FINAL REPORT

SUPERCOMPUTER STUDY COMMITTEE

Presented to the Legislative Council
and the Iowa General Assembly
January 1991

Prepared by the Legislative Service Bureau

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AUTHORIZATION AND APPOINTMENT

The Supercomputer Study Committee was established by the Legislative Council to assess the uses and needs for a supercomputer by Iowa's university and business communities and to explore the costs involved in Iowa's acquiring a supercomputer and the possibility of sharing the technology with other states.

Members serving on the Study Committee were:

Mr. Tom Urban, Chairperson, Des Moines
Senator Jack Nystrom
Senator William Palmer
Senator Paul Pate
Senator Richard Varn
Senator Joseph Welsh
Representative Janet Adams
Representative Rod Halvorson
Representative Mary Lundby
Representative David Osterberg
Representative Bill Trent
Mr. Greg Carmichael, Iowa City
Mr. Michael Crow, Ames
Ms. Mary Ann Hausmann, Cedar Falls
Ms. Jane Lowrance, Cedar Rapids

COMMITTEE PROCEEDINGS

The Study Committee was authorized two meeting days which were held on August 23 and November 19, 1990.

During the August 23 meeting the Study Committee received the following presentations:

Mr. Michael Barry, Account Manager with Cray Research, Inc. addressed the Committee with some general observations about supercomputers, including a

definition of the term supercomputer, a description of several of the possible applications of supercomputers, and also a discussion of the benefits a supercomputer would provide for Iowa. Mr. Barry concluded his presentation with a short video showing some of the current problems being solved with the aid of supercomputers.

Mr. Michael Crow, Director of the Institute for Physical Research and Technology at Iowa State University, discussed the present condition of the University's computer operations, noting many recent investments. Mr. Crow concluded his remarks by recommending a more detailed assessment of the computing needs of industries and universities in Iowa and describing the benefits of a supercomputer to Iowa.

Mr. J. Michael Yohe, Director of Information Systems and Computing Services at the University of Northern Iowa indicated that UNI is most concerned with its general computing needs. Mr. Yohe noted, however, that he believes supercomputer access is a necessity to allow people to be trained in supercomputer usage. Mr. Yohe specified that if the needs for a supercomputer in Iowa are documented, then UNI would enthusiastically support a decision for supercomputer acquisition.

Mr. Fred Harris, Associate Vice President and Director, Office of Information Technology at the University of Iowa, stated that supercomputer access is very desirable, especially since it would enhance the research component at the University. Mr. Harris also noted that before any decisions are made concerning the acquisition of a supercomputer in Iowa, the computing needs of government, universities and industry in Iowa must be clarified.

Mr. Robert Lutz, Director of Computing and Telecommunications at Drake University, supported the position that a supercomputer would benefit the state of Iowa. Mr. Lutz noted that several Drake faculty members could use a supercomputer if it was available to them. He agreed with other speakers that network access to a supercomputer by users throughout the state and the cost-benefit aspects of a supercomputer in Iowa are topics which require further study.

Mr. Bill Francis, Director of Computing at Grinnell College, also endorsed the idea of a supercomputer in Iowa, noting that approximately one dozen faculty members of Grinnell College could presently take advantage of this type of computer. Mr. Francis listed several questions and concerns which he feels should be answered before a final decision is made concerning Iowa's acquisition of a supercomputer. These topics include training and support, software acquisition, user fees, student usage, and funding.

Mr. David Plazak, Chief of the Bureau of Planning and Research, Iowa Department of Economic Development, shared his thoughts concerning an informational trip he made recently to Minnesota, where he inspected their supercomputing institute. He briefly described their computing capabilities and also noted some advantages and disadvantages of supercomputers.

Ms. Nancy Thoms, Director of the Wallace Technology Transfer Foundation, made a statement before the Committee, expressing her willingness to participate in any future discussions concerning the topic of a supercomputer in Iowa.

Ms. Myrt Levin, Executive Director of the Iowa Business Council, was the concluding speaker of the afternoon. She indicated that in surveying several people concerning the subject of a supercomputer in Iowa, both benefits and questions were identified. While it is felt a supercomputer would bring prestige, increased research activity, and more technology transfer to Iowa, questions were raised concerning the amount of benefit a supercomputer can provide that Iowa does not already have. It was her conclusion that more study is needed on this subject.

Chairperson Urban appointed a Subcommittee to further study several issues raised by Committee members during the meeting. The Subcommittee consisted of Ms. Myrt Levin, Mr. Fred Harris, Mr. Michael Crow, Mr. Michael Yohe, Mr. Bill Francis, Mr. Greg Carmichael, Mr. Dale Nelson, Ms. Nancy Thoms, and Mr. Bob Lutz. The Subcommittee was directed to study the following questions and report back to the Committee at its next meeting:

1. Should Iowa purchase or rent a supercomputer?

2. What upgrading will Iowa's fiber optics telecommunications network need to take advantage of supercomputer data exchange?

3. How should the issue of supercomputer training be addressed?

4. How have states similar to Iowa approached supercomputer usage?

5. What are the current computing needs of Iowa's universities?

During the November 19 meeting, the main topic was the introduction and discussion of the Subcommittee report to the Study Committee.

Ms. Levin summarized the Subcommittee's findings, outlining a proposed six-year plan to increase the overall number of computer workstations and mini-supercomputers and to enhance supercomputer access and the overall computer communications network system throughout the state. Ms. Levin concluded by recommending that Iowa should again study the possibility of purchasing its own supercomputer three years after implementation of the proposed

plan because, by then, the necessary network system would be in place to efficiently make use of a supercomputer. A copy of the Subcommittee's report is attached to this report.

COMMITTEE ACTION

While there was an insufficient number of members present to constitute a quorum for formal recommendations, Chairperson Urban and the Committee members present at the second meeting recommended the following action be taken:

1. Copies of the Subcommittee's report and an oral summary of the report should be given to the Legislative Council, the Telecommunications Information Management (TIM) Council, and the Board of Regents at the earliest available opportunity.

2. A bill request establishing a "Supercomputer Authority" as set out in the Subcommittee's report should be drafted and then forwarded to the appropriate legislative standing committee for consideration during the 1991 General Assembly.

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STATE OF IOWA
RESEARCH AND OUTREACH ENHANCEMENT INITIATIVE

A Plan to Create New Pathways to Enable Iowans
to Share Information With Each Other
And to Stay In Touch With the World

A REPORT TO THE LEGISLATIVE INTERIM COMMITTEE ON SUPERCOMPUTING

TOM URBAN, CHAIRMAN

November 5, 1990

The Study Committee:

Greg Carmichael, University of Iowa
Michael Crow, Iowa State University
William Francis, Grinnell College
Fred Harris, University of Iowa
Myrt Levin, Iowa Business Council
Robert Lutz, Drake University
Dale Nelson, State of Iowa Department of General Services
Gary Rudicil, Legislative Service Bureau
Nancy Tomes, Pioneer Hi-Bred International
J. Michael Yohe, University of Northern Iowa

SITUATION AUDIT

There are approximately 750 workstations adaptable to supercomputing in Iowa today. About 500 are located at Iowa State University, 205 at the University of Iowa campus, and the rest at private colleges.

Several communications systems are used to interconnect present systems with supercomputing capacity. At Iowa State, the linkage is through the NSFNET subsystem, known as MIDNET, which is based in Lincoln, Nebraska. The second is the DOENET which connects the Ames laboratory to the supercomputers in the Department of Energy system.

The University of Iowa operates a medium-speed, campus-wide backbone network which utilizes the same network protocols as the NSFNET. Campus backbone is interconnected to the NSFNET through CICNET and MIDNET external connections. This provides access to national supercomputing facilities attached to the NSFNET. All of the aforementioned workstations have access to NSFNET. There is a need to increase the fiber network on campus and implement higher speed services.

Numbers of faculty and students knowledgeable in the use of supercomputers varies from approximately 500 at Iowa State University and slightly over 100 at the University of Iowa, to about 4 at Grinnell College. It appears that the number of faculty and students trained to use supercomputers correlates directly with available high end workstations.

A survey of a sampling of large manufacturing, service and aerospace industries across the country indicates that purchase of supercomputer time by industry is not a viable method of supporting ongoing operating costs of a state supercomputer. For example, at the Alabama supercomputer site several hundred thousand dollars worth of time has been sold to business, but the contribution is a small percentage of the $7 million annual operating cost of the center. Further, the director estimates that the time spent soliciting and servicing these contracts may well have used up any profits to the center. Most industries surveyed indicated that their research is either proprietary or classified and would preclude use of a public system. Further, most companies that do scientific research on a large scale own their own supercomputers and encourage subsidiaries to utilize the in-house systems.

THE RATIONALE

Iowans historically have supported investments in Iowa education from kindergarten through the university system. As a result, education in Iowa has enjoyed a national reputation for excellence. As we approach the 21st century, there is an increasing awareness of the importance of education as a basic economic development tool.

Iowans are now well positioned to capitalize on their long-standing investments in education. Because of our outstanding existing base of knowledge and technology, Iowa stands to make an extraordinary return on an investment in supercomputing -- certainly higher than most states. However, there are certain areas which must be addressed if Iowa is to gain a leadership position.

Information technology is advancing at an incredible pace. The ability of the citizens of Iowa to utilize information technology as a tool for economic well-being

will depend upon the state's investment now in the basic tools necessary to develop a state-of-the-art technology infrastructure. The state universities have not kept up and need to invest in updated systems today so that faculty and students may use current information technology. Further, Iowa's private colleges, community colleges, and K-12 educational system and business must be brought into the loop so that all Iowa students may continue to excel, and thereby increase the number of well-trained scientists and technicians in the state.

Today there is growing need for developing strong linkages among Iowa university research activities, local Iowa companies and secondary schools. Designing an information system which will allow business and the secondary system to have access to research will strengthen the educational system and the technological community. This will enable scientists and engineers from industry to exchange ideas and expertise with universities and facilitate collaborations. Although sale of computer time to business does not appear to be a viable option for operational support, people-to-people linkages through a state-of-the-art information system is one of the best strategies for technology transfer.

Expanding and interconnecting the state of Iowa computing and supercomputing capacity will enrich all educational institutions and businesses in Iowa by allowing students, instructors, and researchers to access the entire spectrum of science and computer applications. By interconnecting the scientists who are dispersed throughout the academe and industry the state can use electronic technology to further the development and unification of its community of scholars. Industry relies on the research community, especially the university-based research community, for advances in basic technology, new methodologies, and the next generation of trained personnel. Researchers depend upon industry for the instrumentation needed for their investigations and experiments.

Statements made by prospective faculty at Iowa universities as well as an assessment of the resources available to peer institutions demonstrate that the competitive position of universities in Iowa is threatened by a lack of access to state-of-the-art computer technology. Although a small state such as Iowa cannot be a leader in all technologies, it is important that Iowa maintain its reputation for educational and research excellence to attract top-notch faculty and graduate students as well as the grants and contracts to support continued excellence in technological and other intellectual pursuits.

This report is written in the context of economic realities in the state of Iowa, recognizing that scarce resources must be divided to meet many important needs. At the same time, the committee believes that an investment in Iowa's technology today will reap significant rewards in the future.

A strong and innovative feature of the plan is bringing the K-12 educational system into the computer network to foster interaction among the primary and secondary schools and universities. This plan will help us reach and maintain the "first in the nation" status of our schools by assuring that Iowa students have access to the best information available to the classroom and laboratory.

From a visionary standpoint, the plan will help Iowans continue and expand their role as fully participatory world citizens. From a practical standpoint, the plan will help eliminate costly, unnecessary duplication of resources.

Doug Gale, program director of the National Science Foundation NSFNET computer network, had the following comment: "Iowa has an excellent national reputation for both its universities and its K-12 and community college education system. Planning now to build an information system which will help to increase educational excellence and economic development for the state of Iowa is an excellent strategy."

THE PLAN

Establish a Supercomputer Authority. The authority shall be constituted by law. Members shall be appointed by the legislative and executive branches, and shall represent all state universities, private colleges and universities, community colleges, the K-12 system and Iowa businesses. Members shall be professionals who are trained to use, design or plan supercomputing systems. The authority shall be responsible for planning, development and implementation of a supercomputer network. All funding requests will come through the authority.

There are four components in providing a scientific or supercomputer network. There is a three-tiered hierarchy of computers and a very high speed network which ties them all together. Each model in the hierarchy is distinguished by cost and computing power, as well as bandwith, location, software support and administrative structure.

- Workstations: High performance computers that can be individual or linked with other workstations in a local area net or wide area net.

- Mini-supercomputers: Powerful computers that bridge the gap between high performance workstations and the fastest computers in the world. They can serve a number of users who have high performance workstations or terminals. These would be in departmental labs, a central campus, or company facility.

- Supercomputer access: A remote connection to a very fast computer capable of performing the millions of mathematical calculations that are used for scientific applications. These are located in centralized facilities such as a state or national center or large industrial site.

- Computer communications networking: High speed communications links that are capable of transporting large quantities of data between network nodes. This provides the essential infrastructure which links the hierarchy of computers. The State of Iowa is in the process of creating a high speed, fiber optics network that can deliver the capacity to network the three levels of identified computing. The Iowa Communications Network (ICN) will be a major factor in the networking of supercomputer resources and the delivering of networked services to schools, universities, libraries, colleges and county governments throughout the state. When the ICN is installed it will be the foundation for high capacity digital communications links that will connect computers and people. The committee strongly supports the continuation of the ICN project.

High performance workstations at various colleges and universities provide the basis for the supercomputer network, K-12 schools, and various government organizations. This would form level one of the three-tier approach.

A second tier would be composed of mini-supercomputers at various strategic locations which would provide an additional level of computing for those workstations whose capacity has been exceeded. Mini-supercomputers would be linked to each other and provide a gateway for access to additional computing capacity when needed.

A third tier would be either a supercomputer owned by the state of Iowa or access to other supercomputer centers where time could be purchased on an as-needed basis. The usage could be monitored and when a supercomputer was justified, one could be purchased.

While the aforementioned components comprise the technical structure, there would be additional requirements to gain the full benefits of the investment.

- Training and education for the use of the supercomputer network. This would range from the research level down to grade schools, government organizations, and private industry.

- Coordination of the computing software and data to provide a dictionary and locator for easy access by users of the system. This would help identify common interest existing databases, existing research, etc.

- Identification of researchers with a commonality of function that would develop a community of common interests where ideas, electronic mail, and other forms of communications could be easily exchanged. This would be of major benefit.

- Very high speed connections to national research and educational network for access to out-of-state colleagues and resources.

The plan is based on two assumptions: (1) that the Iowa research and education network is linked through the Iowa Communications Network, and (2) that it is effectively interconnected to the national networking infrastructure. (The current national backbone for the research and education community, NSFNET, is now being upgraded to DS3 capacity [45 Mbs] and both regional networks with which Iowa's major institutions communicate [MIDNET and CICNET] will have DS3 nodes. Thus, IREN should be connected to NREN via two points, the University of Iowa [a CICNET member] and Iowa State University [a MIDNET member] with DS3 circuits.)

Funding is needed in the areas of:

- The purchase of high performance workstations by educational institutions and government organizations.

- Purchase of mini-supercomputers.

- The purchase or licensing of software for use on the appropriate equipment.

- The monthly maintenance costs associated with each piece of equipment and software.

- The communications or line charges that link the workstations and mini-supercomputers with each other and with supercomputers and the national networks.

- The per hour charge of mini-supercomputer centers and supercomputer centers. The budget includes all hardware, software, and operating costs.

IMPLEMENTATION BUDGET
SUPERCOMPUTER ACCESS PROJECT

This budget represents several assumptions. First, rather than spend $35-40 million on a supercomputer and facility, we would spend over a three-year period about the same kind of money to upgrade Iowa's overall communication capability and interconnectedness. This is built on the assumption that the University of Iowa, Iowa State University, and the University of Northern Iowa would be developed into state-of-the-art computing campuses, given differences in their missions.

The budget represents investments in workstations, mini-supercomputers, on-campus networking, the Iowa Research and Education Network, and supercomputer access (block time). Computing capability has been displayed in such a way so as to maximize the potential of various schools and at the same time provide access within the system through the Iowa Research and Education Network.

Such an investment would, without a doubt, positively alter the fundamental character of the higher education/research enterprise in Iowa. The numbers presented in the budget are all estimates.

Year One

I.	Workstations		$ 8,000,00
	University of Iowa	300 workstations of various levels (average approximately $11,500 per unit)	3,500,000
	Iowa State University	175 workstations of various levels (average approximately $11,000 per unit)	2,000,000
	UNI	130 workstations of various levels (average $7,500 per unit)	1,000,000
	Other colleges	200 workstations of various levels (average $7,500 per unit)	1,500,000
II.	Mini-Supercomputers		$ 3,000,000
	University of Iowa	2 mini-supercomputers and peripherals	2,000,000
	Iowa State University	1 advanced parallel processing machine	1,000,000
III.	On-Campus Networking		$ 1,900,000
	University of Iowa	Ethernet expansion	750,000
	Iowa State University	FDDI expansion	750,000
	UNI	Ethernet mode development	400,000
IV.	Iowa Research and Education Network		$ 2,025,000
	Central Facility	Planning and Design	400,000
	University of Iowa	Communications electronics ($100K) and fiber connects (3 x $50K)	250,000
	Iowa State University	Communications electronics ($100K) and fiber connects (3 x $50K)	250,000
	UNI	Communication electronics ($200K) and fiber connects (3 x $50K)	350,000
	Other Colleges	Communication electronics at 15 colleges (15 x $35K) and fiber connects (25 x $10K)	775,000
V.	Supercomputer Access (Block Time)		$ 750,000
		TOTAL PROGRAM	$15,675,000

Year Two

I.	Workstations		$ 5,800,000
	University of Iowa	200 workstations of various levels (average approximately $11,500/unit)	2,300,000
	Iowa State University	8 graphics workstation clusters ($125,000 per cluster)	1,000,000
	UNI	130 workstations of various levels (average approximately $7,500 per unit)	1,000,000
	Other Colleges	200 workstations of varied levels (average approximately $7,500 per unit)	1,500,000
II.	Mini-Supercomputers		$ 1,950,000
	University of Iowa	Upgrades of systems	1,000,000
	Iowa State University	Graphics laboratory	950,000
III.	On-Campus Networking		$ 1,600,000
	University of Iowa	FDDI development	750,000
	Iowa State University	FDDI expansion	500,000
	UNI	Ethernet expansion	350,000
IV.	Iowa Research and Education Network		$ 2,200,000
	Central facility development		1,500,000
	University of Iowa	(maintenance of fiber connects)	150,000
	Iowa State University	(maintenance of fiber connects)	150,000
	UNI	(maintenance of fiber connects)	250,000
	Other Colleges	(maintenance of fiber connects)	250,000
V.	Supercomputer Access (Block Time)		$ 1,250,000
		TOTAL PROGRAM	$12,800,000

Year Three

I.	Workstations		$ 2,624,000
	University of Iowa	8 graphics workstation clusters ($125K per cluster)	1,000,000
	UNI	3 graphics workstation clusters ($125K per cluster)	375,000
	Other Colleges	10 graphics workstations clusters ($125K per cluster)	1,250,000
II.	Mini-Supercomputers		$ -0-
III.	On-Campus Network		$ -0-
IV.	Iowa Research and Education Network		$ 2,700,000
	Central Facility (operations and equipment)		2,000,000
	Fiber Maintenance of System		700,000
V.	Supercomputer Access (Block Time)		$ 2,000,000
		TOTAL PROGRAM	$ 7,325,000

Years Four Through Six

System Maintenance

Iowa Research and Education Network	$ 3,000,000
Supercomputer Access	$ 2,000,000
BASE PROGRAM AFTER BUILD-UP	$ 5,000,000/Year

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Budget Summary

	Year (In Millions of $)		
	1	2	3
Workstations	8.0	5.8	2.625
Mini-Supercomputers	3.0	1.95	0
On-Campus Networking	1.9	1.9	0
Iowa Research and Education Network	2.025	2.2	2.7
Supercomputer Access (Block Time)	0.75	1.25	2.0
	15.675	12.8	7.325

TOTAL START-UP COSTS: $35.8 Million