**	TBD		
Mac OS										**OS X**	TBD		
New/**Total**							33[‡]	45/**78**	200/**278**	300/**578**	500/**1078**	All[§]	All
Faculty Instructional Laptop Program													
New/**Total**										40	60/**100**	90/**190**[§]	90/**280**

Gray-shaded areas show the operating system (OS) taught in E115. Since 1990, the course has been taught in the Leazar Hall labs, which house ~150 of total Eos workstations. The facility is closing fall 2004, and workstations are moving to Daniels Hall. By 2006, E115 will be taught on laptops.
ETF - Education and Technology Fee **RH** - Red Hat **RHEL** - Red Hat Enterprise Linux **RAS** - Remote Access Services

[*] Total Eos lab seats 1990-1997 ran a variety of UNIX OSes, principally DEC Ultrix and Sun Solaris. By 1998, Eos UNIX labs were exclusively Sun Solaris.

[†] By 2006, Eos and Department Labs will be configured around remote-access services and applications targeted for discipline-specific uses.

[‡] In 2001, SOC pilot laptops were dual-boot Linux and Windows. Since 2002, most students have run Windows XP with remote-access utilities that connect them to UNIX/Linux resources and AFS.

[§] In 2006, all entering students will be expected to have laptops. E115 will be taught on laptops, with a focus on mobile computing using current commercial operating systems. Faculty will have laptops for teaching through a three-year refresh program beginning 2006.

Attachment A

Proposal for Instructional Laptop Computers for College of Engineering Faculty

Proposal for Instructional Laptop Computers for COE Faculty

College of Engineering, North Carolina State University

Purpose

This proposal seeks to improve COE faculty access to up-to-date mobile laptop computing. With 98% of incoming students in possession of a computer—52% of which are laptops—faculty need to be equally equipped with instructional computers to enhance the learning environment and interact with students through technology. Computing is at the base of what engineers do, a primary technology both for the discipline and for education. In the upcoming years, the college will be undertaking a substantial redesign of its computing infrastructure to enhance mobile computing. Getting laptops into the hands of teaching faculty will enable them to lead efforts in engineering computing rather than follow. The college would see faculty and student computing brought closer together, a necessary modernization of our educational facilities, and more and better computing throughout the curriculum. Another important feature of this pilot will be to assess the prospects of establishing a three- or four-year laptop refresh for faculty participants.

Needs and Requirements

The College of Engineering has been running a pilot laptop program in student-owned computing for three years (**http://www.eos.ncsu.edu/soc/**). The pilot has been successful by nearly every standard of measurement except in the area of faculty computing. Some faculty required loaner laptops because they did not have them. Others did not have wireless access that was standard on student computers. More significantly, faculty had no equivalent instruction to what students received in E115 to learn about the tools and technologies available to them, leaving them ill-prepared for the computing questions of their students.

Results from a fall 2003 faculty questionnaire identified the following as additional "barriers facing academic faculty" that prevent them from fully participating in any "implementation of a stated COE policy on student-owned computing":

- Faculty incentives
- Time, time, time
- Faculty computers compatible with SOC (both hardware and software)
- Training – instructional pedagogy
- Training – hardware and software
- Support of faculty computing
- Resources for all of the above
- Facilities (classrooms and equipment) and scheduling of course sections
- Security issues – physical and virus
- Backup resources

Many faculty have a high demand for mobile access. They need a laptop in class every day to connect to a projector and display software, simulations, designs, and other learning materials they have built on their computers. Many would also like their students to have computers in the

classroom to access online resources or run discipline-specific software. The "classroom" in some cases is a non-traditional setting, e.g., a factory, construction site, hospital, etc.

Meeting Requirements

Providing laptops to faculty offers a way to break down barriers to meet the requirements above:

- **Faculty incentive and time**: Having high-quality computers and software to use is a "shot in the arm" for any faculty member trying to bring computing to bear in education. In the 1980s and 90s, faculty routinely got their computers from research grants, but in recent years, granting agencies have turned this commodity back to the university as institutional overhead. Funding laptops for faculty would help recoup the time they spend seeking resources for instructional computing and offer an attractive incentive.
- **Compatible computing and improved facilities and scheduling**: Laptops can configure any space as a classroom or lab, which is more flexible and economical than building dedicated computer classrooms. Special sections and scheduling are not needed, and faculty and students compute on similar platforms in similar ways.
- **Instruction and support**: COE students have E115 to help them learn to use their laptop computers and interface with college infrastructure and resources. If faculty were offered parallel instruction on their laptops, they would be able to build on the skills students develop in E115 and map technology to pedagogy more effectively.
- **Security and backup**: Many security issues challenge computing, so a major thrust in both faculty and student education will be to learn how to keep computers, data, and personal information secure. Backup services provided on university servers will never meet all the storage needs of users. The laptop's local and external drives are other repositories to take advantage of.

User education will be the key to the success of mobile computing. Users will need more instruction and assistance rather than hands-on support for their computers. They must also practice secure and safe computing for the protection of themselves and the computing communities they work in.

Feasibility and Likelihood of Success

At the Dean's Retreat in summer 2003, there was a general consensus among deans, department heads, and directors to broaden our college computing infrastructure to deliver software and services to mobile and "owned" computers, i.e., student-owned computers and university-owned computers belonging to faculty. The three-year pilot program in student-owned computing has given ITECS and the college experience with:

- integrating laptop computers in courses
- working with vendors to license software and specify hardware for laptops
- setting up wireless access in engineering buildings
- preparing E115 instructors to adapt content for students with laptops

At the same time, ITECS and the college have had to develop more services to support the growth in distance education. This development has given us additional experience with:

- delivering services and software by remote access
- improving security for distance access
- developing web applications to replace many command-line tools
- documenting services for the distance user coming in from a variety of platforms

This acquired experience with technologies that support laptop, mobile, and distance computing suggest that the time is right to initiate a college-wide effort. Continuing the student-owned computing pilot with a parallel focus on faculty computing will keep the program in balance and improve the likelihood of its long-term success.

Implementation

Students in the pilot laptop program take courses across the curriculum: English, Math, Economics, Graphic Communication, Computer Science, Foreign Languages, and Engineering 101 and 115. In fall 2004, the college will have 578 students in the laptop program, 300 as entering freshmen and 278 in advanced courses. Many other students have bought computers off the vendor plan and take advantage of SOC resources. Pilot students have been taught in special sections of E115 on their laptops since the pilot's beginning in 2001, either Windows or Linux. This fall, they can also choose Macs. While multi-platform in scope, the pilot makes strong recommendations about running current versions of operating systems (see table below).

SOC Pilot Laptop Computers and Operating Systems **(taught in E115)**				
	2001	**2002**	**2003**	**2004**
Windows	**Win2000**	**XP Pro ---------->**		
Red Hat Linux	**7.1**	**7.3**	**9**	**Fedora**
Macintosh				**OS X**
Total Laptops Each Year	33	45	200	300
Cumulative Totals in SOC Program	33	78	278	578

If faculty were able to participate in the same plan available to students, they would be better prepared for the students they get in their classes who have gone through the program or benefited from its resources. We propose to:

- acquire laptop computers for 40 faculty, who will work to integrate mobile computing in engineering courses, principally in the major.
- provide these faculty with a software stipend for essential applications.
- provide portable projectors to support classes.

- partner with these faculty to set direction for educational computing in the college. With planning under way for Eos 2, ITECS and the COE administration need to work closely with faculty to create an organized approach to mobile computing in our environment.
- test the delivery and use of discipline-specific software in the SOC setting, along with other applications needed by instructors in their classes.
- provide workshops to faculty to help them configure their laptops, work wirelessly, interface with our environment, and practice secure/safe computing. Workshop sessions will also provide an opportunity for faculty to share methods, tools, and strategies with each other and to identify to the technical staff their instructional support needs.

We anticipate a cost of $2,250 per machine and another $250 in software per faculty member. Support and instruction come from existing IT and Help Desk staff in the college. Faculty can use the same procedures for ordering and receiving their equipment that students use at **http://www.eos.ncsu.edu/soc/purchasing.php**. If the program can be funded this spring, equipment purchases and faculty workshops can take place before the end of the fiscal year. The faculty can then begin teaching with their computers in fall 2004.

Attendance at the workshops would be required of faculty to receive their laptops. This follows the model used at Virginia Tech for their 10-year program of providing computers to faculty. The faculty valued the instruction they received, which elevated faculty skill across the program, reduced support demands, and improved communication between faculty and IT staff.

Each department will be allocated a number of laptops, which go on the department inventory. Faculty can choose a laptop computer from the plan with the money allocated. To "option up" in either hardware or software, they will need to pay the difference from department funds. The computers belong to these faculty members until they give them up. When that happens, the department decides how to use or dispose of them.

Responsibility of the Department and Selection Criteria

The departments will choose the 40 faculty for the program. Laptops will be allocated per department based on its number of tenured and tenure-track faculty. In the case of a small allocation of one or two computers, the department head and Computer Committee representative might select the person or people. With larger numbers, they could organize a selection panel. The faculty selected for the pilot should:

- be teaching faculty with instructional responsibilities in the 2004-05 academic year, and also engaged in efforts to integrate computing in instruction.
- provide a description of how the laptop would be used to enhance instruction in the courses taught.
- commit to attending the workshops provided by the college on laptop use, networking, available resources, technical support, software, and secure/safe computing.
- assess the outcome of the project at the end of the semester and report on how the stipend was spent.

Not all students have laptops to bring to class, so faculty cannot organize their proposal around that assumption. The focus has to be on ways the faculty member can make use of the instructional computer to enhance teaching and learning. Suggested ways to use the laptop:

- show students how to use discipline-specific engineering software that they have access to in Eos and/or department labs.
- use it in conjunction with laptop carts available from ITECS for classroom computing, see **http://www.eos.ncsu.edu/soc/faculty.php** (application deadline March 24).
- enrich the class with simulations, animations, and other instructional content that can clarify or demonstrate concepts and techniques.

In some departments, classrooms are without projectors, and portable projectors are in short supply. It is allowable on this grant for a department to substitute a projector for one laptop purchase in order to enhance the delivery of all the courses participating.

Some departments have already made a sizable investment in laptops for faculty. This grant is a way to augment that investment and make additional purchases possible. Faculty who already have laptops that meet the required specification are invited to join the workshops and take advantage of the software resources available to the faculty on the grant.

Assessment of these classes will be coordinated by Joni Spurlin, Director of Assessment in the college. It is important to demonstrate the educational gains made with these resources. We hope to show that more and better computing in the classroom, directed by faculty adequately equipped to make use of it, will encourage further investment and support. Faculty will keep the program tuned to department mission and ensure that it is improving engineering education for students. The greater the participation by faculty, the greater our prospects of establishing a three- or four-year laptop refresh for faculty participants.

Conclusion

Mobile computing is not the only computing direction for the college. It is just the newest one and needs resources to jumpstart it and bring it into the mainstream. Lab computing, high-performance computing, research computing, distance computing, etc., are all important to the college. Their development and improvement are part of the next-generation Eos planning under way in the Computer Committee.

Industry projections suggest that laptop purchases will continue to rise and will eventually replace the desktop as the computer of choice. Like the slide rule and calculator before it, the laptop may not need to be explicitly required of students. The Computing Committee has already determined that a single mandated platform OS is likely to be resisted and is undesirable. What is more promising is to evolve our college infrastructure to make it possible for faculty and students to use a range of platforms and OSes to get to the tools and services they need.

Resources are well placed if they foster innovation and faculty accomplishment in their fields of instruction. This proposal is a stimulus package to engage COE faculty in modern instructional computing and produce an across-the-board improvement in their proficiency and support.

Attachment B

Discipline-Specific Software Subcommittee
2003-04 Academic Year Report

This document continues to be updated to identify essential applications for productivity, general engineering, departments, disciplines (may run across departments, e.g., safety/ergonomics, mechatronics, manufacturing, etc.), and individual courses. Information is gathered by ITECS (contact **Robbie_Little@ncsu.edu**) and by department representatives to the COE Computer Committee (see **http://www.engr.ncsu.edu/computercommittee/** for contact information).

Discipline-Specific Software Subcommittee
College of Engineering, North Carolina State University
2003-2004 Academic Year Report

Introduction

In preparation for the transition from the current Eos computing infrastructure to the student-owned computing (SOC) model (Eos2), our subcommittee was assigned the task of developing a list of essential discipline-specific software (DSS) for engineering education (covering each department and program within the COE) and proposing a strategy to coordinate delivery of this software to students at the time of matriculation. We were also directed to propose requirements (and identify the associated resources) for discipline-specific faculty information technology (IT) training and support.

Presuppositions

- Each engineering student will bring a computer to NC State (98% do now) and most will have laptops (52% now).
- Students will receive basic IT training (computer use, anti-virus, network security, copyright and IP issues) in E115.
- Open platform model for SOC (WIN XP, Mac OSX, Linux).
- Microsoft Office (Word, Excel, PowerPoint, Access) and Matlab installed on laptops.
- Instructors will have access to similar (compatible) hardware and software.

Survey of Discipline-Specific Software

In January 2004, the DSS subcommittee conducted a college-wide survey of essential discipline-specific software applications. Respondents from each department and program within the COE were asked to identify software applications that were considered essential to the undergraduate teaching mission. The complete results are available at http://www.eos.ncsu.edu/docs/coe-dss-detailed.pdf.

The following table provides a listing of software applications requested by multiple departments.

Application	# Depts Requesting	Departments
Matlab	9	BAE, CHE, CSC, ECE, IE, MAE, NE, OR, TE
Maple	6	CSC, ECE, MAE, MSE, NE, OR
MS Office	6	CHE, CSC, ECE, IE, MSE, TE
Fortran	5	CSC, MAE, MSE, NE, OR
C/C++	5	CSC, ECE, MSE, OR, TE
Ansys	4	BAE, BME, MAE, TE
Java SDK	4	CE, CSC, OR, TE

SAS	4	BAE, CSC, IE, TE
SolidWorks/Cosmos	4	GC, IE, MAE, TE
Acrobat Writer	3	BAE, CHE, CSC
AutoCAD	3	CE, IE, MAE
Dreamweaver	3	BAE, CSC, TE
Lindo/Lingo	3	CE, IE, OR
MS Project	3	BAE, CHE, ECE
Photoshop	3	BME, CSC, IE
Visio	3	IE, TE, ECE
Adams	2	BAE, BME
Arena	2	IE, OR
CPLEX/AMPL	2	IE, OR
gcc	2	CSC, ECE
Jmp	2	ECE, IE
Labview	2	BAE, ECE
Mathematica	2	CSC, MAE
Opnet	2	CSC, ECE
Pro/E Wildfire	2	BAE, MAE
Visual Studio.NET	2	ECE, TE
X-Win32	2	CSC, ECE

Proposed Software Delivery Strategy

Software applications were classified into three categories: Freshman core, ITECS core, and DSS. A proposed breakdown of Freshman and ITECS core software applications (based on current applications) is given in the following table.

Freshman core	ITECS core
Microsoft Office	Matlab
Maple	Fortran
Java 2 Software Dev. Kit	C/C++
Adobe Acrobat Reader	SAS
Web browser (Netscape, Explorer, etc.)	Ansys
Symantec AntiVirus	SolidWorks/Cosmos
Utilities (WinZip, X-Win32, PuTTY,	AutoCAD
Wolfcall, pdf PrintFactory, etc.)	MS Project
	Lindo/Lingo
	Dreamweaver
	Adobe Photoshop

Students will receive instruction in the Freshman core applications (productivity software, web browser, utilities, and anti-virus software) in E115. Core engineering applications used by several departments/programs across the COE will comprise the ITECS core applications.

Increasing software costs will require ITECS to prioritize and take advantage of economies of scale whenever possible/practical. Recommendations regarding ITECS core software:

- Organize faculty forums to explore software options for next-generation Eos.
- Standardize on Matlab/Mathematica, a FORTRAN compiler, a scientific plotting package (TecPlot, Origin, SigmaPlot, IGOR Pro, Kaleidagraph), and a web authoring tool (e.g., Dreamweaver).
- Avoid supporting applications with overlapping capabilities, e.g., Matlab, Maple, and Mathematica.
- Specialized software identified as essential by one or two departments will be accessible through targeted labs. Some highly subscribed applications in targeted labs will be supported by Eos fees, and others will require support from departmental funds.

A three-tier software delivery strategy is proposed:

Applications	User Loaded	Remote Access	Targeted Labs
Freshman Core	X		
ITECS Core	X[a]	X	X
DSS	X[b]		X

[a]A limited number of generic applications, e.g., Matlab, Dreamweaver, and a scientific plotting package.
[b]DSS for individual courses (e.g., bundled with textbook).

- User loaded software (student/faculty-owned machines)
    - limited number of core applications to avoid software conflicts and overburdening IT support services.
    - student-purchased software (e.g., bundled with textbook)
    - **challenge:** vast majority of DSS software is for WIN platform
- Remote access software
    - facilitates an open platform SOC model (WIN, Mac, Linux)
    - works currently (more or less) for Solaris and Linux applications
    - explores “thin client mode” delivery
    - **challenge**: remote access to WIN applications
- Targeted (departmental) computing labs
    - DSS applications used by only one or two departments/programs
    - graphics intensive applications that perform poorly via remote access
    - short-term use software (available for limited time for specific course requirements).
    - **challenge:** coordination of timely software delivery for courses

Essential to the proposed software delivery strategy is "just-in-time" delivery of software for students and teaching faculty. This will require close coordination between teaching faculty, ITECS, and departmental support staff.

IT Support Strategy

- Student instruction on computer use, virus protection, network security, and file maintenance (backup) included in E115.
- ITECS faculty workshops will address similar issues. Software tutorials/workshops provided for new software titles.
- Targeted IT support personnel (familiar with the DSS for each department/program) to coordinate software delivery.
- On-line help/tutorials for core applications.

Resources for Faculty Computing

Faculty laptop program. The DSS subcommittee was also asked to propose a process whereby teaching faculty obtain computers and software equivalent to those of their students. In the interim, a plan "Proposal for Instructional Laptop Computers for COE Faculty" was developed and approved by the Dean. The first phase of the plan (Fall 2004) funded the purchase of 40 faculty laptop computers for use in teaching. The faculty participants are required to attend a 1-day IT workshop (hosted by ITECS) and provide teaching/learning assessment data. Full funding of the faculty laptop plan (on a 3-year replacement/upgrade cycle) would put equivalent IT in the hands of teaching faculty and students in the COE.

Faculty IT training and support. The diversity of platforms, applications, and delivery methods envisioned for the next-generation Eos will require additional IT training and support. ITECS should have primary responsibility for providing IT instruction and support to COE faculty. If sufficient resources are not provided by the current Eos fee, then a fee increase should be considered.