COMPUTING RESEARCH NEWS

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Hollings withdraws telecommunications bill

By Juan Antonio Osuna
CRA Staff

After months of haggling over legislative details, Sen. Ernest F Hollings (D-SC) withdrew his much-praised telecommunications bill in September, blaming some of the regional Bell operating companies (RBOCs) for reneging on earlier concessions.

Along with its House counterpart, the Hollings bill would have overhauled the Communications Act of 1934, freeing cable providers, publishers, long-distance carriers and regional Bell operating companies to cross over into each other's markets.

While most policy makers and corporate players advocate removal of antiquated legal barriers such as those imposed by the Modified Final Judgment (MFJ), most also agree that a total free-for-all would not necessarily nurture the market.

Hence, the legislation evolved into a complex web of restrictions designed to balance the need for innovation with the need to ward off monopolies and foster competition.

While the bill allowed the RBOCs to manufacture equipment and provide cellular, video and information services, it also contained many limitations, with the most stringent found in the long-distance arena.

The legislation evolved into a complex web of restrictions designed to balance the need for innovation with the need to ward off monopolies.

"The Bell operating companies should not be permitted to enter the market for other long-distance services until they have eliminated the barriers to competition and interconnection and until the Bell operating company faces competition for local telephone service," the bill stated.

State agencies would determine whether or not barriers to competition have been eliminated. The Federal Communications Commission and the Justice Department would serve as higher authorities to review certain cases.

It is unclear how willingly the RBOCs would have tolerated these restrictions, which, by their predictions, could delay entrance into the long-distance market until the year 2000. A statement by Hollings suggested that they sought to undermine the bill despite a public display of cooperation.

"All of the RBOCs committed to me and the other co-sponsors that they would not seek changes to the long-distance sections of the bill in the committee or on the Senate floor," Hollings said. "I have been surprised and dismayed to learn in the last few days that certain of the RBOCs have violated this agreement."

However, a letter to Hollings, signed by all seven RBOCs, expressed disappointment over the bill's withdrawal, saying that the RBOCs "never sought to change this provision as reported out of your committee, or to use USTA [United States Telephone Association] to change the agreement on our behalf."

Although most of the RBOCs are members of USTA, the letter said, "USTA was not a party to that compromise and has independently pursued changes in the regulatory problems the agreement creates for its non-RBOC members."

Another statement, by the MFJ Task Force, an ad hoc coalition of the seven RBOCs, stated: "The RBOCs struck a difficult agreement in the Senate on long distance to keep the legislation moving forward. We have scrupulously adhered to that commitment."

Of all the sectors of the communications industry that sought to shape the bill, the RBOCs may have had the least to gain from its passage.

The legislation is not the only means of dismantling the Modified Final Judgment, which spawned the seven "baby Bells" from the breakup of AT&T in 1984 and legally delineated the various market sectors. In recent months, a flurry of activity on the state level and in federal courts has unleashed the Bells

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Cocke receives Medal of Science

John Cocke, a retired IBM fellow and computer scientist from IBM's Thomas J. Watson Research Center, was awarded a National Medal of Science in September. He pioneered development of the reduced instruction set-computer (RISC) architecture and optimizing compiler technology.

Cocke received the nation's highest scientific honor for his "contributions to computer science in the design and theory of compilers and for major advances in theory and practice of high-performance computer systems," a National Science Foundation statement said. "The RISC concept is a stunning unification of hardware architecture and optimization compiler technology, and John Cocke had the total mastery of both fields to have made the RISC breakthrough."

David Patterson, chair of the Computing Research Association and a researcher who also helped develop the RISC architecture, said: "John Cocke richly deserves this high honor. His pioneering work in both architecture and compilers laid the foundation for the extraordinary rate of improvement in processor performance that we enjoy today."

Before retiring from IBM in 1993 after 37 years there, Cocke was a key

photo A

John Cocke

figure in some of IBM's most advanced technological developments. Cocke contributed to advances in large-systems architecture and was involved with the Stretch computer, the engineering verification engine for logic simulation, pipelining and the architecture for the RISC System/6000.

"He has been a towering presence in all aspects of computer science and engineering for almost four decades," said IBM Chair Louis V. Gerstner Jr. "He has inspired countless individuals in IBM, academia and throughout the computer industry and has personally created inventions of enduring value."

Cocke received a B.S. in mechanical engineering in 1946 and a Ph.D. in mathematics in 1956 from Duke University. Earlier this year he was awarded the IEEE John von Neumann Medal. His major research interest is systems architecture, particularly hardware design and program optimization.

Eight scientists received the National Medal of Science this year. The medals were authorized by Congress in 1959 and are given periodically by the president in special recognition of outstanding contributions to the physical, biological, mathematical, behavioral or engineering sciences. NSF administers the National Medal of Science for the White House.

Cocke also was recently named recipient of the 1994 Computers and Communication (C&C) Prize. Cocke was recognized for his contributions to the computer industry in the creation of RISC and program optimization technology.

The C&C Prize consists of a certificate, a medal and a cash award. It is underwritten by the NEC Foundation and awarded annually to one scientist outside Japan.

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Letters may be edited for space and clarity.

Opinions and Letters

Working toward the future

BY David Farber

Over the past four years, the United States has undertaken a joint industrial, university and governmental research initiative designed to study the impact of gigabit networking on the future of networks, their applications and computer architecture.

This study has led to the formation of five test beds, each exploring different aspects of the emerging technology as well as motivating several non-US experiments. The first phase of the experiment is now drawing to a close, so it is reasonable to ask what we've learned and what the implications are for the future.

Lessons learned

First, and maybe foremost, we have shown that industry and academia can work together for their mutual benefit. In the US test beds, industry, without government support or extraordinary tax incentives, contributed the largest percentage of resources.

Universities, while supported by the government, found themselves as partners in pushing the frontiers of research. Students and engineers worked together in each other's laboratories. This model of collaborative research, which was so effective here, should be applicable to other frontier activities.

But what did we learn from the research activities themselves? Gigabit speeds have raised a new set of difficult technical issues. Designing and building switching devices and interface devices that can operate at these speeds is not simple. It pushes hardware design and very large-scale integration technology to their limits. As a result, it has been necessary to take innovative architectural approaches to even hope to achieve speeds nearing a gigabit.

Perhaps most interesting though, is the conclusion that many of the ideas developed over the past 20 years in computer architecture, operating system design and networking protocols seem to be ineffectual when applied to such high speeds. It is worth observing that these communication speeds are of the same order of magnitude as the main memory bus speeds of modern workstations.

Thus it is not surprising that we have run into problems. When streams of data arrive at memory speeds, it becomes difficult, given the protocol systems currently in use, to get the data into memory, allow the processor enough processing bandwidth to examine the data and move it, and still have processing power left over for other tasks.

I will not elaborate on the solution I and others have proposed for this problem. But basically, the solution revolves around the creation of a geographically-dispersed distributed machine, the components of which would be interconnected by high-speed networks. This approach has been well documented.

Future challenges

What is more important than a particular solution is the challenge of facing a future in which gigabit speed networking will be considered slow and our communication infrastructure will consist of multigigabit, low-error, high-latency networks, in which our processing units, while growing faster, will not keep up with increasing communication speeds. It is too easy to just remove a few instructions, hack a few solutions and show that one can operate not too badly at current speeds of communication. Perhaps this is equivalent to saying, "Let the next generation solve the problem."

I believe there is a challenge facing the computer communication field of at least the same magnitude as the challenge the field faced in the very early days of networking. Attacking this problem will require the talents of people from every area of both the computer and communications fields—people willing to experiment and willing to face the same set of challenges those in the 1950s faced with the then-new computers.

The next 50 years

In 1996 we will celebrate the 50th anniversary of the Eniac computer, developed at the University of Pennsylvania. The children of the Eniac have transformed our society in many ways, for better and for worse.

As we turn to the next 50 years, we are facing an era in which the convergence of computers and communications will be the key technological innovation. The impact of this development on our technology and our society will most likely be considerably greater than that of the previous 50 years of evolution.

It is time to start thinking and working and innovating, so that in 2046, we can look back at these 50 years as a time of insight and advance even greater than that of the last 50.

David Farber is the Alfred Fitler Moore Professor of Telecommunication Systems at the University of Pennsylvania.

Letters to the Editor

CS field needs to offer more fellowships

Editor:

I appreciated what Fred Weingarten said in his opinion piece, "Budget battles now fact of life," in the September issue of *CRN*. I believe his call for our community to create a leadership that understands how Congress functions is absolutely correct. In the current "redefinition" of the relationship between industry, academia and government, those fields that don't understand politics will be left behind. On a personal level, I also appreciated his call for younger members of our community to learn more about government and how it works so as to provide a savvy leadership for the future.

Unfortunately, the reality is that in computer science, it is not easy for our junior- and middle-level folks (myself included) to lay the groundwork. I'll use an example from my personal experience. I was interested in learning more about the workings of government, so last year I looked into the possibility of getting a congressional fellowship. These fellowships are offered by many scientific organizations to junior- and associate-level faculty and young industrial scientists. Those chosen as fellows spend a year in a program organized by the American Association for the Advancement of Science (AAAS). The fellows work for a congressional office and are exposed (through seminars and workshops) to a number of policy-related issues.

I was advised to first measure that some congressional office would be interested in my scientific area of interest. I talked to several people from Congress, and got an extremely positive reaction to the idea of a computer scientist becoming involved. The scientific personnel in these congressional offices said they often felt out of their element with issues such as National Science Foundation funding, supercomputing, the Internet and the National Information Infrastructure, and they would welcome advice from computer scientists at the staff level.

Despite my warm reception, I didn't apply for the fellowship. The reason is simple. There were only two organizations I could find for which I was eligible to apply for a fellowship—the Institute of Electrical and Electronics Engineers (IEEE) and AAAS. I was told by someone who had been involved in the IEEE fellowship program that a computer scientist "wouldn't have a snowball's chance in hell" of getting a fellowship. (This was off the record. Officially I was told computer scientists can compete on an equal footing with the myriad of qualified engineers.) AAAS told me to apply but said those fellowships were the most competitive anywhere in the system, and they tended to favor people who already had established political ties. It became clear to me

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Expanding the Pipeline

Taulbee report may have been misleading

BY Mary Jane Irwin

Regular readers of *Computing Research News* may remember the headline on the 1992-93 CRA Taulbee Survey report that appeared in the January 1994 issue—"Proportion of female graduates and faculty increases significantly, particularly in CS."

Have we won the battle of achieving the appropriate representation of women in the graduate student population and the faculty ranks? If so, the activities of the CRA Committee on the Status of Women in Computer Science and Engineering and others involved with increasing the representation of women in the field have been amazingly successful in a very short time.

I suspect, however, the answer to the above question is "not yet." I doubted the growth was significant. Definitions of "significant" listed in Webster's include "1) having meaning; suggestive; 2a) having or likely to have influence or effect: important; also of a noticeably or measurably large amount; 2b) probably caused by something other than chance." Even if the growth in 1992-93 was significant, we had such a long way to go that I couldn't believe that one year's increase would solve the problem.

I compiled and investigated information related to women in the CRA Taulbee Survey. I collected five years of data to get a longitudinal perspective on the numbers. The statistics presented in the tables accompanying this article are taken from reports published in *CRN*. (The 1992-93 numbers were provided by CRA and based on a final report released by CRA in the spring. Preliminary numbers were reported in the January 1994 *CRN*.)

Table 1. Departments responding to survey

	CS		CE	
	Number	Percent	Number	Percent
1988-89	129	100	29	91
1989-90	135	99	32	94
1990-91	137	100	29	94
1991-92	140	100	31	94
1992-93	135	97	20	80

Table 2. Female Ph.D.s in CS since 1983

	Total # Ph.D.s	# female Ph.D.s	Percent
1983-84	274	29	10.6
1984-85	326	32	9.8
1985-86	412	50	12.1
1986-87	466	51	10.9
1987-88	577	60	10.4
1988-89	625	87	13.9
1989-90	734	97	13.2
1990-91	862	113	13.1
1991-92	909	108	11.9
1992-93	916	129	14.1

Table 3. Female Ph.D.s in CE since 1988

	Total # Ph.D.s	# female Ph.D.s	Percent
1988-89	182	14	7.7
1989-90	173	17	9.8
1990-91	212	17	8.0
1991-92	204	18	8.8
1992-93	129	4	3.1

To understand how comprehensive the statistics are, one must know the percentage of departments responding to the survey. Table 1 shows the percentage of CS and CE departments responding to the survey over the last five years. The response rate for CS departments has been consistently at or close to 100%. However, the response rate for CE departments dropped by almost 15% in 1992-93. Thus, the 1992-93 CE reported data should be interpreted accordingly.

Has the proportion of female graduates increased significantly? Table 2 shows the number and percentage of female Ph.D. graduates in computer science over the last 10 years. Data for 10 years was easy to obtain because the CRA Taulbee Survey report publishes the running data each year.

Table 3 shows the number and percentage of women in computer engineering over the last five years. Statistics for computer engineering have been collected only since 1986 and, as yet, are not presented in running form.

While the number and percentage of female Ph.D.s in computer science has increased, this increase is not significant—i.e., a measurably large amount. Percentages over the last five years have been relatively constant, with a small increase in 1992-93. The percentage of growth from 1990-91 to 1992-93 was only 1%.

Looking at the growth in raw numbers is somewhat more impressive. The number of female Ph.D.s has increased 48% in the last five years, and 14.2% in the last three years. The overall growth in numbers of Ph.D.s in computer science has increased 46.6% over five years, but only 6.3% over the last three years.

The picture in computer engineering is somewhat less rosy. Because the statistics from 1992-93

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CRA mentor program applications available

Applications are available for the Computing Research Association's Distributed Mentor Project. The program, now in its second year, is designed to increase the participation of women in computer science. Funding from the National Science Foundation provides support to female undergraduates for a summer of research under the guidance of a female professor at a research university.

At least 25 student/mentor matches will be selected. Funding consists of up to $5,000 per match. The money is given directly to the student to pay a stipend and cover lodging and travel. A student's funding is intended to cover up to 10 weeks of research in the summer of 1995, but alternative arrangements are possible. Mentors and their universities receive no funding.

To be eligible, student applicants must be female undergraduates (US citizens or permanent residents) who are attending a US college or university and who are seriously considering graduate studies in computer science and computer engineering.

Potential mentors should be female CS&E professors at US universities with active research programs into which students may be integrated.

To receive application information, contact Joan Bass of CRA at tel. 202-234-2111; fax: 202-667-1066; or E-mail: jbass@cra.org. Indicate whether you would like a hard copy of the brochure or an electronic version. To access an electronic copy of the Distributed Mentor Project brochure, go to http://cra.org/mentor.html.

The deadline for applying is April 1, 1995. Students and mentors will be notified of matches by March 15.

Expanding the Pipeline

Table 4. Female CS and CE faculty since 1988

		1988-89		1989-90		1990-91		1991-92		1992-93	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
CS	Assistant	93	9.9	96	9.8	96	10.4	118	13.7	118	15.0
	Associate	66	9.2	80	10.2	89	10.9	76	9.3	80	9.4
	Full	30	3.4	37	3.9	50	5.1	47	4.5	61	5.6
	Total	**189**	**7.4**	**213**	**7.9**	**235**	**8.6**	**241**	**8.9**	**259**	**9.5**
CE	Assistant	11	5.4	17	7.4	16	8.2	22	10.1	15	9.7
	Associate	8	4.2	9	4.4	9	4.5	8	3.4	7	3.8
	Full	3	1.0	4	1.2	7	2.2	6	1.4	5	1.7
	Total	**22**	**3.2**	**30**	**3.9**	**32**	**4.5**	**36**	**4.2**	**27**	**4.3**

Survey from Page 3

are incomplete, they must be discounted. One can hope they are much more pessimistic than reality. Looking at the time span from 1988 to 1992, both the percentage and number of female Ph.D. graduates in computer engineering have been relatively constant.

Has the proportion of female faculty increased significantly? Table 4 gives the statistics on the number and percentage of CS and CE female faculty over the last five years. The total number of female faculty in computer science has increased steadily from 1988 to 1993, with an average growth rate of about 6.5% a year—a promising trend, but hardly significant growth. Several other interesting points can be raised with respect to the CS data. First, the number of female assistant professors in computer science remained constant from 1991-92 to 1992-93. This could mean that the number of new hires has matched the promotion rate or that new hires and promotions are down.

Second, the number of female full professors in computer science increased from 47 to 61 in just one year. One could deduce from this that women were more successful in gaining full professor status in 1992-93 than in previous years, or that enough women finally have been in the associate professor ranks long enough and have worked hard enough to warrant promotion to full professor. If the latter is the case, we would hope to see another such increase in 1993-94.

A third interesting point comes from comparing the 1988-89 data to the 1992-93 data. A large number of the 93 female CS assistant professors in 1988-89 should have reached the promotion threshold in 1992-93. However, there was an increase of only 14 female CS associate professors from 1988-89 to 1992-93. If one assumes that all of the increase in the full professor ranks in 1992-93 came from the associate pool, this adds another 14. Thus, only 28 of the 96 female assistant professors in 1988-89 achieved promotion to associate, indicating either a low promotion rate or a high dropout rate of women from the academic ranks. Comparing the number of female CS associate professors in 1988-89 to the number of female CS full professors in 1992-93 is also disturbing as the number actually drops. Assuming that few of the 30 female CS full professors in 1988-89 have recently retired (a likely assumption), fewer than 47% of the female CS associate professors in 1988-89 had been promoted by 1993. It would be interesting to compare this to the promotion rate for male associate professors. The representation of women on CE faculties remains dismally low at less than 5% of the total and less than half of that in computer science.

The battle is not won. But we can take heart in that we do seem to be making progress in graduating female Ph.D.s in computer science. However, concerns about the timely promotion of female faculty remain.

Mary Jane Irwin is a professor in the Department of Computer Science and Engineering at the Pennsylvania State University. She is a member of the CRA Board and is co-chair of the CRA Committee on the Status of Women in Computer Science and Engineering.

Hollings from Page 1

into new markets.

For example, in July the FCC approved an application from a telephone company to offer video programming services. Bell Atlantic won the right to offer multimedia services to 38,000 homes and businesses in Toms River, NJ. There are now dozens of applications pending under the FCC's new video dial-tone program.

Also, the Justice Department recently formally recommended allowing the RBOCs to provide long-distance service through wireless and cellular networks.

Shortly after the House passed its telecommunications bills, HR 3636 and HR 3626 (May 1994 *CRN*, Page 1), four RBOCs filed suit on July 6 in federal court, seeking removal of MFJ restrictions against manufacturing telephone equipment and wireline (non-radio) long distance.

If this trend continues and the RBOCs win the case, they may be far better off under new interpretations of current law than under the Hollings bill, which forces them to ask permission from state agencies to offer intrastate long distance, with further reviews possible by the FCC and the Justice Department.

While an MFJ Task Force statement said the RBOCs "are disappointed that Sen. Hollings has decided not to proceed with telecommunications legislation," they have criticized the bill in previous statements:

"Rather than opening America's telecommunications marketplace to competition, leading the way toward development of the information superhighway, S 1822 strengthens many of the anti-competitive shackles which have restrained the Bell companies for 10 years, and adds some new restrictions as well.

"The Bell companies may not provide long-distance service within the areas they provide phone service unless they meet criteria that are more difficult than those they currently face under the MFJ."

Fearing the Bells might bully Congress into making concessions as the bill neared passage, Hollings decided to pull out. "We will not be held hostage at the last minute to ultimatums and to the desires of certain parties to substantially rewrite a bill that passed the committee by an overwhelming and bipartisan vote," Hollings said.

The Senate Commerce, Science and Transportation Committee, chaired by Hollings, reported the bill Sept. 14 to the Senate floor with a 18-2 vote.

Before the full committee reported the bill, S 1822 accrued a number of amendments, including one that banned "obscenity" and "electronic stalking."

"I want to keep the information superhighway from becoming a red light district," said Sen. Jim Exon (D-NE), who introduced the amendment in July. The amendment also sought to address a loophole that allows phone sex services to bypass 900-number blocking by charging via 800-numbers.

Hollings' committee painstakingly attempted to balance the interests of various industrial sectors, holding 11 days of hearings and receiving more than 31 hours of testimony from 86 witnesses. The committee also deliberated on S 1086, a related telecommunications bill. Also, committee staff members held weekly meetings with telephone company representatives over several months.

Although Hollings withdrew the bill as a political maneuver, he promised to reintroduce legislation next year. "We are confident that we will be able to take up comprehensive communications reform early next year."

Various statements about the legislation from Hollings and the telecommunications industry can be found at http://www.bell.com.

Fellowships from Page 2

that the chances of getting a fellowship as a computer scientist were low. Despite being qualified to compete for a fellowship, I decided to put my time into other efforts that had a higher likelihood of succeeding.

It would be helpful to younger members of the CS community if the Computing Research Association, the Association for Computing Machinery and other CS-related organizations considered sponsoring these sorts of fellowships or other programs. I was told during my exploration that "in the past, computer scientists were just not interested" in getting involved in political fellowships. I'm proof that there are interested members of our community, and I know a number of other young faculty members who also would be willing to serve.

In addition to starting a fellowship, I believe there are other things the CS community in general, and CRA in particular, could do. For example, I've been told congressional staffs often get scientists involved in various aspects of legislation and committee work—but on an individual level. These offices don't need people to testify and plot the great course of events. What they need is someone who can focus on much simpler issues ranging from helping legislators get set up on the Internet to helping staffers prepare reports on computer-related issues. It is this sort of grunt work that leads to increased sharing of knowledge and better access between computer scientists and staffers.

Unfortunately, given the closed nature of the society inside the beltway, making the right connections can be extremely difficult. Perhaps if CRA were to informally play more of a matchmaker's role, this could lead to greater involvement by younger members of the CS community (i.e., the future leadership Weingarten talked about).

We have people interested in becoming the sort of leaders Weingarten is looking for. However, the development of informed leaders of tomorrow requires a mentoring role by the senior leaders of today. This may involve a monetary commitment (as in setting up fellowships) and a time commitment (as in playing matchmaker). But the future of our scientific community may depend on it in a very real way.

Jim Hendler
Associate Professor
University of Maryland

Association News

For Your Information

Check your mailing label

By Phillip Louis
CRA Staff

Thank you for your comments and suggestions about my first column. This is just one avenue CRA has to keep its members and the computing community updated on our activities. In this column, I'll cover four areas of interest.

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Department chairs and heads of our affiliate societies are welcome to send me the names of people they would like added to the *CRN* mailing list. *CRN* is mailed free to 1) faculty members, administrators and full-time researchers in college and university computing departments; 2) research staff members and administrators of non-profit and for-profit laboratories involved in computing research; and 3) persons who affect policies related to computing research. Subscriptions are only

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CRA invites nominations for service-related awards

The Computing Research Association invites nominations for the CRA Distinguished Service Award and the Nico Habermann Award. Nominations should be no longer than two pages and describe the contribution that is the basis of the nomination.

CRA Distinguished Service Award

CRA makes an award, usually annually, to a person who has made an outstanding service contribution to the computing research community. This award recognizes service in the areas of government affairs, professional societies, publications or conferences, and leadership that has a major impact on computing research.

Letters in support of the nomination are welcome but not required.
Deadline: Nominations must be received by Dec. 14, 1994.

Nico Habermann Award

CRA makes an award, usually annually, to a person who has made an outstanding contribution to aiding members of underrepresented groups within the computing research community. This award recognizes work in areas of government affairs, educational programs, professional societies, public awareness and leadership that has a major impact on advancing these groups in the computing research community.

Letters in support of the nomination are welcome but not required.
Deadline: Nominations must be received by Dec. 14, 1994.

Send nominations for both awards to:
Dorothy E. Denning, CRA Awards Committee
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CRA AWARD FOR OUTSTANDING UNDERGRADUATES

The Computing Research Association is pleased to announce a new annual awards program to recognize undergraduate students who show exceptional promise in an area of importance to computing research. CRA is delighted to acknowledge the support of Microsoft Corp. as the 1994-95 sponsor.

A cash prize of $1,000 will be awarded to each of two undergraduate students, one female and one male, who are majoring in computer science, computer engineering or an equivalent program. A number of other outstanding candidates will receive certificates of honorable mention. The awards will be presented at a major computing research conference. The two first-prize winners will receive financial assistance toward their travel to the conference. CRA encourages home departments to provide similar assistance to the other winners.

Nominations for this award must be submitted by the candidate's department chair by **Jan. 15, 1995**. Each year, a department may nominate no more than one female and one male candidate. More information on the nomination procedure and the criteria for selecting winners is listed below. This year's selection committee consists of Maria Klawe of the University of British Columbia (committee chair), Rena Bajcsy of the University of Pennsylvania and Daniel Huttenlocher of Cornell University.

Nomination procedure

A nomination package consists of the following items:
1) Nomination form
2) Nominee's resume (two-page maximum)
3) Nominee's transcript of academic record
4) Nomination letter by department chair (two-page maximum)
5) Letter of support from one other supporting nominator (two-page maximum)
6) One-page description of student's research or other achievements

Four copies of the nomination package should be sent to:
CRA Undergraduate Award Competition
Computing Research Association
1875 Connecticut Ave. NW, Suite 718
Washington, DC 20009

To be considered for the competition, the complete nomination must be received by Jan. 15. Department chairs should ensure that only one nomination is submitted in each category (female student, male student). Multiple nominations from the same department for a single category will not be considered.

Criteria for selection of winners

1) Evidence of unusual talent in some area of computing research as demonstrated by one or more of the following:
   a) significant research contributions, individual or as a member of a team
   b) creation of highly innovative software or hardware design
   c) demonstration of exceptional leadership or vision in a field of computing research
   d) other evidence of extraordinary interest, excellence or commitment to computer science and engineering, including industrial experience, participation in special programs and mentoring or tutoring of other students
2) Outstanding academic record

CRA Award for Outstanding Undergraduates 1994-95 Nomination Form

Name of nominee _____

Sex _____

Program of study _____

Year in program _____

Department _____

University _____

Name of department chair _____

Name of supporting nominator _____

Signatures:

_____
Department chair Date

_____
Supporting nominator Date

Policy News

Competitiveness bill stalls

Congressional conferees failed to reach agreement on the National Competitiveness Act (HR 820 and S 4) before Congress adjourned.

Introduced by Sen. Ernest Hollings (D-SC), chair of the Commerce, Science and Transportation Committee, the bill expanded the High-Performance Computing and Communications program, providing funding for education, R&D and demonstration projects involving digital libraries, healthcare, lifelong learning, manufacturing and government information and services.

The bill's failure to pass can be attributed to several factors, one of which was the jurisdictional complexity in appointing House conferees. Senate conferees were appointed March 16, but House conferees were not appointed until July 19. The conferees included representatives from many House committees, with each committee considering various sections of the legislation.

The first conference session was not held until September 27. Several amendments became controversial, including one introduced by Rep. Thomas Manton (D-NY) that prohibited federal funding to foreign companies. At issue was the definition of what constitutes a US company, whether or not its employees are US residents, where it gets parts and supplies, and where manufacturing of parts actually takes place.

However, it was unclear whether the Manton amendment applied to the computing section of the bill. "They would never tell us what it applied to. They weren't interested in talking details," a Senate staff member said, adding that the computing part of the bill was the "least controversial" section.

Some sources blamed Republican filibustering for bringing the legislation to a standstill.

NSF plans digital libraries

The National Science Foundation recently announced awards totaling $24.4 million for six research projects to develop digital libraries.

The award program is a joint initiative with the Advanced Research Projects Agency and NASA. The program will fund four-year projects centered at six major universities. Each effort brings university researchers together with other organizations such as libraries, museums, publishers, government laboratories, state agencies, secondary schools and computer and communications companies.

"We see these projects as taking the next step—and a very large one—in our ability to make available vast stores of knowledge and innovative information services based on high-performance computing and communications technologies to researchers, students, educators and the general public," said Lawrence Young, assistant director of NSF Computer and Information Science and Engineering directorate.

The awards will be given to Carnegie Mellon University ($4.8 million); University of California, Berkeley ($4 million); University of Michigan ($4 million); University of California, Santa Barbara ($4 million); Stanford University ($3.6 million); and University of Illinois ($4 million).

Library program launched

The Library of Congress recently announced plans to put 5 million volumes online by the year 2000.

The library said it would rely mainly on donations from the public and collaborations with publishers, corporations and other institutions. It also will redirect some existing appropriations to the project. The library was expected to announce in October significant donations from the W.K. Kellogg Foundation, the Lucile and David Packard Foundation and John Kluge.

The current plan offers no specifics on how the library will cope with copyright issues. Initial efforts will focus on historical and public domain works prior to 1919.

While the library plans to enter into cooperative agreements with private companies to produce digitized educational packages, it has promised not to grant these companies any exclusive rights to the information.

A draft blueprint of the program offers a list of policy and technical issues yet to be resolved: compression algorithms, accuracy, long-term preservation, periodic migration to new digital media, scalability, security, privacy and copyright.

Security report released

The congressional Office of Technology Assessment released a report in September focusing on information security and privacy issues.

The 243-page report, *Information Security and Privacy in Network Environments*, tackled such issues as national cryptography policy, federal information processing standards, export controls, the Computer Security Act of 1987, safeguarding of federal information, intellectual property, privacy and electronic commerce.

In its report, OTA's aim is to provide Congress with objective analysis of current issues. Rather then give recommendations, OTA offered options to Congress regarding cryptography policy, safeguarding information, privacy protection and intellectual property.

The full report is located at: gopher://marvel.loc.gov/1ftp%3aotabbs.ota.gov%40/pub/information.security/.

Legislative Roundup

Compiled by Juan Antonio Osuna
Source: Library of Congress Information System (telnet to locis.loc.gov)

The 103rd Congress has ended. Rather than the usual roundup of pending legislation, what follows is a summary of bills that passed or failed to pass.

Passed Congress

Untitled (HR 4922, S 2375)

Sponsors: Rep. Don Edwards (D-CA), Sen. Patrick Leahy (D-VT) **Date:** 8/9/94
Status: Passed the House October 5; passed the Senate October 7; the president is expected to sign into law
Description: The soon-to-become law requires telecommunications carriers to make future systems "wiretap-ready" and appropriates $500 million over four years to retrofit existing systems with new wiretap capabilities.

Goals 2000: Educate America Act (Pub. L. No. 103-227)

Sponsor: Dale E. Kildee (D-MI) **Date:** 4/22/93
Status: Became law March 31.
Description: The law covers a spectrum of educational issues from drugs and guns in schools to educational R&D. It contains sections on the National Skill Standards Board, the Parental and Information Resource Center, the National Educational Research Policy and Priorities Board, the National Research Institutes, the National Education Dissemination System and the National Library of Education.

Untitled (Pub. L. No. 103-142)

Sponsor: Rep. Don Edwards (D-CA) **Date:** 1/5/93
Status: Became law Nov. 17, 1993.
Description: The new law authorizes the FBI to obtain certain telephone subscriber information, including name, address, length of service and billing records, provided there is "reason to believe" the subscriber is a foreign counterintelligence agent.

Government Printing Office Electronic Information Access Enhancement Act of 1993 (Pub. L. No. 103-40)

Sponsors: Rep. Charlie Rose (D-NC), Sen. Wendell Ford (D-KY) **Date:** 3/11/93
Status: Became law June 8, 1993.
Description: The law makes more federal information available electronically to the public, including the *Federal Register*, the *Congressional Record* and other publications distributed by the Government Printing Office; a directory of government electronic information; and information other agencies specifically request to be put online.

Did not pass Congress

Export Administration Act of 1994 (HR 3937): Loosened export restrictions on cryptography.

National Communications Competition and Information Infrastructure Act of 1993 (HR 3636 with HR 3626 incorporated): Promoted a national information infrastructure by deregulating the telecommunications industry.

National Science and Technology Policy, Organization and Priorities Act Amendments of 1993 (HR 3476): Amended the National Science and Technology Policy Organization and Priorities Act of 1976, providing new functions for the Office of Science and Technology Policy and establishing various presidential organizations.

Computer and Communication Trade Freedom Act (HR 3431): Amended the Export Administration Act of 1979 with respect to the export of computers, telecommunications equipment and semiconductors.

National Science Foundation Authorization Act (HR 3254): Authorized NSF appropriations for fiscal years 1994 through 1996 and amended the National Science Foundation Act of 1950.

Telecommunications and Information Infrastructure and Public Broadcasting Facilities Assistance Act of 1993 (HR 2639): Authorized appropriations for the development of a national information infrastructure and the construction and planning of public broadcasting facilities.

Privacy for Consumers and Workers Act (HR 1900): Required employers to notify employees and new hirees of the nature, time and place of electronic monitoring.

Electronic Freedom of Information Improvement Act of 1994 (S 1782): Amended the Freedom of Information Act to accommodate electronic information.

National Information Infrastructure Act of 1993 (HR 1757): Called for the Federal Coordinating Council for Science, Engineering and Technology to direct an interagency national information infrastructure program.

Copyright Reform Act of 1993 (HR 897, S 373): Amended current copyright law, allowing copyright owners who failed to register works to still sue for damages.

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Policy News

House, Senate pass wiretap legislation

By Juan Antonio Osuna
CRA Staff

Congress passed a bill in October requiring telecommunications carriers to make future systems "wiretap-ready" appropriating $500 million over four years to retrofit existing systems with new wiretap capabilities.

Introduced by Rep. Don Edwards (D-CA) and Sen. Patrick Leahy (D-VT) in August, the wiretap bill sailed through the House and Senate Judiciary committees in September Edwards chairs the House Judiciary Subcommittee on Civil and Constitutional Rights; Leahy chairs the Senate Judiciary Subcommittee on Technology and the Law

Compared to similar legislation considered in past years, the new bill offers more stringent constraints on police and several new privacy provisions that drew wider public support and led some former foes of the legislation to acquiesce to a compromise solution.

For instance, the Electronic Frontier Foundation (EFF) and Rep. Edwards had opposed wiretap legislation considered in past years. However, both recently worked together to formulate the new bill, which passed the Senate unanimously October 7 and the House two days earlier

In a recent letter to Brock Meeks, editor of the electronic newsletter *Cyberwire Dispatch*, Edwards wrote: "The 'digital telephony' issue appropriately raises grave concerns about government control over technology and intrusions on personal privacy. I share these concerns, which is why I opposed the digital telephony legislation proposed during the Bush administration and why I told the Clinton administration that its proposal could not be introduced in its original form."

Edwards said his current bill more narrowly focuses on legitimate technical issues facing police and takes greater care not to erode privacy and not to impede the development and deployment of new technologies.

> *The bill offers more stringent constraints on police and several new privacy provisions that drew wider public support.*

EFF played a "key role" in shaping the new legislation, Edwards said. "Without EFF, we would not have a narrow scope to this bill or the new privacy protections," he said.

Prior to the bill's passage, EFF Policy Director Jerry Berman had said, "Although we do not support the concept of digital telephony legislation, we believe that if Congress is to pass any version of the bill this year, it should be along the lines of the Leahy/Edwards version."

While the bill seeks to make it technically easier to carry out a wiretap, it does not expand the legal scope of wiretap authorization. In some cases, it actually restrains police surveillance more so than current law

For example, police now only need a subpoena to obtain E-mail addresses and other transactional information from electronic service providers such as Prodigy, CompuServe and bulletin board service operators. The bill strengthens this requirement so that a judge must sign a court order similar to one needed to authorize a full-fledged wiretap.

The bill also explicitly prohibits use of pen registers and trap-and-trace devices to do such things as track the movements of cellular telephone users or the transactions of bank customers using a touch-tone telephone.

The scope of the current legislation is narrower than it was when first introduced under the Bush administration. The bill no longer allows wiretaps on remote police premises. Instead, telephone company employees must install wiretaps on company premises.

In an attempt to strengthen privacy protections, the bill also extends the Electronic Communications Privacy Act by making it illegal to monitor cordless telephone calls.

Finally, the bill limits "wiretap-ready" compliance to common carriers, which does not include Internet service providers and online systems such as Prodigy and CompuServe. In an effort to allow for innovation, the bill also exempts compliance for common carriers in instances where it would not be technologically "reasonable" to do so.

EFF sees the limitations as a major victory. "Although we remain unconvinced that this legislation is necessary, the bill draws a hard line around the Internet and other online networks," Berman said. "We have carved cyberspace out of this legislation."

Despite these concessions, some privacy advocates hold fast to the principle that industry should have no legal obligation to facilitate government surveillance.

The American Civil Liberties Union (ACLU) and the Electronic Privacy Information Center (EPIC), a Washington, DC-based group formed by Computer Professionals for Social Responsibility, campaigned against the bill.

"Any digital telephony bill that mandates that communications providers make technological changes for the sole purpose of making their systems wiretap-ready creates a dangerous and unprecedented presumption that government not only has the power, subject to warrant, to intercept private communications, but that it can require private parties to create special access," the ACLU said in a letter to Rep. Jack Brooks (D-TX), chair of the House Judiciary Committee.

Also, some of the apparent concessions in the new bill will have little effect, the ACLU said.

Continued on Page 8

FBI request to delay release of wiretap data is dismissed

By Juan Antonio Osuna
CRA Staff

A federal judge dismissed a request by the FBI for a five-year delay in releasing survey data of court-ordered wiretaps, saying the matter "can be taken care of in an hour and a half."

The order came as a victory to the Electronic Privacy Information Center (EPIC), a Washington, DC-based project formed by Computer Professionals for Social Responsibility, which requested the survey data under the federal Freedom of Information Act (FOIA).

Prompting the suit was FBI testimony before Congress in support of a bill mandating that telecommunications systems be made "wiretap-ready." In a joint congressional hearing in August, the FBI submitted survey statistics indicating 183 instances where technical problems occurred in executing wiretaps.

The FBI told EPIC it could not release the raw data the statistics were based on until June 1999. However, US District Judge Charles R. Richey said he was "stunned" by the request and ordered the FBI to release the material by November 4 or explain its reasons for withholding it.

The bill—HR 4922 in the House and S 2375 in the Senate—appropriates $500 million to pay telecommunications carriers to fix wiretap problems in current systems and forces them, wherever "reasonable," to include wiretap capability in any new systems.

Although Congress passed the bill October 7, EPIC and other groups such as the American Civil Liberties Union fought the bill, calling it unnecessary, burdensome to taxpayers and a threat to privacy

EPIC charged that the survey data is too politically important to be kept secret. "The requested surveys were part of the FBI's long-standing campaign to gain passage of unprecedented legislation," an EPIC statement said prior to the bill's passage.

Earlier documents EPIC obtained through FOIA revealed no technical obstacles to the exercise of court-authorized wire surveillance.

The FBI showed details of the 183 instances to Rep. Don Edwards

Continued on Page 8

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Policy News

Budget for university research cut by 11%

BY Juan Antonio Osuna
CRA Staff

Although the House attempted to slash $900 million from the Defense Department's fiscal 1995 university research budget in June, congressional conferees agreed in September to less severe but still significant reductions.

The final cuts, which passed Congress and are reflected in conference report 103-747, specify a $200 million reduction (or 11%) from the $1.8 billion university research budget request, with $86 million coming from Defensewide research and $19 million from university laboratories. The rest of the cuts will come from Army, Navy and Air Force programs.

Rep. John Murtha (D-PA), chair of the House Appropriations Subcommittee on Defense, instigated the House cut as a message to the university community. Originally, the drastic cut was thought to have been made in retaliation for the fight against appropriation earmarks led by Rep. George Brown (D-CA). Later, Murtha said universities should "share the pain." The final conference report language dwells on excessive overhead.

"The conferees are concerned about overhead charged by universities to Defense research contracts, particularly the amount that DOD must pay annually to universities for overhead ($500 million), and the variability of overhead rates applied to each institution's research projects," the report said.

The report also directed the Defense secretary to submit a report to Congress by Feb. 1, 1995, outlining a plan to tackle this problem.

Although the final $200 million cut is not nearly as drastic as what Murtha proposed, it is substantial enough to signify discontent among some members of Congress. Many observers expect the attack on Defense research funding to be raised again next year.

Fairing better than university research overall was the Computing Systems and Communications Technology (CSCT) program under the Advanced Research Project Agency.

Despite a Senate recommendation to cut $36 million from the $420 million CSCT request, conferees agreed to a more modest cut of $19 million to be spread through various programs detailed in the report. The bulk of the cut stems from a $25 million transfer of funds requested for counterproliferation programs to a new program element administered by ARPA. It is unclear if and to what extent the $200 million cut in university research funding will affect the CSCT program.

The conference report contains several earmarks for various facilities within the home states of key Senators involved in the appropriations process.

Finally, although the House attempted to cut $130 million from the High-Performance Computing Modernization budget request of $183 million, conferees agreed to limit this cut to $20 million.

Wiretap from Page 7

For instance, police will still be able to intercept Internet or online communications by tapping into the facilities of the telecommunications companies. "As critics of the earlier versions [of the bill] had noted, the coverage of the online providers was largely redundant. All these communications still pass over telephone lines," the ACLU said.

While the ACLU endorsed the anti-eavesdropping provision in the legislation for cordless phones, some experts said this provision will be as ineffective as the one in the original Electronic Communications Privacy Act, which made listening to cellular calls illegal. The market is flooded with millions of devices capable of tuning into cordless or cellular frequencies. Experts question how police can enforce anti-eavesdropping laws, given that consumers can eavesdrop so inexpensively and passively.

The most controversial issue for the telephone companies remains cost. The wiretap bill authorizes $500 million over the next four years to reimburse telecommunications carriers for the cost of facilitating wiretaps.

After four years, the carriers must ensure that all new features and services meet the wiretap requirements, which the FBI argues, should be minimal because they will be built in during the design phase.

While industry says it is impossible to accurately estimate compliance costs, many experts say the $500 million estimate falls far short. For instance, the General Accounting Office estimated the cost could run as high as $2 billion to $3 billion, and the United States Telephone Association estimated that it could cost as much as $1.8 billion just to overcome wiretap problems involved with call forwarding.

In its testimony before Congress, AT&T expressed concern about a possible scenario in which government funds would not be available to cover the costs of wiretaps.

"Law enforcement, as represented by the FBI, has repeatedly indicated their intention to compensate carriers for the full cost of retrofitting their existing services and for meeting law enforcement's ongoing capacity requirements," AT&T said. 'This intention is not, however, fully reflected in the proposed bill. Carriers would be obligated to meet all of the bill's requirements, but they would not be [legally] guaranteed access to the funding law enforcement has agreed to provide."

Another issue is whether surveillance at such an expense is a cost-effective form of law enforcement. The ACLU estimates that taxpayers will pay an average of $125,000 per wiretap, just in upgrade costs.

The Bureau of Justice Statistics reported that only 2,000 of more than 14 million people arrested in the United States in 1991 were arrested as a result of wiretaps, EPIC Director Marc Rotenberg said.

Furthermore, frequently cited FBI anecdotes of wiretaps being used to fight extortion and kidnapping only reflect a thin slice of reality, Rotenberg said. Of 856 wiretap warrants issued in 1991 on the federal and state levels, 536 involved narcotics and 114 involved racketeering.

"Kidnapping and extortion were at the bottom of the list," Rotenberg said. 'There were a total of five wiretaps—three at the federal level and two at the state level—for all cases involving kidnapping in 1991. A total of two cases involved loansharking, usury and extortion."

Judge from Page 7

(D-CA), co-sponsor of the wiretap bill and chair of the House Judiciary Subcommittee on Civil and Constitutional Rights, on the condition that the information not be publicly released. However, Edwards said he is opposed to this condition.

"I believe that this information can and should be made publicly available," Edwards, a former FBI agent, said in a recent letter. "I am working with the FBI to that end, since it is important that all interested members of the public appreciate the factual basis for this legislation."

The suit was filed August 9, the same day the legislation was introduced.

Legislation from Page 6

National Public Telecommunications Infrastructure Act of 1994 (S 2195): Directed the Federal Communications Commission to require the reservation of capacity on telecommunications networks for public uses.

Communications Act of 1994 (S 1822): Fostered development of the telecommunications infrastructure by deregulating the telecommunications industry.

Privacy Protection Act of 1993 (S 1735): Established a Privacy Protection Commission consisting of five members appointed by the president for seven-year terms.

Technology for Education Act of 1993 (S 1040): Enhanced the use of new technologies in education and in sustaining a technologically literate work force.

DOE National Competitiveness Technology Partnership Act of 1993 (S 473): Linked Energy Department laboratories with private sector laboratories and implemented a national information infrastructure program by amending the High-Performance Computing Act of 1991.

Emerging Telecommunications Technologies Act of 1993 (S 335, HR 707): Required the Commerce secretary to make additional frequencies available for commercial assignment to promote the development and use of new telecommunications technologies.

National Competitiveness Act of 1993 (S 4, HR 820): Increased funding for high-performance computing R&D, improved education at all levels, built digital libraries accessible over networks and improved electronic communication among health care providers.

FYI from Page 5

available in the United States and Canada.

If you have subscribed or updated your information with us in the last three months, your subscription is not up for renewal. Please contact me if you need to add or change any information on your mailing label.

CRA Taulbee Survey

By now, all department chairs should have returned the 1993-94 CRA Taulbee Survey. The deadline was October 22. If you have not yet returned the survey, please contact CRA and let us know if you are having trouble completing it. We realize the survey has undergone some major changes, but we hope this year's results will be more precise and a better resource for the computing research community.

GHC merchandise

Merchandise from the Grace Hopper Celebration of Women in Computing is still available. A Hopper conference booklet contains profiles of the main speakers, a look at Adm. Grace Murray Hopper and a resource section that lists organizations and publications useful to students, academics and professionals from different areas of computing. People have bought the booklet for the resource information alone. Booklets and posters are $10 each, and T-shirts are $18. Prices include first-class shipping and handling.

CRA Conference tapes

We have made available, at cost, audio tapes of the plenary sessions from the CRA Conference at Snowbird '94. The topics are: "Educating for the 21st Century", "Research in the 21st Century" and "Perspectives on the Conference Themes." A set of five tapes is $20, including shipping and handling. Send your request and mailing address to plouis@cra.org.

If you have any ideas or announcements for this column, please contact Phillip Louis, Computing Research Association, 1875 Connecticut NW, Suite 718, Washington, DC 20009. Tel. 202-234-2111; fax: 202-667-1066; E-mail: info@cra.org. E-mail submissions are preferred.

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Rutgers University
Department of Computer Science

The Department of Computer Science at Rutgers (New Brunswick), the state university of New Jersey, anticipates hiring for a tenure/tenure-track position starting in fall 1995. Particularly sought are individuals pursuing research in systems, especially parallel and/or distributed computing. A candidate should have a Ph.D. in CE/CS and should be committed to excellence in research and teaching.

The department, with 34 full-time faculty members, has graduate and undergraduate programs, granting 32 M.S., 10 Ph.D. and 150 B.A./B.S. degrees in 1993-94. Rutgers offers excellent opportunities for cultural activities and close professional contact with nearby major research laboratories and other leading universities, as well as many on-campus, interdisciplinary centers (e.g. DIMACS and the Rutgers University Center for Cognitive Science).

Candidates should send a curriculum vitae, including names and addresses of three references, and copies of recent papers to Chair, Faculty Search Committee, Department of Computer Science, Hill Center, Busch Campus, Rutgers University, Piscataway, NJ 08855. E-mail: hiring@cs.rutgers.edu.

Rutgers is an affirmative action, equal opportunity employer.

Syracuse University
School of Computer and Information Science

Attention prospective students at the undergraduate and graduate levels: The School of Computer and Information Science (CIS) offers comprehensive programs in computer science, computational science, and systems and information science. CIS is strongly interdisciplinary, reflecting the fact that information and computation are integral parts of many disciplines.

Computer science, and systems and information science degree programs are offered at the bachelor's and master's levels. A master's degree in computational science and a Ph.D. in computer and information science are available. CIS also offers an undergraduate concentration in computational science and master's and doctoral-level certificates.

The research interests of the faculty are in the theory of computation, programming languages, parallel programming, artificial intelligence, computer architectures for symbolic computation, parallel computing, neural networks, computational science, logic programming, and coding theory and combinatorics.

Two independent research centers maintained by Syracuse University—the Northeast Parallel Architectures Center and the Center for Computer Applications and Software Engineering—provide computing and research opportunities for all students.

For application and financial aid information, contact Barbara Rivers, School of Computer and Information Science, Suite 4-116, Center for Science and Technology, Syracuse University, Syracuse, NY 13244-4100. Tel. 315-443-2368; fax: 315-443-1122.

Pennsylvania State University
Department of Computer Science and Engineering

The Department of Computer Science and Engineering is seeking qualified candidates for expected tenure-track positions. Applications in all areas of computer science will be considered, with emphasis in the areas of networking and operating systems. Salary and rank will be commensurate with experience.

Applicants must have completed all requirements for a Ph.D. degree in computer science, computer engineering or a closely related area before assuming duties. Excellence in research and teaching is required. Candidates for senior positions must have an established research reputation supported by a substantial record of publications. Openings are expected for August 1995.

The Department of Computer Science and Engineering maintains a Computer Systems Laboratory consisting of a distributed system of Sun and DEC workstations and file servers running under Unix.

Applications should be received by Feb. 28, 1995. Applications will be considered until suitable candidates can be identified.

Please send a resume and the names of three or more references to Chair, Faculty Search Committee, Pennsylvania State University, Department of Computer Science and Engineering, 220 Box CRA, Pond Laboratory, University Park, PA 16802.

Pennsylvania State University is an equal opportunity, affirmative action employer. Women and minorities are encouraged to apply.

Case Western Reserve University
Department of Computer Engineering and Science

We invite applications for a tenure-track faculty position from all levels. Candidates from all areas of teaching and research will be considered, but the current research areas in the department are VLSI systems and design automation, applied artificial intelligence and logic programming, database systems, and software engineering and systems. Candidates should be prepared to provide instruction in a number of broad areas of computer engineering and science. Candidates should have a Ph.D. in computer science, computer engineering or a closely allied field. Competitive salaries will be offered to attract the best candidates.

The department has 12 faculty positions and 140 graduate students, 50 of whom are in the Ph.D. program. Departmental facilities are based on an Ethernet LAN that is connected to the Internet and supports a Unix operating system and 50 Sun and other workstations.

Applicants should submit their curriculum vitae and names of at least three references to Lee J. White, Chair, Department of Computer Engineering and Science, Case Western Reserve University, Cleveland, OH 44106-7071. E-mail: leew@alpha.ces.cwru.edu.

In employment as in education, Case Western Reserve University is committed to affirmative action and equal opportunity.

Michigan State University
Department of Computer Science

Michigan State University invites nominations and applications for the position of chair of the Department of Computer Science in the College of Engineering, with a starting date of July 1, 1995. The department of 25 tenure-track faculty has a strong commitment to research, teaching and service. Annual research expenditures are about $2 million. The department has strengths in the areas of pattern recognition, image processing and computer vision; parallel and distributed computing; intelligent systems; high-speed networks and performance evaluation; software engineering and formal methods; and database systems. The department attracts excellent Ph.D. students, most of whom are supported as graduate students (80 M.S. and 70 Ph.D.), and 380 undergraduates. Faculty workshops are connected to the MSUnet, which provides access to an array of campus computing resources, including the facilities of the College of Engineering and the department's Pattern Recognition and Image Processing Laboratory, Intelligent Systems Laboratory, High-Speed Network and Performance Laboratory and Advanced Computing Systems Laboratory. The department's computing facilities include more than 150 high-performance workstations, many high-end servers and two workstation clusters interconnected through high-speed switches (ATM and DEC GIGAswitch).

Michigan State University enjoys a park-like campus of 2,100 developed acres and 3,100 acres of experimental farms, outlying research facilities and natural areas. The campus is adjacent to the cities of East Lansing and Lansing. The Greater Lansing area has about 250,000 residents. The communities have fine school systems and place a high value on education.

The chair of the Department of Computer Science must promote the development of a shared vision of academic excellence within the department and represent the department to the academic community at large. The chair must take an active role in faculty development and work with faculty throughout the department to identify and pursue innovations in teaching, research opportunities, outreach activities and a broad range of external funding sources. The chair must promote cultural diversity throughout the department.

Candidates must have an earned doctorate in computer science, computer engineering or a closely related field. Candidates must be qualified to receive an appointment at the full professor rank at Michigan State University. Candidates must have a strong teaching record and a strong record of outstanding research with broad-based funding. Candidates must provide evidence of scientific and organizational leadership, educational innovation and administrative effectiveness. Applications received before Jan. 6, 1995, will receive full consideration.

Please submit a curriculum vitae, e-mail address and the names and contact information (including address, e-mail and fax and telephone numbers) of at least five references to Chair, Search Committee, Department of Computer Science, A714 Wells Hall, Michigan State University, East Lansing, MI 48824-1027. E-mail: chair-search@cps.msu.edu.

Additional information about this position may be obtained by sending e-mail to chair-search@cps.msu.edu.

Michigan State University is an equal opportunity, affirmative action institution and encourages applications from women and members of ethnic minority groups.

Clemson University
Department of Electrical and Computer Engineering

Clemson University invites applications for a tenure-track position in computer engineering at the assistant or associate professor level. Required qualifications include an earned Ph.D. in electrical or computer engineering or a closely allied field, with a strong background in computer networking. Academic or industrial experience is a plus.

The individual selected will be expected to develop and maintain a significant research effort, teach both undergraduate and graduate level courses and assume a technical leadership role in Clemson's interdisciplinary Center for Computer Communication Systems, which is described under Mosaic at www.engclemson.edu.

Send a resume and names and addresses of at least three references to Computer Networking Search Committee, Department of Electrical and Computer Engineering, Clemson University, Clemson, SC 29634-0915. Or send the information via E-mail in ASCII format to dianna.kelley@engclemson.edu. Evaluation of applications will begin Nov. 15, 1994, and continue until the position is filled.

Clemson University is an equal opportunity, affirmative action employer.

Universite de Montreal
Departement d'Informatique et de Recherche Operationnelle

The Departement d'Informatique et de Recherche Operationnelle (DIRO) seeks candidates for two tenure-track positions in computer science and one tenure-track position in operations research starting June 1. In computer science, the preferred area of expertise for one position is quantum computing or cryptography; for the other position, it is artificial intelligence, databases or human-computer interfaces. Each of the latter three domains are oriented toward intelligent tutoring systems or multimedia systems. In operations research, the preferred area of expertise is stochastic aspects of the discipline, but not exclusively.

Universite de Montreal is the largest North American university operating entirely in French. DIRO offers graduate and undergraduate degrees. There are 37 faculty members, including nine specializing in operations research.

Applications, a curriculum vitae, the names of at least three referees and up to three reprints should be sent before Nov. 30, 1994, to Guy Lapalme, Departement d'Informatique et de Recherche Operationnelle, Universite de Montreal, C.P. 6128, Succ. Centre-Ville, Montreal, Quebec, Canada H3C 3J7.

In accordance with Canadian immigration requirements, this advertisement is directed in the first instance to Canadian citizens and permanent residents. Universite de Montreal is an equal opportunity employer.

Northwestern University
Department of Electrical Engineering and Computer Science

The Department of Electrical Engineering and Computer Science seeks outstanding faculty at all levels for a new initiative in computational media, with special emphasis on fundamental enabling technologies. Areas of interest include interfaces, encompassing HCI, interface design and user-interface management systems; computer graphics and animation; very high-level graphical programming environments and authoring systems; distributed multimedia systems, including interactive digital video; multimedia and hypermedia database technology; and augmented reality and virtual reality.

The initiative is aimed at complementing the department's existing strengths in artificial intelligence and interactive learning environments.

Apply to Christopher Riesbeck, Northwestern University, Institute for the Learning Sciences, 1890 Maple Ave., Evanston, IL 60201. E-mail: riesbeck@ils.nwu.edu.

Northwestern University is an affirmative action, equal opportunity employer. Hiring is contingent upon eligibility to work in the United States.

Georgia Institute of Technology
College of Computing

Georgia Tech's College of Computing invites applications for faculty positions at all levels. We primarily are seeking faculty with expertise in graphics, information visualization, human-computer interaction and educational technology. But outstanding candidates in any area will be considered. With an academic faculty of 39 and a research faculty of 10, the college has a current enrollment of 425 undergraduates, 120 master's students and 135 Ph.D. students. One of the college's missions is to interact with other academic units, so candidates with an interdisciplinary

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Professional Opportunities

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research focus and interest in potential joint appointments are most welcome.

Georgia Tech is located in Atlanta (home of the 1996 Summer Olympics) and is a unit of the University System of the State of Georgia.

Candidates should send complete resumes and names of at least three references, preferably by Jan. 15, 1995, or until positions are filled, to Professor Umakishore Ramachandran, Chair, Faculty Search Committee, College of Computing, Georgia Institute of Technology, Atlanta, GA 30332-0280. Tel. 404-894-5136; fax: 404-894-9846; E-mail: recruiting@cc.gatech.edu.

For more information about the College of Computing, see the World Wide Web at URL http://www.cc.gatech.edu.

Georgia Tech is an affirmative action, equal opportunity employer. Applications from women and underrepresented minorities are strongly encouraged.

Washington University, St. Louis
Department of Computer Science

The Department of Computer Science at Washington University is expanding its research program and invites applications for regular (tenure-track) faculty positions. Applicants should hold a Ph.D. or D.Sc. degree in computer science and have a strong commitment to and record of accomplishment in research. The search will focus on candidates at the assistant professor level, but applications at other levels also will be considered.

Washington University is a leading national university with about 11,000 students and exceptional professional schools in medicine, engineering, business, law, architecture, social work and fine arts. It has an endowment of $1.5 billion and annual federal research support of approximately $150 million. The Computer Science Department is in the School of Engineering and Applied Science. It has about 200 undergraduate majors, 90 graduate students, 16 faculty and an annual external research funding of approximately $4 million. The department plans to grow to about 20 faculty members by the end of the decade to expand its research and graduate programs, while continuing to enhance its already outstanding undergraduate program.

The department and its associated research laboratories have exceptional facilities to support computing research, including more than 150 workstations and file servers and a variety of specialized equipment, including a Sun System 2000 multiprocessor, a Convex supercomputer and a complete computer-visualization laboratory. An experimental eight-node ATM network has been constructed to demonstrate multimedia networking applications ranging from full-rate video distribution to electronic radiology. This soon will support multimedia networking to every faculty member's office. An NSF research infrastructure grant is providing support to expand this further and to extend the ATM network to collaborating faculty members across the university.

The department seeks outstanding candidates whose research is directed toward solving important problems in computer science and technology. A major research focus in the department over the next several years will be distributed multimedia computing and communication systems. Consequently, we are particularly interested in individuals with an interest in distributed computing, high-speed networks, high-performance computing and advanced user interfaces. The department also has strong research interests in artificial intelligence and the computational sciences. Applications from outstanding candidates in these and other areas are welcome.

Washington University is located on a pleasant, 168-acre suburban campus adjacent to Forest Park, one of the largest municipal parks in the country and home to the St. Louis Zoo, the Art Museum and the Science Center. St. Louis is a delightful place to live, with many fine residential neighborhoods, a minimum of urban hassles and all the amenities one expects of a major metropolitan area, including a world-class symphony orchestra, an excellent baseball team, one of the world's most beautiful botanical gardens and a rich and varied theater community.

Qualified applicants should send a curriculum vitae and the names and addresses of at least three references to Dr. Jonathan Turner, Chair, Department of Computer Science, Campus Box 1045, Washington University, One Brookings Drive, St. Louis, MO 63130-4899.

Applications will be considered as they are received. Those received after Dec. 1, 1995, may not receive full consideration. Washington University is an equal opportunity, affirmative action employer.

Texas A&M University
Department of Computer Science

The Department of Computer Science invites applications for tenure-track faculty positions at the assistant, associate and full professor levels. Research areas of particular interest are database systems, information retrieval systems, multimedia systems, programming languages and software engineering. However, exceptional candidates from all areas of specialization will be considered.

Candidates should have a Ph.D. in computer science, computer engineering or a closely related field; a strong commitment to both research and teaching; and demonstrated ability to perform research and acquire external funding appropriate to the rank being sought.

Applicants should send a statement of research and teaching interest; a complete resume; and the names, postal addresses, E mail addresses, telephone numbers and fax numbers of at least three references to Faculty Search Committee, Department of Computer Science, Texas A&M University, College Station, TX 77843-3112. Applications will be accepted until the positions are filled.

Applications from minority and female candidates are especially encouraged. Texas A&M University is an affirmative action, equal opportunity employer committed to diversity.

Arizona State University
Department of Computer Science and Engineering

The Department of Computer Science and Engineering seeks outstanding candidates for tenure-track faculty positions, with primary emphasis in the areas of computer architecture, information systems, database management and software engineering. Rank is open. Applicants are required to have completed a Ph.D. in computer science, computer engineering or a closely related field by the date of appointment, and must show exceptional promise in teaching and research.

Arizona State University is a major research university widely recognized as one of the most rapidly emerging educational institutions in the United States. The main campus is in the city of Tempe, in the metropolitan Phoenix area. The College of Engineering and Applied Sciences has been recognized for its innovative Engineering Excellence Program, a three-way partnership between state government, the university and high-technology industry.

Please send a curriculum vitae, a selection of most important publications and the names and addresses of four references to Dr. Stephen S Yau, Chair, Department of Computer Science and Engineering, Arizona State University, Tempe, AZ 85287-5406. E-mail: cs-facsearch@asu.edu.

Questions and inquiries may be submitted by E-mail, but applications and nominations must be received by post. The closing date is Jan. 10, 1995. Applications received after that date will be reviewed as necessary until the positions are filled. Salary is competitive.

Arizona State University is an equal opportunity, affirmative action employer.

Cornell University
Department of Computer Science

Applications are invited for tenure-track positions beginning August 1995. These positions are at the assistant professor level, although appointments at the associate and full professor level will be considered for highly qualified applicants. Applicants should have a Ph.D. in computer science or in a closely related field. The department requires demonstrated research accomplishment at a very high level as well as teaching ability and leadership qualities.

The Department of Computer Science at Cornell University encompasses a wide range of research areas, including algorithms, applied logic and semantics, artificial intelligence, computing theory, concurrency and distributed computing, databases, information organization and retrieval, numerical analysis and scientific computing, programming languages and methodology, and robotics and computer vision.

Other available positions:

• Lecturer to teach first- and second-year computer science courses and participate in curriculum development.

• Research positions in scientific computing and software systems.

Applicants should submit a curriculum vitae and the names of at least three references to Chair, Faculty Recruiting Committee, Department of Computer Science, 4130 Upson Hall, Cornell University, Ithaca, NY 14853-7501.

Cornell University is an equal opportunity employer and welcomes applications from women and underrepresented minorities.

Northeastern University
College of Computer Science

The College of Computer Science invites applications for a tenure-track faculty position at all ranks, especially in the areas of networks, distributed computing, information systems, high-performance computing, software development and graphics. Exceptionally qualified candidates in other areas will be considered. A Ph.D. in computer science or a related field is required.

The college has a diverse full-time faculty of 19, and 300 undergraduate, 150 master's and 40 Ph.D. students. The faculty has significant external support and is engaged in a broad range of successful research programs. Research seminars draw upon extensive computer science talent from the greater Boston area. The college maintains state-of-the-art equipment, including three parallel computer architectures (Masspar, PCM-2 and transputer), a large network of SPARC and DEC workstations and additional specialized laboratories: a virtual-reality lab, a multimedia lab and a Macintosh teaching lab.

Please send a resume, statement of research interests and names of three references to Faculty Hiring Committee, College of Computer Science, 161 Cullinane Hall, Northeastern University, Boston, MA 02115. The applications deadline is Feb. 1, 1995. For more information, send E-mail to hiring@ccs.neu.edu.

Northeastern University is an equal opportunity, affirmative action employer. We strongly encourage applications from women and minorities.

George Mason University
Department of Computer Science

We invite applications for faculty at the ranks of assistant and associate professor. We are particularly interested in persons dedicated to teaching, research and professional service. Our priorities in research are computer graphics, graphical user interfaces and multimedia computing. Applicants should be prepared to teach in these areas, plus in algorithms and data structures, programming languages and computer systems. Appointments start Sept. 1, 1995.

George Mason University is located in Fairfax County, VA, 17 miles west of Washington, DC. The Department of Computer Science is in the School of Information Technology and Engineering, which has made a commitment to engineering education in a world shaped by information technologies. There are numerous opportunities for government and industrial interaction in this region.

To apply, send a letter of application, a resume, samples of two recently written works and the names of four references. The application letter should state 1) your professional objectives, 2) your experiences and goal in research and 3) your experience and effectiveness in teaching. All of these items should be submitted together for proper consideration of your application. Send all material to Professor David C. Rine, Chair Recruitment Committee, Department of Computer Science, Mail Stop 4A5, George Mason University, Fairfax, VA 22030-4444. Send inquiries to recruit@cs.gmu.edu. The application deadline is Feb. 1, 1995.

The university is an affirmative action, equal opportunity employer.

North Carolina State University
Department of Computer Science

Applications are invited for a tenure-track assistant professor position to begin Aug. 16, 1995. This position requires a Ph.D. in computer science or computer engineering and a commitment to excellence in both teaching and research. Candidates should specialize in database systems, interpreted broadly to mean the theory, design and applications of databases and methods for accessing them. Candidates interested in nonstandard types of databases, such as scientific data or multimedia databases, also are encouraged to apply.

The Department of Computer Science is in the College of Engineering, and it offers B.S., M.S. and Ph.D. degrees. There are 26 tenure-track faculty members, 400 undergraduate majors and 125 graduate students. Several faculty specialize in database systems or closely related topics, and student interest in this topic is exceptionally good. The department seeks an ambitious candidate who can help this group achieve higher visibility, and it intends to strongly support such efforts. There are excellent computing facilities, including a Database Systems Lab with dedicated space and equipment. There are numerous opportunities for collaboration and consulting with local industry and for joining interdisciplinary research projects within the department and the university.

The College of Engineering is highly ranked in national surveys and has several major research centers funded by NSF, NASA, ONR and industry. NCSU is the Land Grant university of North Carolina. It is one of the top 10 universities in the country in industry funding. The university is in Raleigh, consistently rated one of the best places to live and work in the United States. Raleigh forms one vertex of the world-famous Research Triangle, which has a high concentration of high-tech companies, including more than 150 software companies.

Interested candidates should send their curriculum vitae (including citizenship and visa status) and the names of four references to Database Recruitment Chair, Department of Computer Science, North Carolina State University, Raleigh, NC 27695-8206. Prospective candidates are encouraged to find out more by sending electronic mail to databasesearch@csc.ncsu.edu.

NCSU is an equal opportunity, affirmative action employer.

University of Texas, Austin
Department of Computer Sciences

The Department of Computer Sciences at the University of Texas at Austin invites applications for tenure-track positions at all levels, particularly at the assistant professor level. Of interest to the department are candidates whose research accomplishments are in experimental systems that will broaden and complement the research interests of our faculty in architecture, compilers, databases, graphics, networking, operating systems, robotics and scientific computing. Candidates must hold or be making satisfactory progress toward a Ph.D. or equivalent degree in computer science or a related area, with a reasonable expectation of completion by Aug. 31, 1995. Offers of employment are contingent upon completion of the Ph.D. degree requirements by that date. Successful candidates are expected to pursue an active research program, perform both graduate and undergraduate teaching and supervise graduate students.

The department is ranked among the top 10 computer science departments in the country. It has 40 faculty members throughout all areas of computer science. Austin, the capital of Texas, is located on the Colorado River, at the edge of the Texas Hill Country. Live music and outdoor recreation are among the many attractions of this beautiful area. Austin is also a center for high-technology industry, including AMD, IBM, MCC, Motorola, Sematech, Tandem and TI.

Applicants should submit a curriculum vitae, a statement of research interests, a list of references and up to three representative publications by Jan. 15 to Professor Al Mok Recruiting Committee Chair, Department of Computer Sciences, University of Texas at Austin, Austin, TX 78712-1188.

Letters of reference will be sought separately. Women and minority candidates are especially encouraged to apply. The University of Texas is an equal opportunity, affirmative action employer.

University of Rochester
Department of Computer Science

The Department of Computer Science at the University of Rochester invites applications for a tenure-track position in the systems area at the rank of assistant professor. Candidates must have received, or be about to receive, a doctorate in computer science or a related discipline and must demonstrate exceptional potential for both research and teaching.

Our department is small (12 faculty members), with a strong record of research publication and external funding. We offer an outstanding research environment with excellent students and facilities, and an unusually close-knit and collegial atmosphere. Current research interests include artificial intelligence (vision/robotics, natural language/

Professional Opportunities

knowledge representation), parallel systems and theory of computation. Approximately 40 students are enrolled in the Ph.D. program. There is no professional master's program. Plans are underway to establish a selective undergraduate major beginning in 1995.

Applicants should send a curriculum vitae, copies of relevant papers and the names and addresses of at least three references to Faculty Recruiting Committee, Department of Computer Science, University of Rochester, Rochester, NY 14627-0226.

The University of Rochester is an equal opportunity, affirmative action employer. Women and members of minority groups are strongly encouraged to apply.

York University
Department of Computer Science

The Department of Computer Science at York University invites applications for tenure-track faculty positions at the assistant professor level. The department plans to develop its overall faculty strengths through these new positions and has particular interests in computer and software systems, computer networks, parallel algorithms and architecture, programming languages and databases. However, outstanding perceived quality is our main criterion and excellent candidates from any area are strongly encouraged to apply. A recent Ph.D. in computer science is required. Applicants must demonstrate strong potential for excellence in research and teaching at both the graduate and undergraduate levels.

The department has grown to more than 25 faculty members and recently moved to expanded facilities in the new Chemistry and Computer Science Building. York University, the third-largest university in Canada, is located in Metropolitan Toronto and is within easy reach of downtown Toronto.

Send curriculum vitae and the names of four references to Patrick Dymond, Department of Computer Science, CCB126, Faculty of Pure and Applied Science, York University, 4700 Keele St., North York, Ontario, Canada, M3J 1P3.

Applications should be received by Dec. 15, 1994, but applications received before Jan. 31, 1995, also will be considered if positions remain available. Appointments are subject to the commitment of funds.

York University has a policy of employment equity, including affirmative action in recruiting female faculty members. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

Rensselaer Polytechnic Institute
Department of Computer Science

The Department of Computer Science invites applications for a tenure-track junior faculty position. Postdoctoral and visiting appointments also may be available. Preference will be given to applicants in computer systems, particularly in networks, distributed/parallel systems and databases. However, exceptional candidates in all areas will be considered. Applicants should have a doctorate in computer science or a related area and a commitment to excellence in teaching and research. The department offers S.B., M.S. and Ph.D. degrees in computer science and has excellent computing facilities.

Send resumes and three references to Professor Boleslaw Szymanski, Chair of the New Staff Committee, Department of Computer Science, Rensselaer Polytechnic Institute, Troy, NY 12180-3590.

Rensselaer is an equal opportunity, affirmative action employer.

University of California, Berkeley
Department of Electrical Engineering and Computer Sciences; Computer Science Division

The University of California at Berkeley invites applications for tenure-track positions in electrical engineering and computer sciences beginning fall semester 1995. We expect between one and four faculty positions, pending final budgetary approval. Applications for appointments at the assistant professor level will be given highest preference, but other levels also will be considered.

Applicants should have received (or be about to receive) a doctoral degree in computer science, electrical engineering, computer engineering or a related field. All areas of research in computer science and electrical engineering will be considered. A principal requirement is demonstrated excellence in research. In addition, potential for excellence in teaching and leadership are important requirements. Successful applicants will be expected to set up a quality research program and to teach both graduate and undergraduate courses in their general area of specialty.

Interested persons should send a resume, a select subset of papers, a one- to two-page statement of their future research plans and interests, and the names of three references by Jan. 20, 1995, to the appropriate address below. In addition, the applicant should ask the three references to send letters directly to the same address. These letters will not be requested directly by the department. Applications submitted after the deadline will not be considered.

Send electrical engineering applications to Professor David Messerschmitt, Chair, Department of Electrical Engineering and Computer Sciences, 231 Cory Hall, University of California, Berkeley, CA 94720-1770.

Send computer science applications to Professor Robert Wilensky, Associate Chair, Computer Science Division, 381 Soda Hall, University of California, Berkeley, CA 94720-1776.

The University of California is an equal opportunity, affirmative action employer.

University of California, Santa Barbara
Department of Computer Science

The Department of Computer Science at the University of California at Santa Barbara invites applications for a junior tenure-track faculty position. Applicants should demonstrate exceptional promise. The College of Engineering and the Department of Computer Science have embarked on a multiple-year plan to strengthen the department in experimental computer science. Applicants in all areas of computer science are welcome. However, special emphasis will be given to software systems research.

The Department of Computer Science is part of an expanding College of Engineering, which encompasses more than 100 faculty in various engineering disciplines. Excellent instruction and research computing facilities are available. UCSB is a major research institution and member of the nine-campus University of California System, widely regarded as the most distinguished system of public higher education in the United States. Graduate degrees in computer science are offered at the M.S. and Ph.D. levels.

Applicants should hold a doctoral degree in computer science or a related field. Appointments are scheduled to begin in 1995-96. Send resume and names of at least four referees to Recruitment Committee, Department of Computer Science, University of California, Santa Barbara, CA 93106-5110.

The University of California is an equal opportunity, affirmative action employer.

New Mexico Institute of Mining and Technology
Department of Computer Science

The New Mexico Institute of Mining and Technology seeks applicants for two new tenure-track positions in computer science. We wish to fill the position of department chair and an additional position. Applicants for the position of department chair must be qualified for appointment at the full or associate professor rank and have demonstrated outstanding achievements in research, teaching and academic leadership. Candidates must have an earned Ph.D. in computer science or computer engineering at the time of appointment and demonstrated potential for excellence. The ability to teach graduate and undergraduate courses and conduct research in major areas of computer science is essential.

The ideal candidates will broaden, complement or strengthen our faculty research interests in programming languages, software engineering, databases, computer architecture and networks, neural networks, artificial intelligence, verification and theory. Duties include teaching, research, thesis supervision and service.

New Mexico Tech is a scientific and technical institute with 1,700 students. The Computer Science Department (offering S.B.

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Elsevier

AD # 1

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Canadian News

Can Canada develop an electronic highway?

BY Douglas Powell

New-found political willpower, better technology and, most importantly, a stunning about-face by federal regulators may finally invigorate the plodding efforts to develop Canada's version of the information highway. But without improvements in local access to high-speed backbones, the country will be separated by a few information-haves riding electronic superhighways, and many information-havenots traveling electronic cow paths.

The main stumbling block has been the cost of high-speed data lines. Even fractional-T lines are at least two to three times more expensive than in the United States. Canadian rates also are artificially skewed through regulation, where local telephone service is subsidized by long-distance revenues.

That is about to change. In late September, the Canadian Radio-television Telecommunications Commission ruled that telephone companies could raise local charges by $72 over three years, with the revenues being used to reduce long-distance charges. The result should be more affordable, high-speed telecommunications. However, it may be too little, too late. A report commissioned by the federal government found that many of the country's business and academic leaders fear the window of opportunity for the information superhighway is closing. The United States is considered to be at least two years ahead. Further, Canada lacks any leadership.

The report is based on interviews and focus groups, consisting of a range of network suppliers and network users across Canada, conducted between December 1993 and February 1994. The report, written by Angus TeleManagement Group in Ajax, Ontario, and Toronto-based Decima Research, concluded that Canada still has the choice "to be a leader or to fall behind." According to the 183-page report, *Canada's Information Highway: Services, Access and Affordability*, the federal government must develop an integrated policy that would do the following:

• Redefine "universal service." To participate in the information highway, all Canadians need single-party digital-access lines and electronic access to government services and public information databases.

• Support the interconnection and interoperability of all public networks, making Canada's infrastructure open and accessible to all users and service providers on a non-discriminatory basis.

• Support increased and fair competition in networks and services.

• Establish clear guidelines and criteria for government support of network users and user groups.

• Support increased access to high-bandwidth interactive network capacity by all users, in particular by small business and institutional users in regional economies.

• Support measures to rapidly extend network access connections to all schools and health care institutions and include special rates as needed to make information networks and services affordable for the education and health care sectors.

The report will form the basis of a government action plan to be issued in the near future under the auspices of the Information Highway Advisory Council created in March. Actions by the council would have to comply with four federal operating goals for governing the information highway. The goals are to have:

• an interconnected and interoperable network of networks;

• collaborative public- and private-sector development;

• competition in facilities, products and services; and

• privacy protection and network security.

According to researchers at Bell Northern Research (BNR), the intercity public backbone networks of the year 2001 will be capable of transmitting 50 gigabits/sec. through optical channels—20 times faster than today's fastest intercity networks. The challenge is to provide high-speed access at a reasonable cost to as many individuals and institutions as possible. BNR engineers interviewed in the report said a hybrid network, with fiber in the backbone and coaxial connections to the home, is the optimal combination of media for delivering high-bandwidth services.

The main stumbling block of a Canadian information superhighway has been the high cost of high-speed data lines.

Stentor, the consortium of Canada's nine major telephone companies, announced plans in April to add broadband capacity to regional and national networks, and to spend $8 billion (Canadian) by 2005 to convert their local-access networks to a hybrid fiber-coaxial infrastructure. Although more than 98% of all Canadian homes—and virtually all businesses—are connected to the telephone network, there is a bottleneck in local, high-speed access.

"We have islands of networks rather than a network of networks," the report said. Because universities often are the custodians of the local connection to CAnet (the national backbone) and thus provide Internet access, administrators increasingly are facing problems with the information-have and information-have-not communities. University researchers want as much bandwidth as possible, which must be balanced against the needs of the larger community, especially because all Canadian universities are publicly funded. Network administrators and academics throughout the country, particularly those in small- and medium-sized universities, told the authors of the report they feel a pressure to provide for the needs of their local communities as well as the university researchers and students. And that's expensive.

"I provide a rack of modems. Is it going to cost me a minimum of a million dollars a year as an investment, and at least $200,000 per year in ongoing operating costs," a focus group participant from Calgary said. "I can't find anybody that is willing to help me out at that level."

Douglas Powell is a graduate student at the University of Guelph in Ontario.

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M.S. and Ph.D degrees) will have eight faculty members after the current openings are filled, and it currently has about 100 students. There are excellent facilities for research and teaching and opportunities to interact with nearby institutions including the National Radio Astronomy Observatory and Los Alamos and Sandia national laboratories.

New Mexico Tech is located in the Rio Grande Valley with fabulous weather and endless outdoor recreational opportunities.

Send applications (include the names of at least three references, a one-page description of research interests and accomplishments, and transcripts of graduate work) to New Mexico Institute of Mining and Technology, Human Resources, Weis Hall, Box C-085A, Socorro, NM 87801. E-mail applications to tellinger@admin.nmt.edu. E-mail inquiries to al@nmt.edu.

New Mexico Tech is an equal opportunity, affirmative action employer

Northwestern University

Department of Electrical Engineering and Computer Science

The Department of Electrical Engineering and Computer Science is seeking outstanding faculty at the assistant and associate professor levels in computer systems. Areas of interest include computer architecture, ASIC, parallel processing, computer graphics, compilers and operating systems. Other areas of interest include hardware and software areas that support multimedia systems, multimedia networks and new forms of human-computer interaction

The deadline for nominations and applications is May 1995, but the search will continue until suitable candidates are found. Please send applications to Jorge Nocedal, Department of EECS, Northwestern University, Evanston, IL 60208-3118. Tel. 708-491-5038; fax: 708-491-4455; E-mail: nocedal@eecs.nwu.ed.

Northwestern University is an equal opportunity, affirmative action educator and employer. Applications from women and minorities are especially encouraged. Employment verification required upon hire.

State University of New York, Buffalo

Department of Computer Science

The Department of Computer Science seeks candidates for faculty positions at the assistant or associate professor levels. We will consider only candidates who demonstrate exceedingly high research promise. A Ph.D. in computer science or a related field is required prior to assuming duties. We seek candidates in experimental areas of computer science who will collaborate with researchers in other disciplines. We are especially interested in strong candidates who will help develop a thrust in digital libraries.

The department has 16 tenure-track faculty, three full-time lecturers and nine research and adjunct faculty members. Primary research areas include AI, complexity theory, computer vision, numerical linear algebra, parallel algorithms, pattern recognition, programming languages, systems and VLSI. Department members are actively engaged in interdisciplinary research with the Graduate Group in High-Performance Computing, Cognitive Science Center, Hauptman-Woodward Medical Research Institute Inc., NSF National Center for Geographic Information and Analysis and the USPS Center of Excellence for Document Analysis and Recognition.

Send applications, including cover letter, curriculum vitae, a one-page research statement and names and addresses of three references, to Professor Sreejit Chakravarty, Chair, Recruiting Committee, 226 Bell Hall, Department of Computer Science, State University of New York at Buffalo, Buffalo, NY 14260-2000. Tel. 716-645 3180 Ext. 109; fax: 716-645 3464; E-mail: sreejit@cs.buffalo.edu.

SUNY is an equal opportunity, affirmative action employer

Duke University

Department of Computer Science

We invite applications and nominations for a tenure-track or tenured faculty position at all ranks starting September 1995. The search is restricted to two fields of interest: experimental systems and artificial intelligence. Areas of primary interest in experimental systems include operating systems, computer architecture and digital systems design, high-speed networks, software development environments, parallel processing, databases and object-oriented systems, multimedia, graphics and algorithm animation, and compilers. Areas of primary interest in artificial intelligence include robotics and intelligent systems, natural language processing, planning, knowledge representation, reasoning systems, learning, automatic programming, collaborative agents, multimodal communication, and artificial intelligence architectures and languages.

The department has major research efforts and funding in the areas of systems architecture, algorithms complexity, scientific computing and artificial intelligence. Facilities include a CM-5 parallel computer, more than 120 computers and high-performance graphics workstations and access to a variety of supercomputers through MCNC in nearby Research Triangle Park. The department also connects to the North Carolina Information Highway, the first fully integrated and functioning high-speed statewide network in the United States.

The department recently relocated to spacious new quarters in the $80 million Levine Science Research Center, a state-of-the-art facility devoted to interdisciplinary research in computer science, environmental science, biomedical science and engineering and medicine.

The Durham, NC, area, rated by *Money* and *Fortune* magazines as the best place in the United States to live and work, offers a wide variety of professional, cultural and recreational attractions.

Applications should include a curriculum vitae, a list of publications and copies of the most important publications. A Ph.D. in computer science or related area is required. Applicants should also request at least four letters of reference to be sent directly to the faculty search chair. To guarantee full consideration, applications and letters of reference should be sent by Dec. 1, 1995, to Professor Carla Ellis, Faculty Search Chair, Department of Computer Science, Duke University, Durham, NC 27708-0129

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