to exploration of the Moon and the planets, including Space Station Freedom. In 1992, activities will focus on continued development of the Space Station and increased investments in long-lead exploration technologies such as nuclear power, nuclear propulsion and life support.

BIOTECHNOLOGY

The budget proposes nearly $4 billion for biotechnology R&D.—Biotechnology offers unprecedented opportunities for improving the Nation's health, food supply and environment. In medicine, biotechnology is responsible for a generation of new products that will prevent and treat disease. Significant agricultural advances and environmental techniques are also underway. Twelve Federal agencies are working on biotechnology-related R&D and are developing priorities for future Federal investments.

ENHANCING RESEARCH AND DEVELOPMENT

Research and development (R&D) yields new knowledge, products and processes that, over the long term, result in economic growth and an improved quality of life for all Americans. Investment in research and development is a top priority for an Administration that believes in investing in the future. Investments in research and development form the foundation for the exploration of all of the new frontiers of today and tomorrow.

BACKGROUND: INCREASED INVESTMENTS IN R&D PROVIDE BENEFITS TO THE NATION

R&D investment provides both direct and indirect productivity benefits to society. In addition to the economic benefits associated with R&D, many studies suggest that private (industrial) R&D spending has a very high social rate of return. This social return appears to be much higher than the rate of return to the individual company funding the R&D, giving R&D spending the character of what economists call a "public good." One researcher estimated a social rate of return of 56 percent and a private rate of return of 25 percent for a specific group of innovations. Several decades of econometric research have demonstrated that private sector R&D investments are a strong positive stimulus for private productivity. There is also evidence that Federal R&D spending stimulates private R&D. This appears to be especially true for basic research or pre-competitive, generic applied research that contributes to many industrial sectors.

It is not possible to determine analytically the "optimal" level for total national investment in R&D or the best mix of R&D investments. However, the evidence that increased R&D investment adds to the productivity of the Nation, and that Federal investments are important, provides ample justification for increased Federal investment in R&D as well as for Federal action to increase the level of private R&D investment.

THE 1992 FEDERAL R&D BUDGET: OVERVIEW AND TRENDS

The budget proposes to allocate about $76 billion for R&D, including R&D facilities. This is an increase of over $8 billion, or 13 percent, over 1991 levels. Within this total, $13 billion will be allocated for basic research, an increase of $1 billion, or 8 percent, and $12 billion for applied research, an increase of $903 million, or 8 percent, over 1991. Federal civilian R&D will increase by 10 percent while defense-related R&D will increase by 14 percent.

The ratio of Federal R&D outlays to GNP has been holding steady in recent years at about 1.2 percent, after a sharp drop in the 1970s due to the end of the Apollo project and slower growth in defense. During the 1980s, defense R&D recovered considerably. Federal civilian R&D (excluding defense and space activities) has been nearly level for 30 years at about 0.4 percent of GNP. The budget provides increases and incentives designed to increase Federal R&D investment as a percent of GNP.

Table C–2. THE BUDGET PROPOSES AN $8.4 BILLION INCREASE IN FEDERAL INVESTMENT IN RESEARCH AND DEVELOPMENT

(Dollar amounts in millions)

	Budget Authority				Outlays			
	1991 Enacted	1992 Proposed	Dollar change	Percent change	1991 Enacted	1992 Proposed	Dollar change	Percent change
Governmentwide totals:								
Conduct of R&D:								
Basic Research	12,320	13,320	+1,000	+8	11,597	12,414	+818	+7
Civilian	11,296	12,278	+982	+9	10,623	11,362	+739	+7
Defense[1]	1,024	1,041	+17	+2	973	1,052	+79	+8
Applied Research and Development	51,791	58,758	+6,967	+13	51,839	55,650	+3,811	+7
Civilian	15,031	16,552	1,521	+10	14,045	15,503	+1,458	+10
Defense[1]	36,760	42,206	+5,447	+15	37,794	40,147	+2,353	+6
Subtotal, Conduct of R&D	64,111	72,078	+7,967	+12	63,436	68,065	+4,629	+7
R&D Facilities	3,082	3,545	+464	+15	2,845	3,264	+419	+15
Total, Conduct of R&D and Facilities[2]	67,192	75,623	+8,431	+13	66,281	71,329	+5,048	+8
Conduct of R&D by Agency:								
Defense-military	35,176	40,479	+5,303	+15	36,142	38,421	+2,279	+6
Health and Human Services	9,273	9,836	+564	+6	8,704	9,235	+531	+6
Energy	6,149	6,410	+260	+4	5,810	6,273	+463	+8
National Aeronautics and Space Administration	7,271	8,602	+1,330	+18	6,974	7,767	+793	+11
National Science Foundation	1,828	2,112	+284	+16	1,675	1,897	+222	+13
Agriculture	1,224	1,261	+37	+3	1,152	1,198	+46	+4
Interior	584	562	–22	–4	572	567	–5	–1
Environmental Protection Agency	433	491	+59	+14	418	450	+33	+8
Commerce	517	538	+22	+4	454	499	+45	+10
Transportation	407	435	+28	+7	373	411	+38	+10
Agency for International Development	385	413	+28	+7	337	445	+108	+32
Veterans Affairs	219	219	—	—	215	219	+4	+2
Other Agencies[3]	645	720	+75	+12	611	684	+73	+12

[1] Includes military-related programs of the Departments of Defense and Energy.

[2] Components may not add to totals because of rounding.

[3] Includes the Departments of Education, Justice, Housing and Urban Development, Labor, the Treasury, the Nuclear Regulatory Commission, Tennessee Valley Authority, Smithsonian Institution, and the Corps of Engineers.

As a percentage of total Federal domestic discretionary spending, total civilian R&D has declined from a peak of 25 percent in the Apollo years to about 13 percent in recent years. Excluding space R&D, civilian R&D has remained relatively constant at about 10 percent of the domestic discretionary budget. Again, the budget seeks to increase this share.

APPLIED R&D: EXPANDING THE FRONTIER OF TECHNOLOGICAL DEVELOPMENT

Traditionally, the Federal Government has supported a broad spectrum of applied civilian R&D in support of agency missions. Unlike basic research, where the Federal role has bee stable and widely acknowledged, the appropriate Federal role in applied civilian R&D has been the subject of debate and has changed significantly over time. Past Federal investments in civilian R&D have led to major technological advances (e.g., computers, new aircraft) while others have been major failures (e.g., synfuels plants).

The Administration believes that appropriate Federal investments in applied civilian R&D can result in high payoff to the economy, and the budget provides for R&D funding increases across a wide range of technology areas. In total, the budget proposes about $17 billion, an increase of $1.5 billion or 10 percent.

The principal strategy for the Federal applied civilian R&D programs is to invest in R&D areas that support agency mission requirements, but also where some of the R&D has broad applications in the private sector ("dual use" technologies), even though these commercial applications would not necessarily by funded by the government. In such cases, the Government's role is to support generic or enabling technologies at the pre-competitive stage of R&D:

- generic or enabling technologies have the potential to be applied to a broad range of products or processes across many firms;
- pre-competitive R&D is the stage of the R&D process where the results can be shared widely within and between industrial sectors, without reducing the incentive for individual firms to develop and market commercial products and processes based upon the results.

There are a number of different mechanisms that agencies may use to support generic applied research and technology development. These include: cost-sharing of individual projects; creation of R&D consortia (often involving government, industry and university laboratories; and more informal government/university/industry collaboration). Overall, the budget provides increased funding for all major civilian applied research and development areas.

Increased investments in applied civilian R&D will support technology development across a number of agencies and programs in support of both agency mission needs and a broad technology base for potential future commercial applications. This increased emphasis on federally supported technology development should not be confused with industrial policy. The Administration remains opposed to efforts to target specific industries (e.g., consumer electronics) for R&D assistance to develop new products (e.g., high-definition television).

1992 Budget Initiatives in Applied Research and Development

High Performance Computing and Communications.—The budget proposes $638 million for Federal support for R&D focused on high performance computing and communciations. High performance computing systems (i.e., hardware, software, networks, etc.) are likely to have a significant positive impact on productivity. For example, supercomputers have been credited with bringing the Ford Taurus, currently the best-selling American-made car, to market much sooner, with higher quality, and at significantly lower cost than would have been possible without them. While the supercomputer industry has grown from $89 million in worldwide revenues in 1980 to over $1.1 billion in 1990, it is still a very small market (less than one percent of the worldwide computer market) and traditionally limited to very complex public and private high-risk, high-return ventures (e.g., oil and gas exploration, defense and aerospace systems, etc.). A similar situation exists with high-capacity, high-speed digital networks. Because of the small scale of the market and the high-cost of research, high performance computing has not attracted the private sector R&D investments typically seen in the broader computer industry.

The Federal Government has played a significant role in the development of the supercomputer and network industry. A lead-

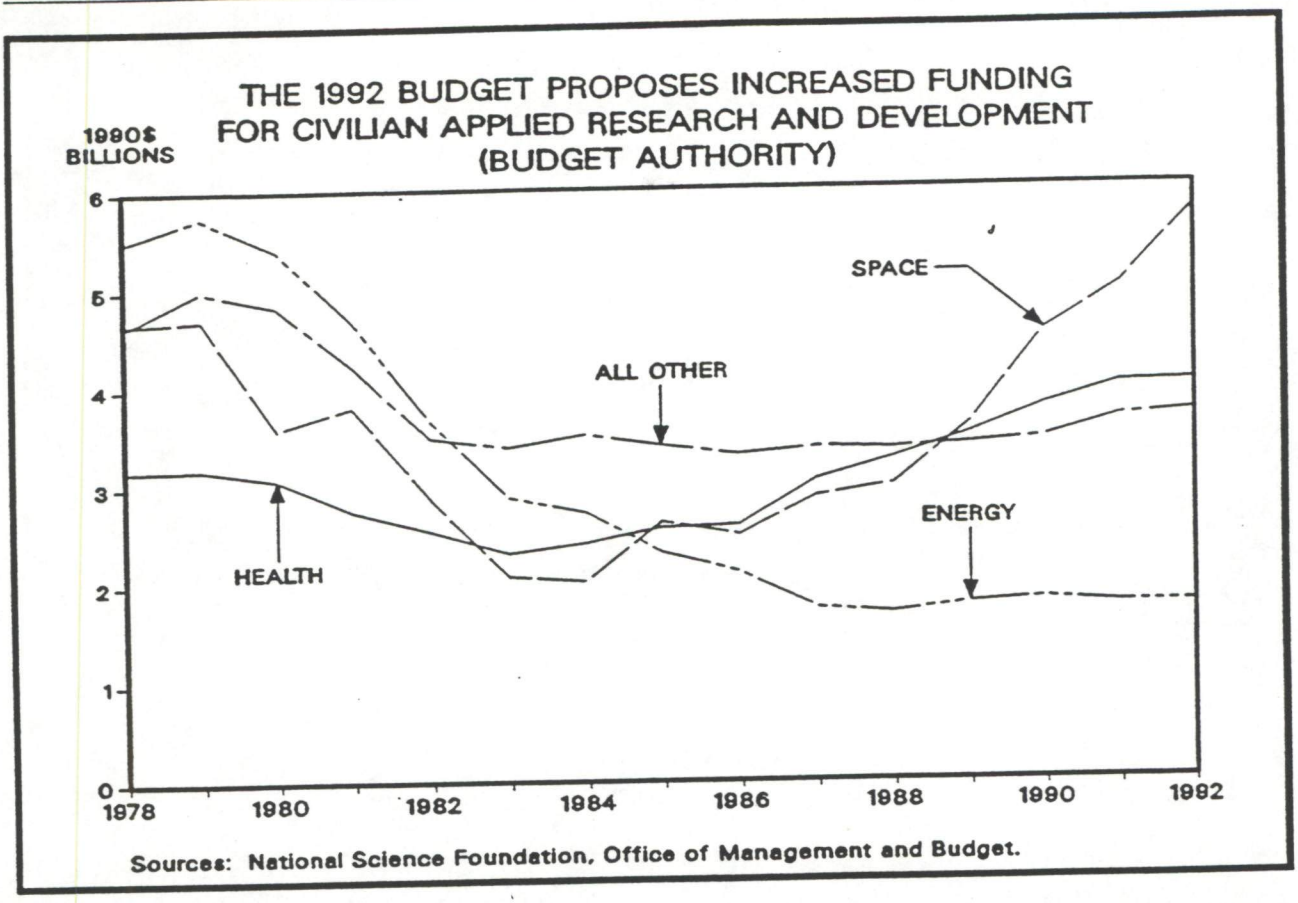

Table C–5. THE BUDGET INCLUDES INITIATIVES IN SEVERAL KEY AREAS OF APPLIED R&D

(Dollar amounts in millions)

Initiative	Budget Authority			
	1991 Enacted	1992 Proposed	Dollar change	Percent change
High Performance Computing and Communications	489	638	+149	+30
Advancing New Energy Technologies	676	903	+227	+34
Enabling New Products and Processes: Advanced Manufacturing and Materials	1,316	1,310	–6	—
HIV/AIDS Research	1,152	1,210	+58	+5
Moving Fusion Energy from Science to Engineering	275	337	+62	+23
Improving the Air Transport System: Aeronautics R&D	482	543	+61	+13
Expanding Applied R&D at the National Institute of Standards and Technology	215	248	+33	+15

ing computer industry executive has stated that "If it weren't for the U.S. government, there would be no U.S. supercomputer industry." The role of government R&D in developing innovative computer technologies has its roots in the World War II research that became the foundation for the UNIVAC system. Many of today's commercial high performance

computing system and network advances are attributable to research supported by Federal agencies.

Through the Office of Science and Technology Policy's Federal Coordinating Council on Science, Engineering, and Technology (FCCSET), eight agencies have developed a new integrated research initiative in High Performance Computing and Communications (HPCC). The program focuses on the underlying research and the human talent needed to develop the next generation of supercomputer systems (including hardware, software, and networks).

The goal of the proposed initiative is to meet, by 1996, the needs of Federal research agencies to investigate and understand a wide range of fundamental scientific and engineering computational problems and, at the same time, allow the private sector to "leap frog" over the expected incremental improvements in conventional supercomputers.

Investments in research and technology development are planned in four HPCC program components:

- *High Performance Computing Systems (Hardware):* Undertaking research in scalable computer processors, memory, input/output devices and operating systems needed for scalable teraflop (trillion operations per second) supercomputers. The budget proposes $157 million.
- *Advanced Software Technology and Algorithms (Software):* In the long-run, the return to both the Government and the economy generally of software investments may be even greater than that of hardware investments. The computational model used to simulate the solid rocket booster failure blamed for the Space Shuttle Challenger disaster takes roughly 14 hours to run on a typical research lab minicomputer. Using a parallel processor significantly reduced this time, but optimized software brought it to under five seconds. This component has a large share of the initiative because there is a great need for adequate and affordable software to address unique fundamental scientific and engineering problems. The software usually represents five times the hardware costs. The budget proposes $265 million.
- *National Research and Education Network (Networks and Communications):* The goal of the National Research and Education Network (NREN) is to enable rapid access by the Nation's educational and research institutions to a broad range of Federal resources, including libraries, databases, and scientific facilities (e.g., computers, telescopes, accelerators). The focus of this element would be on integrating and up-

Table C–6. **THE BUDGET PROPOSES A 31 PERCENT INCREASE FOR HIGH PERFORMANCE COMPUTING**

(Dollar amounts in millions)

Agency	Budget Authority			
	1991 Enacted	1992 Proposed	Dollar change	Percent change
Defense (DARPA)	183	232	+49	+27
National Science Foundation	169	213	+44	+26
Energy	65	93	+28	+43
National Aeronautics and Space Administration	54	72	+18	+33
Health and Human Services (National Library of Medicine)	14	17	+3	+21
Environmental Protection Agency	1	5	+4	+400
National Institute of Standards and Technology	2	3	+1	+50
National Oceanic and Atmospheric Administration	1	3	+2	+200
Total, All agencies	489	638	+149	+30

grading existing federally supported research networks and on research in gigabit (billion bit per second) network switches, protocols, software, and security mechanisms. These improvements would be used to enable the transition of the existing Federal research network into a national gigabit research and education network. The budget proposes $92 million.

- *Basic Research and Human Resources (Research/Training):* This component would focus on fundamental "leapfrog" advances in HPCC technology and the training of students in the computational sciences. The budget proposes $124 million.

Advancing New Energy Technologies.—A major element of the Administration's National Energy Strategy (NES) will be increased investment in energy technology R&D. The budget includes $903 million, an increase of $227 million or 34 percent, for increased investments in R&D in support of NES R&D initiatives Governmentwide. The budget proposes $653 million for Department of Energy NES-related R&D, an increase of $134 million or 26 percent. Over the five year period 1992 through 1996, DOE would invest $3.5 billion in NES R&D initiatives discussed in this section.

The NES R&D strategy is based on several key elements:

- an emphasis on R&D areas that, if successful, could lead to significant displacement of petroleum;
- selection of R&D areas based on high R&D payoff potential—i.e., the potential to achieve significant cost and performance improvements;
- a comprehensive, interagency R&D program that includes both technology enhancements (e.g., more efficient engines) and more fundamental system changes (e.g., the potential for high speed rail and Maglev systems to displace automobile and air travel);
- collaborative, cost-shared, Government-university-industry effort. This implementation approach would rely upon industry-joint Government-industry R&D plan- and management and 50:50 cost sharing, with the research performed by industry or universities (except in situations where Government labs have unique research and testing capabilities). The formation of industry R&D consortia would be encouraged where feasible (e.g., in the pre-competitive R&D stage). This implementation approach would maximize the involvement of the ultimate technology users, enhancing the technology transfer process, and would minimize Government overhead costs.

The Department of Energy (DOE) estimates that the NES R&D Initiative could lead to a reduction in oil consumption of 5–8 million barrels per day by the year 2030, depending on the success of the proposed R&D programs.

The NES R&D strategy is intended to foster a new, results-oriented approach, and not merely more-of-the-same traditional Government-funded energy R&D programs. The Federal Government has had a substantial, broad-based energy R&D program since the 1973 oil embargo. From 1980 through 1990, the Government has invested about $21 billion in energy technology R&D. This investment has had relatively little payoff, for a combination of reasons: (1) the inherently high risks of some R&D, (2) poor R&D choices (e.g., synfuels, breeder reactors), and (3) lack of significant private sector financial and management involvement linking R&D to successful commercial deployment. The NES energy R&D initiative will take better advantage of the Nation's tremendous university and private sector technical talent, while avoiding the mistakes of past Government managed, crisis-born energy R&D programs.

The specific components of the NES R&D initiative are shown in Table C–7. These include:

- *Improved Vehicle Propulsion Technology* through research on high temperature diesel and gas turbine engines. Conventional spark-ignited and diesel engines have efficiencies of up to 31 percent. More efficient engines, including gas turbines, could achieve efficiencies approaching 40 percent.
- *Electric Vehicles,* including a new joint auto industry-government consortium to

share of contributions to the cost of the war.

And, it is a good government bill because it sends a very clear signal that Congress is interested in this information, wants this information, and places a very high priority on having this information. The administration has issued figures from time to time on the contributions and pledges of our allies, but in the midst of international turbulence, the administration has hardly assigned the reporting of this information a high priority. That is not the administration's job. That is the job of Congress. And that is why this bill is necessary.

On December 13 of this recent year, I sent a letter to the President along with my distinguished colleague from Delaware, Senator ROTH, requesting periodic updates of contributions pledged and received for Operation Desert Shield. Now that war has been engaged, the costs will indeed spiral upward which, in my view, is sufficient and compelling enough reason to enact legislation in this regard.

The fact of the matter, Mr. President, is that we cannot afford to pay for this war by ourselves. America's contribution of human and military resources is much more than ample. It is a great sacrifice. For this, our Persian Gulf allies, as well as Germany, Japan, and other nations, are benefiting directly, substantially, and quantifiably. While we have defended the oil and territorial interests of our allies, they have received an overwhelming share of the windfall benefits. Recent estimates showed, for instance, that our gulf allies were receiving up to $5 billion per month in windfall oil profits, not to mention the security of their well-defended borders by U.S. troops.

Let me briefly describe this bill, Mr. President. It would require that the Director of the Office of Management and Budget specify each month in a report to Congress the costs incurred and spent by the Defense Department for Operation Desert Shield, to include costs to date for Operation Desert Storm.

These figures would not include those costs that would have been incurred anyway, without these two operations.

Specifically, the costs to be identified in the report would include the following:

First, airlift costs;

Second, sealift costs;

Third, medical costs;

Fourth, costs associated with the call-up of Reserves;

Fifth, operations and maintenance costs;

Sixth, personnel costs;

Seventh, costs of logistical support;

Eighth, fuel cost increases;

Ninth, military construction costs; nd

Tenth, all other costs.

In addition to these categories of costs, the report will list the following, by country:

First, contributions pledged as cash payments;

Second, contributions pledged as in-kind payments;

Third, contributions received as cash payments;

Fourth, contributions received as in-kind payments.

The first report would be submitted not later than 14 days after the date of enactment of the law, and it would cover the period beginning on August 1 of last year.

Mr. President, I would urge my colleagues to support this bill and hope we can put it on a fast track so we can begin to get this information before the supplemental appropriations bill reaches the floor.

By Mr. GORE (for himself, Mr. HOLLINGS, Mr. KENNEDY, Mr. PRESSLER, Mr. FORD, Mr. BREAUX, Mr. BINGAMAN, Mr. ROBB, Mr. KERRY, Mr. KASTEN, Mr. GLENN, Mr. JEFFORDS, Mr. KERREY, Mr. REID, Mr. DURENBERGER, Mr. HATFIELD, Mr. KOHL, Mr. CONRAD, and Mr. RIEGLE):

S. 272. A bill to provide for a coordinated Federal research program to ensure continued U.S. leadership in high-performance computing; to the Committee on Commerce, Science, and Transportation.

HIGH-PERFORMANCE COMPUTING ACT

● Mr. GORE. Mr. President, today I rise to introduce the High-Performance Computing Act of 1991, a bill to ensure that the United States stays at the leading edge in computer technology. I am especially pleased that more than 16 of my colleagues, both Democrats and Republicans, from all parts of the country and all ends of the political spectrum, have joined me as cosponsors of this critically important legislation.

During the last 30 years, computer technology has improved exponentially, faster than technology in any other field. Computers just keep getting faster, more powerful, and more inexpensive. According to one expert, if automobile technology had improved as much as computer technology has in recent years, a 1991 Cadillac would now cruise at 20,000 miles per hour, get 5,000 miles to a gallon, and cost only 3 cents!

As a result of these amazing advances, computers have gone from being expensive, esoteric research tools isolated in the laboratory to an integral part of our everyday life. We rely on computers at the supermarket, at the bank, in the office, and in our schools. They make our life easier in hundreds of ways.

Yet the computer revolution is not over. In fact, according to some measures, the price performance of computers is improving even faster now than it has in the past.

Anyone who has seen a supercomputer in action has a sense of what computers might be capable of in the future. Today, scientists and engineers are using supercomputers to design better airplanes, understand global warming, find oilfields, and discover safer, more effective drugs. In many cases they can use these machines to mimic experiments that would be prohibitively expensive or downright impossible in real life. With a supercomputer model, engineers at Ford can simulate auto crash tests and test new safety features for a fraction of the cost and in much less time than it would take to really crash an automobile. And they can observe many more variables, in much more detail, than they could with a real test.

The bill I am introducing today is very similar to the first title of S. 1067, the High-Performance Computing Act of 1990, which passed the Senate unanimously last October. Unfortunately, the House was unable to act on the bill before we adjourned. It is my hope that we will be able to move this bill quickly this year. There is widespread support in both the House and the Senate. Today, in the House, Congressman GEORGE BROWN, the new chairman of the House Committee on Science, Space, and Technology, is introducing the bill, along with Congressmen TIM VALENTINE, SHERWOOD BOEHLERT, and NORM MINETA. I am looking forward to working with them to move this bill as soon as possible.

This legislation provides for a multiagency high performance computing research and development program to be coordinated by the White House Office of Science and Technology Policy [OSTP]. The primary agencies involved are the National Science Foundation [NSF], the Defense Advanced Research Projects Agency [DARPA], the National Aeronautics and Space Administration [NASA], and the Department of Energy [DOE]. Each of these agencies has experience in developing and using high-performance computing technology. NSF funds four university supercomputer centers and is a major source of Federal funding for university research in advanced computing. NASA helped developed some of the first supercomputers and uses them extensively to help design and improve spacecraft like the space shuttle and the national aerospace plane. DARPA has been a real innovator, providing the research funding needed for computer designers to develop the next generation of supercomputers and the advanced software needed to use them. And for more than 20 years, DARPA has been at the leading edge in computer networking, developing ARPANET, the first national computer network, in the late 1960's, and now working on networks that are millions of times faster. DOE has dozens of supercomputers at the national labs, like Los Alamos, Oak Ridge, and Lawrence

Livermore, and is constantly finding new, exciting ways to use them.

The High-Performance Computing Act will provide for a well-planned, well-coordinated research program which will effectively utilize the talents and resources available throughout the Federal research agencies. In addition to NSF, NASA, DOE, and DARPA, this program will involve the Department of Commerce—in particular the National Institute of Standards and Technology—the Department of Health and Human Services, the Department of Education, the U.S. Geological Survey, the Department of Agriculture, the Environmental Protection Agency, and the Library of Congress, as well. The technology developed under this program will find application throughout the Federal Government and throughout the country.

This bill will roughly double funding for high-performance computing at NSF and NASA during the next 5 years. Additional funding—more than $1 billion during the next 5 years—will also be needed to expand research and development programs at DARPA and DOE. Last year, I worked closely with Senators JOHNSTON and DOMENICI on the Energy Committee to pass legislation to authorize a DOE High-Performance Computing Program, and I hope to work with them and the other members of the Energy Committee to see that program authorized and funded in fiscal year 1992. In addition, I worked with Senators NUNN and BINGAMAN and others on the Armed Services Committee to authorize and appropriate additional funding for DARPA's high-performance computing program, money that has been put to good use developing more powerful supercomputers and faster computer networks. Because this program involves many agencies, it necessarily involves several congressional committees and subcommittees. Fortunately, everyone has an important contribution to make to this effort. I look forward to working with my colleagues to make this program a reality.

Today, we are focused on the war in the Persian Gulf where we are seeing how important computer technology is to our national security. The amazing smart weapons being used in Iraq and Kuwait today are a direct result of past Federal investment in computer technology. The Patriot missile that are protecting our troops and Israeli and Saudi civilians from Saddam Hussein's Scud missiles rely upon powerful, advanced computers unavailable 10 years ago. Similarly, the laser-guided bombs and the Tomahawk cruise missiles are able to find their targets because they contain some of the more sophisticated computer technology available today.

The High-Performance Computing Act will help ensure the technological lead in weaponry that is helping us win the war with Iraq and which will improve our national security in the future.

This same technology is improving our economic security by helping American scientists and engineers develop new products and processes to keep the U.S. competitive in world markets. Supercomputers can dramatically reduce the time it takes to design and test a new product—whether it is an airplane, a new drug, or an aluminum can. More computing power means more energy-efficient, cheaper products in all sectors of manufacturing. And that means higher profits and more jobs for Americans.

Perhaps the most important contribution this bill will make to our economic security is the National Research and Education Network, the cornerstone of the program funded by this bill. By 1996, this fiber-optic computer network would connect more than 1 million people at more than 1,000 colleges and universities in all 50 States, allowing them to send electronic mail, share data, access supercomputers, use research facilities such as radio telescopes, and log on to data bases containing trillions of bytes of information on all sorts of topics. This network will speed research and accelerate technology transfer, so that the discoveries made in our university laboratories can be quickly and effectively turned into profits for American companies.

Today, the National Science Foundation runs NSFNET, which allows researchers and educators to exchange up to 1.5 million bits of data—megabits per second. The NREN will be at least a thousand times faster, allowing researchers to transmit all the information in the entire Encyclopedia Brittanica from coast to coast in seconds. With today's networks, it is easy to send documents and data, but images and pictures require much faster speeds, they require the NREN, which can carry gigabits, billions of bits, every second.

With access to computer graphics, researchers throughout the country will be able to work together far more effectively than they can today. It will be much easier for teams of researchers at colleges throughout the country to work together. They will be able to see the results of their experiments as the data comes in, they will be able to share the results of their computer models in realtime, and they will be able to brainstrom by teleconference. William Wulf, formerly Assistance Director for Computer and Information Science and Engineering at NSF, likes to talk about the "national collaboratory"—a laboratory without walls—which the NREN will make possible. Researchers throughout the country, at colleges and labs, large and small, will be able to stay on top of the latest advances in their fields.

The NREN and the other technology funded by this bill will also provide enormous benefits to American education, at all levels. By most accounts, we are facing a critical shortage of scientific and technical talent in the next 10 years. By connecting high schools to the NREN, students will be able to share ideas with other high school students and with college students and professors throughout the country. Already, some high school students are using the NSFNET to access supercomputers, to send electronic mail, and to get data and information that just is not available at their schools. In this way, the network can nurture and inspire the next generation of scientists.

Today, most students using computer networks are studying science and engineering, but there are more and more applications in other fields, too. Economists, historians, and literature majors are all discovering the power of networking. In the future, I think we will see computers and networks used to teach every subject from kindergarten through grade school. I was recently at MIT, where I was briefed on Project Athena, a project to integrate computers and networks into almost every course at MIT. Students use computers to play with the laws of physics in computer models, to test airplane designs in wind tunnel simulations, to improve their writing skills, and to learn foreign languages. Many of the ideas being developed at Project Athena and in hundreds of other experiments elsewhere could one day help students and teachers throughout the country.

The library community has been at the forefront in using computer and networking technology in education. For years, they have had electronic card catalogs which allow students to track down books in seconds. Now they are developing electronic text systems which will store books in electronic form. When coupled to a national network like the NREN, such a digital library could be used by students and educators throughout the country, in underfunded urgan schools and in isolated rural school districts, where good libraries are few and far between.

I recently spoke to the American Library Association annual meeting in Chicago and heard many librarians describe how the NREN could transform their lives. They are excited about the new opportunities made possible by this technology.

The technology developed for the NREN will pave the way for high-speed networks to our homes. It will give each and everyone of us access to oceans of electronic information, let us use teleconferencing to talk face-to-face to anyone anywhere, and deliver advanced, digital TV programming even more sophisticated and stunning than the HDTV available today. Other countries, Japan, Germany, and others, are spending billions of install optical fiber to the home, to take full advantage of this technology.

I hope that my colleagues will join me in supporting this bill. With this bill we can help shape the future—

shape it for the better. This is an investment in our national security and our economic security which we cannot afford not to make.

I ask unanimous consent that a summary of the bill and the bill in its entirety be printed in the RECORD.

There being no objection, the material was ordered to be printed in the RECORD, as follows:

S. 272

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "High-Performance Computing Act of 1991".

SEC. 2. FINDINGS AND PURPOSE.

(a) The Congress finds the following:

(1) Advances in computer science and technology are vital to the Nation's prosperity, national and economic security, and scientific advancement.

(2) The United States currently leads the world in the development and use of high-performance computing for national security, industrial productivity, and science and engineering, but that lead is being challenged by foreign competitors.

(3) Further research, improved computer research networks, and more effective technology transfer from government to industry are necessary for the United States to fully reap the benefits of high-performance computing.

(4) Several Federal agencies have ongoing high-performance computing programs, but improved interagency coordination, cooperation, and planning could enhance the effectiveness of these programs.

(5) A 1989 report by the Office of Science id Technology Policy outlining a research nd development strategy for high-performance computing provides a framework for a multi-agency high-performance computing program.

(b) It is the purpose of Congress in this Act to help ensure the continued leadership of the United States in high-performance computing and its applications. This requires that the United States Government—

(1) expand Federal support for research, development, and application of high-performance computing in order to—

(A) establish a high-capacity national research and education computer network;

(B) expand the number of researchers, educators, and students with training in high-performance computing and access to high-performance computing resources;

(C) develop an information infrastructure of data bases, services, access mechanisms, and research facilities which is available for use through such a national network;

(D) stimulate research on software technology;

(E) promote the more rapid development and wider distribution of computer software tools and applications software;

(F) accelerate the development of computer systems and subsystems;

(G) provide for the application of high-performance computing to Grand Challenges; and

(H) invest in basic research and education; and

(2) improve planning and coordination of Federal research and development on high-rformance computing.

. 3. DEFINITIONS.

as used in this Act, the term—

(1) "Director" means the Director of the Office of Science and Technology Policy; and

(2) "Council" means the Federal Coordinating Council for Science, Engineering, and Technology chaired by the Director of the Office of Science and Technology Policy.

SEC. 4. MISCELLANEOUS PROVISIONS.

(a) Except to the extent the appropriate Federal agency or department head determines, the provisions of this Act shall not apply to—

(1) programs or activities regarding computer systems that process classified information; or

(2) computer systems the function, operation, or use of which are those delineated in paragraphs (1) through (5) of section 2315(a) of title 10, United States Code.

(b) Where appropriate, and in accordance with Federal contrating law, Federal agencies and departments shall procure prototype or early production models of new high-performance computer systems and subsystems to stimulate hardware and software development.

SEC. 5. NATIONAL HIGH-PERFORMANCE COMPUTING PROGRAM.

The National Science and Technology Policy, Organization, and Priorities Act of 1976 (42 U.S.C. 6601 et seq.) is amended by adding at the end the following new title:

"TITLE VII—NATIONAL HIGH-PERFORMANCE COMPUTING PROGRAM

"NATIONAL HIGH-PERFORMANCE COMPUTING PLAN

"SEC. 701.(a)(1) The President, through the Federal Coordinating Council for Science, Engineering, and Technology (hereinafter in this title referred to as the 'Council'), shall, in accordance with the provisions of this title—

"(A) develop and implement a National High-Performance Computing Plan (hereinafter in this title referred to as the 'Plan'); and

"(B) provide for interagency coordination of the Federal high-performance computing program established by this title.

The Plan shall contain recommendations for a five-year national effort and shall be submitted to the Congress within one year after the date of enactment of this title. The Plan shall be resubmitted upon revision at least once every two years thereafter.

"(2) The Plan shall—

"(A) establish the goals and priorities for a Federal high-performance computing program for the fiscal year in which the Plan (or revised Plan) is submitted and the succeeding four fiscal years;

"(B) set forth the role of each Federal agency and department in implementing the Plan; and

"(C) describe the levels of Federal funding for each agency and department and specific activities, including education, research activities, hardware and software development, establishment of a national gigabits-per-second computer network, to be known as the National Research and Education Network, and acquisition and operating expenses for computers and computer networks, required to achieve the goals and priorities established under subparagraph (A).

"(3) The Plan shall address, where appropriate, the relevant programs and activities of the following Federal agencies and departments:

"(A) the National Science Foundation;

"(B) the Department of Commerce, particularly the National Institute of Standards and Technology, the National Oceanic and Atmospheric Administration, and the National Telecommunications and Information Administration;

"(C) the National Aeronautics and Space Administration;

"(D) the Department of Defense, particularly the Defense Advanced Research Projects Agency;

"(E) the Department of Energy;

"(F) the Department of Health and Human Services, particularly the National Institutes of Health and the National Library of Medicine;

"(G) the Department of Education;

"(H) the Department of Agriculture, particularly the National Agricultural Library; and

"(I) such other agencies and departments as the President or the Chairman of the Council considers appropriate.

"(4) In addition, the Plan shall take into consideration the present and planned activities of the Library of Congress, as deemed appropriate by the Librarian of Congress.

"(5) The Plan shall identify how agencies and departments can collaborate to—

"(A) ensure interoperability among computer networks run by the agencies and departments;

"(B) increase software productivity, capability, portability, and reliability;

"(C) expand efforts to improve, document, and evaluate unclassified public-domain software developed by federally funded researchers and other software, including federally funded educational and training software;

"(D) cooperate, where appropriate, with industry in development and exchange of software;

"(E) distribute software among the agencies and departments;

"(F) distribute federally funded software to State and local governments, industry, and universities;

"(G) accelerate the development of high performance computer systems, subsystems, and associated software;

"(H) provide the technical support and research and development of high-performance computer software and hardware needed to address Grand Challenges in astrophysics, geophysics, engineering, materials, biochemistry, plasma physics, weather and climate forecasting, and other fields;

"(I) provide for educating and training additional undergraduate and graduate students in software engineering, computer science, and computational science; and

"(J) identify agency rules, regulations, policies, and practices which can be changed to significantly improve utilization of Federal high-performance computing and network facilities, and make recommendations to such agencies for appropriate changes.

"(6) The Plan shall address the security requirements and policies necessary to protect Federal research computer networks and information resources accessible through Federal research computer networks. Agencies identified in the Plan shall define and implement a security plan consistent with the Plan.

"(b) The Council shall—

"(1) serve as lead entity responsible for development of the Plan and interagency coordination of the program established under the Plan;

"(2) coordinate the high-performance computing research and development activities of Federal agencies and departments and report at least annually to the President, through the Chairman of the Council, on any recommended changes in agency or departmental roles that are needed to better implement the Plan;

"(3) review, prior to the President's submission to the Congress of the annual budget estimate, each agency and departmental budget estimate in the context of the Plan and make the results of that

review available to the appropriate elements of the Executive Office of the President, particularly the Office of Management and Budget; and

"(4) consult and coordinate with Federal agencies, academic, State, industry, and other appropriate groups conducting research on high-performance computing.

"(c) The Director of the Office of Science and Technology Policy shall establish a High-Performance Computing Advisory Panel consisting of prominent representatives from industry and academia who are specially qualified to provide the Council with advice and information on high-performance computing. The Panel shall provide the Council with an independent assessment of—

"(1) progress made in implementing the Plan;

"(2) the need to revise the Plan;

"(3) the balance between the components of the Plan;

"(4) whether the research and development funded under the Plan is helping to maintain United States leadership in computing technology; and

"(5) other issues identified by the Director.

"(d)(1) Each appropriate Federal agency and department involved in high-performance computing shall, as part of its annual request for appropriations to the Office of Management and Budget, submit a report to the Office identifying each element of its high-performance computing activities, which—

"(A) specifies whether each such element (i) contributes primarily to the implementation of the Plan or (ii) contributes primarily to the achievement of other objectives but aids Plan implementation in important ways; and

"(B) states the portion of its request for appropriations that is allocated to each such element.

"(2) The Office of Management and Budget shall review each such report in light of the goals, priorities, and agency and departmental responsibilities set forth in the Plan, and shall include, in the President's annual budget estimate, a statement of the portion of each appropriate agency or department's annual budget estimate that is allocated to each element of such agency or department's high-performance computing activities.

"(e) As used in this section, the term 'Grand Challenge' means a fundamental problem in science and engineering, with broad economic and scientific impact, whose solution will require the application of high-performance computing resources.

"ANNUAL REPORT

"SEC. 702. The Chairman of the Council shall prepare and submit to the President and the Congress, not later than March 1 of each year, an annual report on the activities conducted pursuant to this title during the preceding fiscal year, including—

"(1) a summary of the achievements of Federal high-performance computing research and development efforts during that preceding fiscal year;

"(2) an analysis of the progress made toward achieving the goals and objectives of the Plan;

"(3) a copy and summary of the Plan and any changes made in such Plan;

"(4) a summary of appropriate agency budgets for high-performance computing activities for that preceding fiscal year; and

"(5) any recommendations regarding additional action or legislation which may be required to assist in achieving the purposes of this title.".

SEC. 6. NATIONAL RESEARCH AND EDUCATION NETWORK.

(a) In accordance with the Plan developed under section 701 of the National Science and Technology Policy, Organization and Priorities Act of 1976 (42 U.S.C. 6601 et seq.), as added by section 5 of this Act, the National Science Foundation, in cooperation with the Department of Defense, the Department of Energy, the Department of Commerce, the National Aeronautics and Space Administration, and other appropriate agencies, shall provide for the establishment of a national multi-gigabit-per-second research and education computer network by 1996, to be known as the National Research and Education Network (hereinafter referred to as the "Network"), which shall link government, industry, and the education community.

(b) The Network shall provide users with appropriate access to supercomputers, computer data bases, other research facilities, and libraries.

(c) The Network shall—

(1) be developed in close cooperation with the computer, telecommunications, and information industries;

(2) be designed and developed with the advice of potential users in government, industry, and the higher education community;

(3) be established in a manner which fosters and maintains competition and private sector investment in high speed data networking within the telecommunications industry;

(4) be established in a manner which promotes research and development leading to deployment of commercial data communications and telecommunications standards;

(5) where technically feasible, have accounting mechanisms which allow, where appropriate, users or groups of users to be charged for their usage of the Network and copyrighted materials available over the Network; and

(6) be phased into commercial operation as commercial networks can meet the networking needs of American researchers and educators.

(d) The Department of Defense, through the Defense Advanced Research Projects Agency, shall be the lead agency for research and development of advanced fiber optics technology, switches, and protocols needed to develop the Network.

(e) Within the Federal Government, the National Science Foundation shall have primary responsibility for connecting colleges, universities, and libraries to the Network.

(f)(1) The Council, within one year after the date of enactment of this Act and consistent with the Plan developed under section 701 of the National Science and Technology Policy, Organization, and Priorities Act of 1976 (42 U.S.C. 6601 et seq.), as added by section 5 of this Act, shall—

(A) develop goals, strategy, and priorities for the Network;

(B) identify the roles of Federal agencies and departments implementing the Network;

(C) provide a mechanism to coordinate the activities of Federal agencies and departments in deploying the Network;

(D) oversee the operation and evolution of the Network;

(E) manage the connections between computer networks of Federal agencies and departments;

(F) develop conditions for access to the Network; and

(G) identify how existing and future computer networks of Federal agencies and departments could contribute to the Network.

(2) The President shall report to Congress within one year after the date of enactment of this Act on the implementation of this subsection.

(g) In addition to other agency activities associated with the establishment of the Network—

(1) the National Institute of Standards and Technology shall adopt a common set of standards and guidelines to provide interoperability, common user interfaces to systems, and enhanced security for the Network; and

(2) the National Science Foundation, the National Aeronautics and Space Administration, the Department of Energy, the Department of Defense, the Department of Commerce, the Department of the Interior, the Department of Agriculture, the Department of Health and Human Services, and the Environmental Protection Agency are authorized to allow recipients of Federal research grants to use grant monies to pay for computer networking expenses.

(h) Within one year after the date of enactment of this Act, the Director, through the Council, shall report to the Congress on—

(1) effective mechanisms for providing operating funds for the maintenance and use of the Network, including user fees, industry support, and continued Federal investment;

(2) plans for the eventual commercialization of the Network;

(3) how commercial information service providers could be charged for access to the Network;

(4) the technological feasiblity of allowing commercial information service providers to use the Network and other federally-funded research networks;

(5) how Network users could be charged for such commercial information services;

(6) how to protect the copyrights of material distributed over the Network; and

(7) appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks.

SEC. 7. ROLE OF THE NATIONAL SCIENCE FOUNDATION.

(a) The National Science Foundation shall provide funding to enable researchers to access supercomputers. Prior to deployment of the Network, the National Science Foundation shall maintain, expand, and upgrade its existing computer networks. Additional responsibilities may include promoting development of information services and data bases available over such computer networks; facilitation of the documentation, evaluation, and distribution of research software over such computer networks; encouragement of continued development of innovative software by industry; and promotion of science and engineering education.

(b)(1) The National Science Foundation shall, in cooperation with other appropriate agencies and departments, promote development of information services that could be provided over the Network established under section 6. These services shall include, but not be limited to, the provision of directories of users and services on computer networks, data bases of unclassified Federal scientific data, training of users of data bases and networks, access to commercial information services to researchers using the Network, and technology to support computer-based collaboration that allows researchers around the Nation to share information and instrumentation.

(2) The Federal information services accessible over the Network shall be provided in accordance with applicable law. Appropriate protection shall be provided for copyright and other intellectual property rights of information providers and Network users,

including appropriate mechanisms for fair remuneration of copyright holders for availability of and access to their works over the Network.

(c)(1) There are authorized to be appropriated to the National Science Foundation for the purposes of this Act, $46,000,000 for fiscal year 1992, $88,000,000 for fiscal year 1993, $145,000,000 for fiscal year 1994, $172,000,000 for fiscal year 1995, and $199,000,000 for fiscal year 1996.

(2) Of the monies authorized to be appropriated in subsection (c)(1), there is authorized for the reserach, development, and support of the Network, in accordance with the purposes of section 6, $15,000,000 for fiscal year 1992, $25,000,000 for fiscal year 1993, $55,000,000 for fiscal year 1994, $50,000,000 for fiscal year 1995, and $50,000,000 for fiscal year 1996.

(3) The amounts authorized to be appropriated under this subsection are in addition to any amounts that may be authorized to be appropriated under other laws.

SEC. 8. THE ROLE OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.

(a) The National Aeronautics and Space Administration shall continue to conduct basic and applied research in high-performance computing, particularly in the field of computational science, with emphasis on aeronautics and the processing of remote sensing and space science data.

(b) There are authorized to be appropriated to the National Aeronautics and Space Administration for the purposes of this Act, $22,000,000 for fiscal year 1992, $45,000,000 for fiscal year 1993, $67,000,000 for fiscal year 1994, $89,000,000 for fiscal year 1995, and $115,000,000 for fiscal year 1996.

(c) The amounts authorized to be appropriated under subsection (b) are in addition to any amounts that may be authorized to be appropriated under other laws.

SEC. 9. ROLE OF THE DEPARTMENT OF COMMERCE.

(a) The National Institute of Standards and Technology shall adopt standards and guidelines, and develop measurement techniques and test methods, for the interoperability of high-performance computers in networks and for common user interfaces to systems. In addition, the National Institute of Standards and Technology shall be responsible for developing benchmark tests and standards for high performance computers and software. Pursuant to the Computer Security Act of 1987 (Public Law 100-235; 101 Stat. 1724), the National Institute of Standards and Technology shall continue to be responsible for adopting standards and guidelines needed to assure the cost-effective security and privacy of sensitive information in Federal computer systems.

(b)(1) The Secretary of Commerce shall conduct a study to—

(A) evaluate the impact of Federal procurement regulations which require that contractors providing software to the Federal Government share the rights to proprietary software development tools that the contractors used to develop the software; and

(B) determine whether such regulations discourage development of improved software development tools and technigues.

(2) The Secretary shall, within one year after the date of enactment of this Act, report to the Congress regarding the results of the study conducted under paragraph (1).

SUMMARY OF MAJOR PROVISIONS

The High-Performance Computing Act would authorize a five-year program for research and development on supercomputers, advanced computer software, and computer networks. The provisions are:

Section 1 is the title of the bill.

Section 2 contains the findings and purpose of the bill.

Section 3 provides definitions.

Section 4 contains miscellaneous provisions to make clear that computer systems for classified information are not affected by this bill. In addition, Federal agencies and departments are encouraged to purchase prototype and early production models of new high-performance computer systems.

Section 5 amends the National Science and Technology Policy, Organization, and Priorities Act of 1976, which established the White House Office of Science and Technology Policy (OSTP). The section establishes an interagency national High-Performance Computing program involving the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), the Department of Energy, and the Department of Defense, and other relevant agencies. Interagency coordination and planning for the program would be provided by OSTP's Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), which shall work closely with industry. The program would be a comprehensive one, dealing with high-performance computing hardware and software, networking, and the education and training in high-performance computing.

Section 6 requires NSF to work with other agencies to establish a a multi-gigabit National Research and Education Network (NREN) by 1966. This network would be capable of transmitting several billions of bits of data per second and would link hundreds of thousands of researchers in government, industry, and universities around the country. The Defense Advanced Research Projects Agency will be lead agency for developing the networking technology needed for the NREN. NSF will have primary responsibility for connecting colleges, universities, and libraries to the NREN. The FCCSET shall provide for the planning and oversight needed to coordinate the efforts of the agencies contributing and using the NREN. The National Institute of Standards and Technology (NIST) will be responsible for standards and security for the NREN. The FCCSET shall prepare a report on how commercial information providers and network companies can contribute to and use the NREN.

Section 7 defines several specific roles for the NSF, including providing supercomputer access and networking services to researchers, enhancing development of information services available on the NREN, and promoting development and distribution of research software for supercomputers.

AUTHORIZATIONS FOR NSF

[In millions of dollars]

	Fiscal year—				
	1992	1993	1994	1995	1996
NREN	15	25	55	50	50
Other	31	63	90	122	149
Total	46	88	145	172	199

Section 8 mandates NASA to conduct basic and applied research in high-performance computing, particularly in the field of computational science, with emphasis on aeronautics and the processing of remote sensing and space science data.

AUTHORIZATIONS FOR NASA

[In millions of dollars]

	Fiscal year—				
	1992	1993	1994	1995	1996
Total	22	45	67	89	115

Section 9 defines the role of the Department of Commerce in high-performance computing. The Department's NIST shall adopt standards and guidelines for interoperability of high-performance computers, so that different types of computers could effectively exchange data over networks. NIST will also be responsible for developing benchmark tests for evaluating high-performance computer systems. In accord with the Computer Security Act, NIST will provide for computer security and the privacy of information for Federal computer systems. This section also instructs the Secretary of Commerce to evaluate the impact of Federal procurement rules for software on development of new, improved software technology.●

● Mr. BINGAMAN. Mr. President, as you know, last year the Senate passed the High-Performance Computing Act of 1990, which was similar to the legislation introduced today. Unfortunately, the House of Representatives did not act on this legislation in the 101st Congress. Today, as Senator GORE reintroduces this important legislation, I rise to urge my colleagues to once again support this bill.

Mr. President, I would like to briefly outline why I believe this legislation deserves our support.

First, it is clear to me that there is a consensus on the importance of high-performance computing. Last year we received the Department of Commerce Emerging Technologies report and the second annual Department of Defense critical technologies plan, reports which identified the technologies most critical to national security and economic competitiveness.

The Commerce Department identified high-performance computing as a critical emerging technology for the United States. High-performance computing was also a factor in five of the technologies identified as critical by the Department of Defense: Software producibility, parallel computer architectures, simulation and modeling, data fusion, and computational fluid dynamics. High-performance computing has been identified by industry and academia as a critical area, and shows up on critical technologies lists prepared by Japan and the European Community. There is no doubt about the importance of high-performance computing. The only thing in doubt is whether we will act now to foster the development of this technology.

Second, it is clear to me that a national policy in support of high-performance computing is needed. The Department of Commerce reports that, while the United States currently holds a lead in high-performance computing, it is losing ground to Japan. And the Department of Defense reports that many aspects of

high-performance computing are critical to our national defense.

To address the policy issues involved with fostering this technology, the President's science adviser and the Office of Science and Technology Policy, through the Federal Coordinating Committee on Science, Engineering, and Technology, developed an implementation plan for a national high-performance computing initiative.

The FCCSET panel did an excellent job of garnering industry input in developing the plan, and that can be seen in the support industry has shown for this initiative. Industry groups such as the Council on Competitiveness are pointing to this as a model for support of other critical technologies.

Finally, last year the Senate approved similar legislation establishing a national policy and authorized funding which would have leveraged the resources and expertise of our mission agencies to support high-performance computing in America. I hope that the Senate will once again support this initiative.

Mr. President, the final point I would like to make is that this legislation, and the manner in which it was developed, can serve as a model for policies to foster critical technologies. We need to do a better job of soliciting and acting on industry views in the promotion of other critical technologies. The interagency consultation which resulted in the identification of lead agencies for certain missions is another process that should be undertaken for each of our critical technologies. Each technology would most likely require a different structure, and a process such as the one which led to this legislation should be undertaken for each.

I hope that we can move quickly on this bill. As I said, I believe that it can serve as a model for other critical technologies, and I urge my colleagues to support swift passage.

I yield the floor.●

● Mr. JEFFORDS. Mr. President, I want to commend my colleague, Senator GORE, for his efforts in keeping America a leader in computer technology. The High-Performance Computing Act of 1991 represents a strong step toward maintaining America's strength in this area. I strongly support this bill.

Education is one area that will immediately benefit from this bill. Sharing of software and greater access to computer facilities will help American scientists advance the boundaries of our knowledge. For example, many environmental models are becoming increasingly complex as our understanding of the world improves. Supercomputers are needed to perform the billions of calculations these models require. This legislation, I believe, will increase scientists' access to supercomputers. Scientists in fields ranging from astrophysics to engineering to weather forecasting will benefit. Some of the fruits of their research will undoubtedly help all mankind.

I also believe this legislation will help America maintain its lead in this vital technology. Whereas in the past we could take it for granted that we were the leaders in computer technology, we can be complacent no longer. Other countries develop national strategies and plans for becoming leaders in specific technologies. It is time we did the same.

I urge my colleagues to support this bill and work for its rapid passage. Let's keep America the leader in supercomputers.●

By Mr. STEVENS:

S.J. Res. 46. Joint resolution disapproving the action of the District of Columbia Council in approving the Assault Weapon Manufacturing Strict Liability Act of 1990; to the Committee on Governmental Affairs.

DISAPPROVAL OF DISTRICT OF COLUMBIA ASSAULT WEAPON LEGISLATION

Mr. STEVENS. Mr. President, I support and introduce a joint resolution to disapprove the action of the District of Columbia Council in approving the Assault Weapon Manufacturing Strict Liability Act of 1990. An identical resolution has been introduced in the House of Representatives by Representative THOMAS BLILEY of Virginia.

That District of Columbia act imposes strict liability on the manufacturers, importers, or dealers of assault weapons—without regard to fault or proof of defect—for all direct and consequential damages that arise from bodily injury or death if the injury or death results from the discharge of the assault weapon in the District of Columbia.

The rationale for strict liability doctrine is to ensure that manufacturers are held accountable for the costs of injuries which result from defective products. In general, a person has a right of action under strict tort liability if the injury from a defect is forseeable. The application of strict liability without regard to fault or proof or defect to manufacturers of asault weapons for the criminal activity of D.C. residents is unwarranted.

The sale of these firearms is expressly prohibited in the District under the law. The District should ensure that the possessors of firearms, who are engaging in illegal activity by owning and using such weapons, are held accountable for their actions. Out-of-the-District firearms manufacturers who operate legitimate businesses should not be held responsible.

The purpose of this act is, in effect, to shift the burden to firearms manufacturers out of the District. The constitutional rights of the makers and owners of firearms who have complied with all applicable Federal, State, and local laws outside the District have been ignored by the District. It cannot hold the firearms industry liable for the injury caused by guns which were lawfully sold to purchasers but misused in the District. Firearms manufacturers should not be held liable for the actions of persons over whom they have no control.

The end result, should this act become effective, will be that manufacturers might be held responsible for the drug-crazed, violent murders that have become daily occurrences in the District of Columbia.

It should be noted that today's Washington Post has reported that Mayor Dixon plans to ask the D.C Council to repeal the Assault Weapon Manufacturing Strict Liability Act of 1990.

If that does not occur, Congress should disapprove the recent action of the D.C. Council. I ask unanimous consent that the text of this joint resolution and the Washington Post article be printed at the conclusion of my remarks.

There being no objection, the material was ordered to be printed in the RECORD, as follows:

S.J. RES. 46

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Congress hereby disapproves of the action of the District of Columbia Council described as follows: The Assault Weapon Manufacturing Strict Liability Act of 1990 (D.C. Act 8-289), signed by the Mayor of the District of Columbia on December 17, 1990, and transmitted to Congress pursuant to section 602(c) of the District of Columbia Self-Government and Governmental Reorganization Act on January 11, 1991.

[From the Washington Post, Jan. 24, 1991]

DIXON PREPARED TO SCUTTLE GUN LAW TO SECURE HILL AID

(By Rene Sanchez)

Mayor Sharon Pratt Dixon, in a move to win favor in Congress for emergency aid for the District, said yesterday she will ask the D.C. Council to repeal a bill passed last month that makes assault-weapon merchants liable for shooting injuries or deaths in the city.

Dixon's decision, relayed by a top aide, came amid further signs of congressional opposition to the gun-liability measure, and it followed a signal from D.C. Council Chairman John A. Wilson (D) yesterday that a council majority is prepared to overturn the measure.

Dixon met yesterday with Rep. Thomas Bliley (R-Va.), the ranking minority member of the House District of Columbia Committee, in part to discuss the gun-liability bill's impact on her request for an additional $100 million in federal aid.

Bills passed by the council and signed by the mayor are subject to congressional review. Bliley has introduced a resolution opposing the law.

After her meeting with Bliley, Dixon warned that congressional displeasure with the gun bill could harm the city's chances of receiving emergency aid to reduce its budget deficit.

"I think we'd all prefer for [Bliley's] resolution not to take on a life of its own," Dixon said, adding that the D.C. Council "knows the resolution is looming."

Wilson said later that he believes a majority of the council's members are prepared to

**In the Air Force Reserve there are 3 appointments to the grade of lieutenant colonel (list begins with Charles O. Bruce III) (Reference No. 25)

**In the Army there are 6 promotions to the grade of colonel and below (list begins with Hugh D. Thorfinnson) (Reference No.)

**In the Army there are 36 promotions and appointments to the grade of colonel (list begins with Barbara Blatter) (Reference No. 30)

**In the Navy there are 48 appointments to the grade of lieutenant (list begins with Kevin K. Bach) (Reference No. 31)

**In the Navy Reserve there are 23 appointments to the grade of commander and below (list begins with Manuel V. Ordonez) (Reference No. 32)

**In the Air Force there are 1,679 appointments to a grade no higher than captain (list begins with Steven L. Abernathy) (Reference No. 34)

**In the Army Reserve there are 57 promotions to the grade of colonel and below (list begins with James F. Butler, Jr.) (Reference No. 35)

**In the Army Reserve there are 69 promotions to the grade of colonel and below (list begins with Michael J. Bayer) (Reference No. 36)

**In the Army there are 1,146 promotions and appointments to the grade of lieutenant colonel (list begins with Jose C. Abiles) (Reference No. 37)

**In the Navy there are 154 appointments to the grade of ensign (list begins with Lynn E. Acheson) (Reference No. 43)

**In the Air Force Reserve there is 1 appointment to the grade of lieutenant colonel (Fortunato T. Elizaga) (Reference No. 49)

**In the Air Force Reserve there are 13 appointments to the grade of colonel and below (list begins with Donald E. Bayles) (Reference No. 50)

In the Army there are 12 promotions and appointments to the grade of colonel and below (list begins with Joseph S. Hunter) (Reference No. 52)

**In the Army Reserve there are 17 appointments to the grade of colonel and below (list begins with Ray D. Berringer) (Reference No. 53)

**In the Army Reserve there are 18 promotions to the grade of colonel (list begins with Craig B. Anderson) (Reference No. 54)

**In the Army Reserve there are 37 promotions to the grade of lieutenant colonel (list begins with Thomas E. Batsky) (Reference No. 55)

**In the Army there are 186 appointments to the grade of colonel and below (list begins with Mary P. Celio) (Reference No. 56)

**In the Army Reserve there are 68 promotions to the grade of colonel and below (list begins with Alexander H. Burgin) (Reference No. 57)

**In the Navy there are 242 appointments to the grade of captain and below (list begins with Walter M. Elliott) (Reference No. 58)

*Colonel John J. Cuddy, USA, to be brigadier general (Reference No. 67)

**In the Navy there are 1,837 appointments to the grade of ensign (list begins with Kenneth S. Acfalle) (Reference No. 68)

**In the Army Reserve there are 758 promotions to the grade of colonel (list begins with Robert T. Adams) (Reference No. 69)

**In the Air Force there are 24 appointments to the grade of second lieutenant (list begins with Neil T. Allen) (Reference No.

In the Navy and Naval Reserve there 23 appointments to the grade of commander and below (list begins with Michael W. Abraham) (Reference No. 83)

*In the Navy and Naval Reserve there are 46 appointments to the grade of commander and below (list begins with Enrique N. Panlilio) (Reference No. 84)

*Lieutenant General Jimmie V. Adams, USAF, to be general (Reference No. 90)

*Major General William G. Pagonis, USA, to be lieutenant general (Reference No. 91)

Total 6,542.

INTRODUCTION OF BILLS AND JOINT RESOLUTIONS

The following bills and joint resolutions were introduced, read the first and second time by unanimous consent, and referred as indicated:

By Mr. METZENBAUM (for himself, Mr. LIEBERMAN, and Mr. COHEN):

S. 340. A bill to amend the Internal Revenue Code of 1986 to impose a tax on the excess profits of large oil companies, and for other purposes; to the Committee on Finance.

By Mr. JOHNSTON (for himself and Mr. WALLOP):

S. 341. A bill to reduce the Nation's dependence on imported oil, to provide for the energy security of the Nation and for other purposes; to the Committee on Energy and Natural Resources.

By Mr. JOHNSTON (for himself, Mr. WALLOP, Mr. FORD, Mr. DOMENICI, Mr. BINGAMAN, and Mr. CRAIG):

S. 343. A bill to provide for continued United States leadership in high-performance computing; to the Committee on Energy and Natural Resources.

By Mr. ROTH:

S. 344. A bill to establish the Northern Yukon-Arctic International Wildlife Refuge; to the Committee on Environment and Public Works.

By Mr. PELL (for himself and Mr. CHAFEE):

S. 345. A bill to amend the Small Business Act to provide disaster loan eligibility to small business concerns located in States in which one-third or more of the depository institutions have been simultaneously closed for a period of at least 5 days; to the Committee on Small Business.

By Mr. HEINZ (for himself, Mr. BENTSEN, Mr. RIEGLE, Mr. GARN, Mr. HELMS, Mr. KERRY, Mr. HATCH, Mr. D'AMATO, Ms. MIKULSKI, Mr. THURMOND, Mr. LOTT, and Mr. SHELBY):

S. 346. A bill to strengthen the Foreign Agents Registration Act of 1938; to the Committee on Foreign Relations.

By Mr. RIEGLE (for himself, Mr. GARN, Mr. DIXON, Mr. HEINZ, Mr. SARBANES, Mr. D'AMATO, Mr. DODD, and Mr. SASSER):

S. 347. A bill to amend the Defense Production Act of 1950 to revitalize the defense industrial base of the United States, and for other purposes.

By Mr. RIEGLE (for himself, Mr. GARN, and Mr. DIXON):

S. 348. A bill to extend the expiration date of the Defense Production Act of 1950 to March 13, 1991; considered and passed.

By Mr. BUMPERS (for himself, Mr. PRYOR, Mr. KASTEN, Mr. EXON, Mr. DOLE, Mr. KOHL, Mr. HATCH, Mr. HARKIN, Mr. COCHRAN, Mr. REID, Mr. LOTT, Mr. HEFLIN, Mr. HELMS, Mr. BOREN, Mr. WALLOP, Mr. DECONCINI, Mr. GRAMM, Mr. SHELBY, Mr. BURNS, Mr. BRYAN, Mr. MCCAIN, Mr. DIXON, Mr. BOND, Mr. BREAUX, Mr. CRAIG, and Mr. KERREY):

S. 349. A bill to amend the Fair Labor Standards Act of 1938 to clarify the application of such Act, and for other purposes; to the Committee on Labor and Human Resources.

By Mr. KOHL (for himself and Mr. GRASSLEY):

S. 350. A bill to amend the Federal Deposit Insurance Act to include foreign deposits and non-deposit liabilities in the assessment base; to the Committee on Banking, Housing, and Urban Affairs.

By Mr. METZENBAUM (for himself, Mr. D'AMATO, Mr. KENNEDY, Mr. LUGAR, Mr. ADAMS, Mr. COATS, Mr. SHELBY, Mr. BURDICK, Mr. HATFIELD, Mr. ROCKEFELLER, Mr. INOUYE, and Mr. AKAKA):

S. 351. A bill to provide participants in private pension plans which were terminated before September 1, 1974, the nonforfeitable pension benefits which were lost by reason of the termination, and for other purposes; to the Committee on Labor and Human Resources.

By Mr. GLENN (for himself, Mr. INOUYE, and Mr. ADAMS):

S. 352. A bill to protect the rights of persons to due process of law and equal protection of the laws in guardianship proceedings; to the Committee on the Judiciary.

By Mr. JEFFORDS (for himself, Mr. METZENBAUM, Mr. REID, Mr. LIEBERMAN, Mr. D'AMATO, Mr. LEVIN, Mr. MOYNIHAN, Mr. GORE, and Mr. CHAFEE):

S. 353. A bill to require the Director of the National Institute for Occupational Safety and Health to conduct a study of the prevalence and issues related to contamination of workers' homes with hazardous chemicals and substances transported from their workplace and to issue or report on regulations to prevent or mitigate the future contamination of workers' homes, and for other purposes; to the Committee on Labor and Human Resources.

By Mr. KASTEN:

S. 354. A bill to amend the Internal Revenue Code of 1986 to permit mortgage revenue bond financing of mortgages for veterans of Operation Desert Shield; to the Committee on Finance.

S. 355. A bill to amend the Internal Revenue Code of 1986 to permit mortgage revenue bond financing of mortgages for veterans of Operation Desert Shield; to the Committee on Finance.

By Mr. THURMOND (for himself, Mr. SIMPSON, Mr. LEAHY, Mr. HATCH, Mr. GRASSLEY, Mr. BOND, Mr. COCHRAN, Mr. DECONCINI, and Mr. HEFLIN):

S. 356. A bill to assure fairness in the allocation and award of antitrust damages; to the Committee on the Judiciary.

By Mr. REID (for himself and Mr. BRYAN):

S. 357. A bill to convey fee title to Pershing County Water Conservation District, certain Federal lands known as the Battle Mountain Community Pastures, in recognition that the land was initially acquired by the District and subsequently transferred to the United States for the Humbolt River Project; to the Committee on Energy and Natural Resources.

By Mr. INOUYE:

S. 358. A bill to establish a temporary program under which perental diacetylmorphine will be made available through qualified pharmacies for the relief of intractable pain due to cancer, and for other purposes; to the Committee on Labor and Human Resources.

By Mr. BOREN (for himself, Mr. DANFORTH, Mr. MOYNIHAN, Mr. CHAFEE, Mr. PRYOR, Mr. GRASSLEY, Mr. SANFORD, Mr. KERRY, Mr. LIEBERMAN, and Mr. COCHRAN):

Mr. President, it is inconceivable any other country in the world so rich and so blessed as is America with energy resources and wealth would deny itself so many of those things to the point it put in jeopardy its children's future, its grandchildren's future, and the lives of its current generation. It is not conceivable that we allow that to take place any longer. The American people are entitled to the wealth that they possess and produced in the care and manner in which it will be produced here.

We will continue to consume. We will continue to strive for ways and means to conserve, and the bill represents a good strong balance between not only induced conservation but an encouraged conservation as well as an induced production and an encouraged production.

These things come together at a time and place in history where it is just may be the time.

I remind the Congress there are 44 committees and subcommittees in both our Houses which have some say in the turf of the energy battle, whether it is a security one, environmental one, a trade one, or what have you. There are, I think, nine of the President's Cabinet who have some say in energy policy; there are five offices in the Office of the President and seven independent agencies which have some say in this process.

When Senator JOHNSTON says it is controversial, the most controversial thing will be if people will give up their turf long enough to understand the American people are entitled to his policy.

Our staffs have been coordinating with the Department of Energy, Mr. President, and I say we expect the administration's energy strategy within about 2 weeks. In many respects, it will mirror and reflect the effort we have worked on because we have been working with Admiral Watkins, the Secretary. Our staffs have been working together.

But it is time now we do this thing and it is time we put aside the petty battles over turf and look to the interest of the American people. It can be done. And I take my hat off to Senator JOHNSTON and I thank him; it has been a pleasure working with him. If we can get the administration with this, we will end up with an energy strategy for the first time.

Mr. JOHNSTON. I thank my colleague from Wyoming for his comments and for the good work he and the minority staff have done on the Energy Committee, and the majority staff have done as well. It is a monumental effort on their part to put a 264-page bill together. It works well for the Energy Committee this year that we have such an excellent and friendly and cooperative and productive attitude by the distinguished minority member and his staff and all e committee members of the Energy nmittee.

Mr. WALLOP. Mr. President, I say once again I thank the Senator. I pointed out there are some things which he would have liked to have had in the bill that are not there; there are some things I would have liked to have had in the bill that are not there. Those will be worked out as the Senate works its will. But what we have put together is what both of us believe will be in the benefit of the people of this country.

Mr. President, I yield the floor.

Mr. WIRTH addressed the Chair.

The PRESIDENT pro tempore. The Chair recognizes the Senator from Colorado, Mr. WIRTH.

By Mr. CRAIG:

S. 342. A bill to amend the Internal Revenue Code of 1986 to allow penalty-free distributions for participants in Operation Desert Storm; to the Committee on Finance.

PENALTY-FREE DISTRIBUTIONS FOR PARTICIPANTS IN OPERATION DESERT SHIELD

● Mr. CRAIG. Mr. President, today I am introducing a bill to make life a little easier back home for the families of our Desert Storm troops.

Many of these families are finding themselves in unexpectedly tough financial circumstances. Those who have put money aside, investing for the future in certain retirement or savings plans, are finding that the tax law will penalize them if they try to make ends meet by withdrawing that money.

That doesn't make sense, at a time when we're searching for ways to ease the special burdens of these families. And, more fundamentally, it's not fair to penalize those who are already making so many sacrifices for our Nation and the world.

My bill recognizes that these are extraordinary times. It would allow individuals who are members of the Armed Forces or Reserves and are active in Desert Storm to withdraw money from annuities, IRA's, and other retirement plans without having to pay the 10-percent Federal tax penalty for early withdrawal. This is a companion bill to legislation being introduced today in the House of Representatives by Congressman TOM CAMPBELL of California.

This bill is not intended to be a comprehensive solution to all the problems faced by our men and women in the Persian Gulf and their families back home. It is my hope, however, that this sensible and fair reform will be included in whatever comprehensive package ultimately passes this body.

Mr. President, our men and women in the gulf are earning every consideration we can give them. Their families back home need to be able to concentrate on providing them the support they need to do the hard and dangerous job we've given them. The very least we can do is prevent them from being penalized for using their own savings to take care of themselves.●

By Mr. JOHNSTON (for himself, Mr. WALLOP Mr. FORD, Mr. DOMENICI, Mr. BINGAMAN, and Mr. CRAIG):

S. 343. A bill to provide for continued United States leadership in high-performance computing; to the Committee on Energy and Natural Resources.

DEPARTMENT OF ENERGY HIGH-PERFORMANCE COMPUTING ACT

Mr. JOHNSTON. Mr. President, today I am introducing a bill entitled the "Department of Energy High-Performance Computing Act of 1991." The bill is very similar to legislation reported by the Committee on Energy and Natural Resources in the 101st Congress, and passed by the Senate as title II of S. 1067, the High-Performance Computing Act of 1990. S. 1067 was a related bill dealing with high-performance computing, introduced by Senator GORE and reported by the Committee on Commerce, Science, and Transportation. Our committee worked closely with the Commerce Committee last year to combine our two related bills prior to passage by the Senate. Unfortunately, the House was unable to act on the legislation before adjournment of the Congress.

Today our committee is starting the process anew with the introduction of this legislation. Our bill includes many of the compromises reached at the end of last year between the two committees. As this process moves forward, I expect that the two committees will again work together to create a national high-performance computing initiative that includes an aggressive program within the Department of Energy and establishes a national high-performance computer network. Senator GORE has already introduced S. 272, the High-Performance Computing Act of 1991, and I look forward to working with him as this process unfolds.

The Energy Committee bill would establish a high-performance computing program within the Department of Energy. As part of the program, the Secretary of Energy is directed to establish a national multi-gigabit-per-second computer network. The bill directs the Secretary to promote education and research in high-performance computing. Finally, the Secretary is directed to establish at least two collaborative consortia to undertake research and development of high-performance computing hardware, software, and networks.

The United States invented high-performance computing and continues to lead the world in the development of high-performance computing. However, that lead is being challenged. Some estimate that the Japanese will dominate the supercomputer market in the early 1990's. Yet, the Japanese did not enter the field of high-performance computing until 1983. Today, outside of the United States, Japan is the single biggest market for,

and supplier of, supercomputers. Even if our lead was not being challenged, the need for increased emphasis on the development of high-performance computing systems is unquestioned.

It is essential that the United States remain aggressive in the area of supercomputer technology. Last year, I quoted from a report released 5 years ago by the White House Science Council Committee on Research in Very High-Performance Computing. The quote bears repeating:

> The bottom line is that any country which seeks to control its future must effectively exploit high performance computing. A country which aspires to military leadership must dominate, if not control, high performance computing. A country seeking economic strength in the information age must lead in the development and application of high performance computing in industry and research.

Many scientific endeavors would not be possible without the use of supercomputers. For example, the data we collect from outer space can only be understood and visualized by a supercomputer. The superconducting supercollider will require supercomputers to understand the data it produces. Weather forecasting becomes more accurate the more powerful the supercomputer. The human genome project is possible only because of high-performance computers.

According to Dr. William Wulf, the former Assistant Director of the National Science Foundation's Directorate for Computer and Information Science and Engineering, supercomputing and high-speed networking can increase the productivity of many American researchers by up to 200 percent.

Important policy questions depend on high-performance computing. Better models of global climate change would lead to better policies to address global warming. In fact, today's supercomputers are inadequate for some global studies that have been designed. The studies are waiting for sufficiently powerful supercomputers. The outcome of these studies could lead to important policy decisions with substantial implications for the world.

American industry has discovered the benefits of high-performance computers. When Airbus, a European consortium, started using supercomputers to help design more efficient airplanes, Boeing and McDonald Douglass were forced to follow. Boeing then used a supercomputer to design a 30-percent more efficient airplane. This savings offset the cost of the supercomputer and helped Boeing to remain competitive.

Arco used a Cray supercomputer to increase production of its Prudhoe Bay oil field resulting in an additional $2 billion in profits. Alcoa used supercomputing modeling to reduce the amount of aluminum needed in its aluminum cans by 25 percent. This reduction saved billions of dollars from reduced materials, production, and transportation costs.

Historically, the Department of Energy and its predecessor agencies played the lead role in the development of high-performance computing, particularly the supercomputer. The biggest single factor accounting for the development of high-performance computing has been the large computational demands required by defense research, particularly in the area of nuclear weapons design.

Supercomputing originated with the Los Alamos problem, the design of the first atomic bomb. In 1945, researchers at Los Alamos National Laboratory used the first large-scale electronic computer, the ENIAC, to help solve the Los Alamos problem. Subsequent collaborations with supercomputer vendors, such as IBM, Univac [now Unisys], Control Data, and Cray Research, have continued to this day, enabling the United States to become the leader in computational science.

In fact, Cray Research would not exist without the Los Alamos National Laboratory of the Department of Energy. In 1976, Cray offered its first supercomputer to Los Alamos without software or an operating system if the laboratory would develop the technologies needed to operate the machine. The Department of Energy and Los Alamos were crucial in getting the first Cray supercomputer to work. Today, Cray is the biggest manufacturer of supercomputers in the world, and Los Alamos is the most powerful scientific computing center in the world, serving more than 8,000 researchers throughout the Nation via a computer network.

The Department's laboratories have become the world's most demanding, sophisticated, and experienced users of supercomputers. Today, the Department of Energy remains the biggest user of supercomputers with more than 33 unclassified supercomputers. The Department of Energy and its laboratories are in a position to help the United States maintain its leadership, strengthen the U.S. computing industry, and encourage deployment of high-performance computing in analysis, design, concurrent, engineering, and manufacturing.

The bill directs the Secretary to establish collaborative consortia between the Department's national laboratories and other Federal laboratories or agencies, education institutions, and industry. The consortia will undertake basic research and development of high-performance computing hardware, software, and networks. The consortia will carry out its research directed at scientific and technical problems which require the application of high-performance computing resources.

The consortia will create an integrated, cooperative effort among industry, universities, and Government in supercomputing to meet the challenge of foreign competition. Manufactuers of high-performance computers will send new prototype computers to the national laboratories for testing. The laboratories will help the manufacturer identify problems, find solutions for them, and write the unique software packages supercomputers require. At the same time, industrial users will become more familiar with supercomputers and their benefits.

The bill establishes a framework in which Government, industry, and the university community can all come together within to keep the United States at the forefront of this critical technology.

The bill also authorizes the establishment of a multigigabit-per-second national research and education computer network. This network will link Government, industry, and the higher education community. Computer users at universities, Federal laboratories, and industry research centers will have access to supercomputers, computer data bases, and other research facilities.

The Federal network will also act as a catalyst for a much larger effort by the Nation as a whole. As services over the network and the number of users increase, the private sector will begin to demand more and more from the network. Universities and private industry will come to rely more and more on the network. Eventually they may be willing to fund the network itself or contribute to its support.

Initially, Federal agencies and Departments will work together to connect their individual networks. Existing user communities of Federal networks will be expanded. New user communities will be brought into these networks. Network speeds and capabilities will be upgraded as the results of research carried out under this legislation becomes fruitful. Eventually, a national network, operating at over a billion bits of data per second will be in place. Even then, the network will continue to grow, becoming faster, connecting more and broader user communities. It will become much like the telephone system we have in place today.

At the same time, each individual agency will be free to operate its own individual network to meet individual agency mission needs. To the extent an agency can contribute to the national network, it should do so. To the extent individual agency mission needs require autonomy from the national network, that autonomy is preserved.

This national network can only succeed as a cooperative effort of all the interested agencies. We do not know what the network will look like in the coming years. Technology to develop the network envisioned in this legislation is still being developed. This legislation governing the network therefore must be flexible. Instead of creating a rigid, unchangeable management structure, the legislation simply directs the Secretary to establish the network, and to do so in consultation

with other Federal Departments and agencies.

This country has lost the lead in a great number of technologies. Today, we are poised at a crossroad. We can continue down the road we are on and eventually lose our lead to foreign competition, and perhaps ultimately, the whole supercomputer industry. We can change our course by taking the actions called for in this bill and put to work the resources found within our national laboratories. If we can make this commitment, this country will maintain its preeminent status in the field of high-performance computing.

I ask unanimous consent that the text of the bill and a section-by-section analysis of the bill be printed in the RECORD.

There being no objection, the material was ordered to be printed in the RECORD, as follows:

S. 343

Be it enacted by the Senate and the House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be referred to as the "Department of Energy High-Performance Computing Act of 1991".

SEC. 2. FINDINGS.

The Congress finds that:

(a) advances in high-performance computer science and technology are vital to the Nation's defense, scientific advancement, international competitiveness and long-term prosperity;

(b) the Department of Energy and other Federal agencies have a critical need for a nationwide high-capacity computer network;

(c) the Department of Energy is the Federal agency having the greatest degree of expertise and knowledge in the research, development and use of high-performance computers, associated software and networks;

(d) the Department of Energy's expertise and knowledge is due in part to its ownership and use of the greatest number of high-performance computers of any Federal agency;

(e) the Department of Energy's expertise and knowledge is due in part to its numerous national laboratories that have personnel with particular expertise in the research, design, development and use of high-performance computers, associated software and networks; and,

(f) the Department of Energy is the Federal agency that is particularly well equipped to undertake additional research and development of high-performance computing hardware and associated software, and to design, implement and manage a multi-gigabit-per-second nationwide computer network connecting Federal departments and agencies.

SEC. 3. PURPOSES.

The purposes of this Act are:

(a) to promote the research and development of high-performance computers and associated software; and

(b) to create a multi-gigabit-per-second nationwide computer network for use by the Department of Energy and other Federal departments and agencies.

SEC. 4. DEFINITIONS.

For the purposes of this Act, the term—

(a) "Secretary" the Secretary of Energy;

(b) "Department" means the Department of Energy;

(c) "Federal laboratory" means any laboratory, or any federally funded research and development center, that is owned or leased or otherwise used by a Federal agency or department and funded by the Federal Government, whether operated by the Government or by a contractor;

(d) "national laboratory" means any Federal laboratory that is owned by the Department of Energy;

(e) "educational institution" means a degree granting institution of at least a baccalaureate level; and

(f) "software creation" means any innovation or preparation of new computer software of whatever kind or description whether patentable or unpatentable, and whether copyrightable or noncopyrightable.

(g) "Director" means the Director of the Office of Science and Technology Policy.

SEC. 5. DEPARTMENT OF ENERGY HIGH-PERFORMANCE COMPUTING PROGRAM.

(a) The Secretary, acting in accordance with the authority provided by the Federal Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. 5901 et seq.) shall establish a High-Performance Computing Program (hereinafter referred to as the "HPC Program").

(b) Within one year after the date of the enactment of this Act, the Secretary shall establish a management plan to carry out HPC Program activities. The plan shall—

(1) be developed in conjunction with the Director's overall efforts to promote high-performance computing;

(2) summarize all ongoing high-performance computing activities and resources at the Department that are not classified or otherwise restricted;

(3) describe the levels of funding for each aspect of high-performance computing that are not classified or otherwise restricted;

(4) establish long range goals and priorities for research, development, and application of high-performance computing at the Department, and devise a strategy for achieving them; and

(5) ensure that technology developed pursuant to the HPC Program is transferred to the private sector in accordance with applicable law.

SEC. 6. DEPARTMENT OF ENERGY HIGH-PERFORMANCE COMPUTING PROGRAM ACTIVITIES.

(a)(1) The Secretary shall establish a national multi-gigabit-per-second computer network to be known as the "Federal High-Performance Computer Network."

(2) The Secretary shall provide for the linkage of Federal agencies and departments, and other persons as the Secretary may deem appropriate.

(3) The Network shall be designed, implemented and managed by the Secretary of Energy, in consultation with other Federal departments and agencies.

(4) The Secretary may make use of existing Federal facilities and networks as may be appropriate to carry out the requirements of this section, provided that the Federal department or agency concurs in such use.

(b) The Secretary shall promote education and research in high-performance computational science and related fields that require the application of high-performance computing resources by making the Department's high-performance computing resources more available to undergraduate and graduate students, postdoctoral fellows, and faculty from the Nation's educational institutions.

(c) The Secretary shall establish at least two Collaborative Consortia, and as many more as the Secretary determines are needed to carry out the purposes of this Act, by soliciting and selecting proposals.

(1) Each Collaborative Consortium shall—

(A) undertake basic research and development of high-performance computing hardware and associated software technology;

(B) undertake research and development of advanced prototype networks;

(C) conduct research directed at scientific and technical problems whose solutions require the application of high-performance computing resources;

(D) promote the testing and uses of new types of high-performance computing and related software and equipment;

(E) serve as a vehicle for computing vendors to test new ideas and technology in a sophisticated computing environment; and

(F) disseminate information to Federal departments and agencies, the private sector, educational institutions, and other potential users on the availability of high-performance computing facilities.

(2) Each Collaborative Consortium shall be comprised of a lead institution, which has responsibility for the direction and performance of the consortium and participants from industry, Federal laboratories or agencies, educational institutions, and others, as may be appropriate.

(3) Each lead institution shall be a national laboratory which has the experience in research on problems that require the application of high-performance computing resources.

(4) the consortium may fund research and development associated with prototype computing technology provided that industrial participants in each consortium shall not be reimbursed for costs associated with their own involvement.

(d) The provisions of the National Cooperative Research Act of 1984 (15 U.S.C. 4301-4305) shall apply to research activities taken pursuant to this section.

(e) Each Collaborative Consortium may be established by a Cooperative Research and Development Agreement as provided in section 12 of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3710a).

(f) The Secretary shall report annually to the Committee on Energy and Natural Resources of the Senate and the Committee on Science, Space, and Technology of the House of Representatives regarding the HPC Program.

SEC. 7. GOVERNMENT AND PRIVATE SECTOR COOPERATION.

In accordance with applicable law, the Secretary may cooperate with, solicit help from, provide funds to, or enter into contracts with private contractors, industry, government, universities, or any other person or entity the Secretary deems necessary in carrying out the provisions of this Act.

SEC. 8. OWNERSHIP OF INVENTIONS AND CREATIONS.

(a) Except as otherwise provided by the National Competitiveness Technology Transfer Act of 1989 (103 Stat. 1674) and any other applicable law, title to any invention or software creation developed under this Act shall vest in the United States and shall be governed by the provisions of section 9 of the Federal Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. 5908).

(b) Trade secrets and commercial or financial information that is privileged and confidential and which is obtained from a non-Federal party participating in research or other activities under this Act may be withheld in accordance with section 552(b)(4) of title 5, United States Code.

(c) The Secretary, for a period of up to 5 years after the development of information

that results from research and development activities conducted under this title and that would be a trade secret or commercial or financial information that is privileged or confidential, under the meaning of section 552(b)(4) of title 5, United States Code, if the information had been obtained from a non-Federal party, may provide appropriate protection against the dissemination of such information, including exemption from subchapter II of chapter 5 of title 5, United State Code.

SEC. 9. AUTHORIZATION.

There is authorized to be appropriated such sums as are necessary to carry out the purposes of this Act.

SECTION-BY-SECTION ANALYSIS

Section 1 establishes the short title, "The Department of Energy High-Performance Computing Act of 1991".

Section 2 contains the findings of Congress.

Section 3 contains the purposes of the Act.

Section 4 contains definitions of terms used in the bill.

Section 5 establishes a high-performance computing program within the Department of Energy. The Secretary is directed to establish a management plan to carry out program activities.

Section 6 establishes the program activities. The Secretary of Energy is to establish a national multi-gigabit-per-second computer network to be known as the "Federal High-Performance Computing Network." The Network would link Federal agencies and departments. The Network is to be designed, implemented and managed by the Secretary.

The Secretary is to promote education and research in high-performance computing and related fields. The Secretary is to establish at least two Collaborative Consortia to undertake basic research and development of high-performance computing hardware, software and networks. Also, the Consortia are directed to promote testing and use of new types of high-performance computing, and to disseminate information on the availability of high-performance computing facilities.

The membership of each Consortium would include Federal laboratories, industry, universities, and others. Each Consortium be headed by a Department of Energy national laboratory that has experience in high-performance computing. Industrial participants are not to be reimbursed for costs associated with their own involvement.

Each consortium may be established as a Cooperative Research and Development Agreement as provided by section 3710a of title 15 United States Code. The National Cooperative Research Act of 1984 also applies to research activities undertaken by the consortia.

Section 7 authorizes the Secretary to, in accordance with applicable law, cooperate with and enter into contracts with other Federal agencies and the private sector to carry out the Act.

Section 8 establishes that title to inventions or creations (a defined term which essentially deals with software) vests in the United States in accordance with section 5908 of title 42, United States Code. Trade secrets or commercial or financial information obtained from non-Federal parties is given protection from disclosure.

Section 9 authorizes funding to carry out the purposes of the Act.

● Mr. DOMENICI. Mr. President, along with the distinguished chairman and ranking Republican member of the Committee on Energy and Natural Resources, I am pleased to cosponsor the Department of Energy High-Performance Computing Act of 1991.

During the 101st Congress, the Energy Committee reported similar legislation, and worked cooperatively with the Commerce Committee to incorporate the provisions into S. 1067 which the Senate passed unanimously. Unfortunately, the House was unable to act on this bill before adjournment of the Congress.

The legislation we are today introducing contains the two most significant provisions of last year's bill: First, it would create a nation-wide, high-speed computer network; and second, it would create supercomputing collaborative consortia to undertake research and development on high-performance computing hardware and associated software.

Mr. President, this legislation is of national importance because advances in high-performance computing and networking are vital to our economic growth, to our national security and to scientific advancement.

High-performance computing got its start in the late 1940's in the national security field, but today it is ubiquitous. Computers run our telephones; they are used to design automobiles and airplanes; they operate machines on manufacturing lines; they are integral to medical imaging devices; they are used for oil exploration; and they were even involved in the writing of this statement. Computers are now involved in every phase of our everyday life.

Supercomputers are also an integral part of the cutting edge of scientific research. For example, supercomputers are required to run and understand the data created by the superconducting super collider; and the human genome project would only be a dream without a supercomputer; and supercomputers are used to design new drugs to combat illness.

Daily supercomputers are being put to new uses. For example, a recent New York Times article reported that supercomputers were employed to assess the potential damage to the environment of burning the oil that Iraq had spilled into the Persian Gulf. The article also noted that supercomputers are being put to uses such as providing advanced warning of killer storms, predicting changes in global climate and the monitoring of hazardous wastes. I ask unanimous consent that this article be printed at the end of my statement.

Although existing supercomputers are making enormous contributions to our society, in order for these advances to continue today's supercomputer needs to be made tomorrow's home computer.

This legislation would advance supercomputing by creating in the Department of Energy a High-Performance Computing Program—in effect giving the Department a new mission.

Now some may ask why the Department of Energy? The answer is really quite simple: No other Federal agency or organization has the breadth or depth of experience in the use of supercomputers and networks, or in research and development of supercomputers, supercomputer software and allied networks.

High-speed computing was first put to use to design the atomic weapons that were used to end World War II. Today the Department of Energy has more computers than any other Federal agency, and it's National Laboratories are the world's most demanding, sophisticated and experienced users of supercomputers.

If we can harness this knowledge, experience and expertise to develop the next round of supercomputers and associated software—and transfer that technology to private industry—we can materially benefit our society and economy.

The collaborative consortia created by this legislation will be led by the Department's national laboratories, and participants will include private industry, researchers from educational institutions and other Federal laboratories. They will undertake research and development of high-performance computing hardware, software, and networks.

Part and parcel of this effort is the need to interconnect agency supercomputers through a ultra-high-speed-network. That is why this legislation also proposes to create a ultra-high-speed computer network.

Mr. President, it is for these reasons that I cosponsored last year's legislation, and it is for these reasons that I am cosponsoring this legislation. I look forward to working closely with the distinguished committee's chairman and ranking Republican member to move this legislation as quickly as possible.

Mr. President, I ask unanimous consent that the New York Times article mentioned earlier be printed in the RECORD.

There being no objection, the article was ordered to be printed in the RECORD, as follows:

[From the New York Times, Jan. 31, 199[illegible]]

A FRESH EYE ON THE ENVIRONMENT

(By John Markoff)

The world's fastest computers, once used almost exclusively to build nuclear weapons and crack codes, are finding a variety of new uses as environmental tools.

In the Persian Gulf, for instance, supercomputers were employed to assess the damage to the environment from the burning of huge quantities of oil. The computers also make it possible to warn of killer storms further in advance, to understand the forces changing the global climate and to help monitor the disposal of hazardous wastes.

Concerned about the potential environmental damage if Kuwait oil-fields were set on fire, the Pentagon last year commissioned researchers at the Pacific Sierra Research Corporation, a California consulting company, to create a supercomputer model

of such an event. Only a supercomputer, which can perform billions of mathematical operations in a second and can store and retrieve large amounts of data, can accurately simulate the complex chemical interactions in the atmosphere.

The scientists found that little of the moke generated by such fires would reach he upper atmosphere and prevent sunlight from reaching the earth, creating global climate changes and harming agriculture.

Other scientists, who have built supercomputer simulations detailing the climatological effects of a nuclear war, dispute the underlying assumptions of the Pentagon's model. Dr. Richard Turco, an atmospheric scientist at the University of California at Los Angeles, said that under certain circumstances, enough smoke from the fires could reach the upper atmosphere to cause regional cooling.

Another environmental application of the supercomputer involved smog, which scientists thought dispersed each evening, only to form again in the morning. Recently, using a supercomputer. Carnegie-Mellon University scientists demonstrated that smog stays in place high above the ground, moving lower each morning as warming air circulates, compounding the new day's pollution. That knowledge promoted a broadening of anti-pollution policies aimed mainly at car emissions, and led Los Angeles to adopt the nation's strictest pollution controls.

The supercomputer has proved to be a powerful tool for policy makers, who can use it to experiment rapidly by creating a series of hypothetical situations and measuring the effects of isolated changes. For instance, Carnegie-Mellon used the computer to "remove" cars from the streets of Los Angeles, testing what effect that would have on pollution. In this and thousands of wide-ranging applications, the supercomputer s become indispensable for many public-icy researchers, regulators and corporate .ecutives.

"Even in times of fairly tight budget constraints there is going to be money to buy these tools," said Willis E. Greenstreet, the director of administration at the North Carolina research operation of the Environmental Protection Agency. "It leads to more cost-effective regulation."

Supercomputers, which are thousands of times more powerful than a desktop computer, cost $3 million to $30 million each. They were conceived primarily for military purposes that require billions and billions of calculations, such as creating the models of nuclear explosions that are used in the design of weapons.

ANALYZING THE WEATHER

But in the last two years, financing declined for computer-intensive military research programs, including the "Star Wars" missile-defense system. That forced the country's national research laboratories, which historically pursued advanced weapons programs, to look for new projects.

At the same time, the ability of supercomputers to make forecasts has improved to the point where they have become useful for environmental purposes like weather analysis.

Supercomputers can study the weather through the use of mathematical models that account for dozens of factors, like atmospheric pressure, temperature, regional topography and wind direction. by breaking up a large region into many small areas, highly accurate forecasts can be developed. ılike satellite whether images, which ly show current conditions, the super-puter can reliably predict changes in the weather.

In addition to the environmental project in the Persian Gulf, the military is using supercomputer weather forecasts to plan bombing sorties. Indeed, many countries fighting against Iraq are censoring weather forecasts generated by supercomputers to cut off the Iraqis from such information.

In October 1987, a hurricane unexpectedly struck southern England, killing 13 people and causing millions of dollars' worth of damage. The storm was not predicted by the more modest computers used by British weather forecasters. But scientists at the European Community Medium-Range Weather Facility in Reading, England, were able to predict the storm on their Cray supercomputers and issued a warning.

The cost of the supercomputer is peanuts compared to what you can save," said Gregory J. McRae, a chemical engineer at Carnegie-Mellon. His research on smog formation has been used by California air-quality authorities to help choose the most effective polution-control strategies.

GREENING OF THE SUPERCOMPUTER

Supercomputers are also widely used for dozens of scientific and engineering tasks, including the simulation of automobile accidents to learn how to design safer cars; the creation of aircraft models to improve their aerodynamic efficiency, and the study of the interplay of specific molecules to create more effective medications.

The complexity of creating models of environmental conditions has made the machines essential for serious scientific analysis.

Environmental projects are the largest and fastest-growing business for Cray Research Inc., the nation's top supercomputer maker.

"It represents the greening of the supercomputer," said John A. Rollwagen, chairman and chief executive of Cray. "It now rivals anything that the weapons business has ever had."

At Cray, which is based in Minneapolis, the number of installed multimillion-dollar supercomputers purchased for weather and environmental applications has jumped to 17 at 15 sites, from 4 machines at 4 sites in 1988. Cray said another dozen machines were used substantially for such environmental applications and for other tasks as well. Supercomputers for environmental uses now account for about 20 percent of Cray's annual revenue.

Cray is getting more orders for environmental applications than any other supercomputer maker, but others are benefiting as well. These include I.B.M., Thinking Machines and Convex Computer in the United States, and NEC and Fujitsu in Japan.

Cray was the main beneficiary last year when ETA Systems Inc., a subsidiary of the Control Data Corporation, whose machines were popular with meteorologists, went out of business. But Cray now faces tough competition from NEC. Computer scientists say NEC's new SX-3 supercomputer rivals the fastest Cray machine. In December, the Japanese company announced that it had sold one of the new supercomputers to a meteorological research center in Brazil.

Cray Research was founded by Seymour Cray, who left in 1989 to form a new company, the Cray Computer Corporation. It, too, is benefiting from the growing environmental market. Cray Computer, based in Colorado Springs, recently announced that it had sold its first Cray 3 supercomputer to the Livermore National Laboratory's energy research center.

STUDYING CLIMATE CHANGES

Computer scientists at the laboratory said the new machine, which many scientists think will be the world's fastest for certain applications when it is installed in 1992, will be mostly used to evaluate competing theories about the forces shaping changes in the global climate.

Weapons researchers at Livermore are also exploring how to use software, developed to monitor radiation leaks at nuclear test sites, to simulate problems caused by hazardous waste.

The Livermore laboratory, which has a stable of supercomputers including machines from Cray Research, Bolt Baranek & Newman and Thinking Machines, is perhaps the most striking example of the contrast between the declining fortunes of the weapons designers and the growing advantages of environmental users.

Robert Borchers, head of computation for Livermore, said it was unlikely that even a single large new supercomputer would be purchased this year for the side of the laboratory that deals with classified weapons.

"We don't know where the money would come from," he said.

In contrast, researchers at the Environmental Protection Agency's research laboratories at Research Triangle Park in Chapel Hill, N.C., said that they had received approval to buy two of the world's largest supercomputers but that they had not decided which to buy. The National Weather Service in Camp Springs, Md., is also planning to buy two machines from Cray Research this year.

ACID RAIN SIMULATIONS

The Environmental Protection Agency now uses Cray and I.B.M. supercomputers to run simulations of the formation of acid rain and smog in the eastern United States and southeastern Canada. Besides providing a better understanding of this phenomenon, the supercomputers offer a daily tool to regulatory officials. They use information gleaned from the models to make decisions on what are permissible emissions from large polluters like power plants, and they can order the plants to reduce output.

"In the Northeast corridor, pollutants created in Baltimore and Washington go upstream to Philadelphia and then go to New York, and all of that goes to Boston," said Gary J. Foley, the director of the E.P.A.'s atmospheric rsesearch and exposure assessment laboratory. "We can look at this string of cities and develop better control strategies using our simulations."●

● Mr. WALLOP. Mr. President, I am pleased to cosponsor the Department of Energy High-Performance Computing Act of 1991 which Senator JOHNSTON is today introducing.

During the 101st Congress, the Committee on Energy and Natural Resources worked closely with the Committee on Commerce, Space and Transportation to develop comprehensive supercomputing and networking legislation, which unanimously passed the Senate. This occurred too late last year for the House to act on the Senate bill.

I had hoped that we would pick up where we left off last year with the Senate-passed bill, but unfortunately that was not agreeable to the Commerce Committee. So instead, both the Energy Committee and the Commerce Committee each start afresh, and differences will have to be worked out before Senate action can occur.

The bill I am today cosponsoring contains the two key elements of last year's bill. First, it would create super-

computing collaborative consortia to undertake research and development on high-performance computing hardware and associated software. Second, it would create a nationwide, ultra high-speed computer network to interconnect Federal agencies and others.

The legislation assigns responsibility for these activities to the Department of Energy because it is the Federal agency which has the greatest degree of expertise and knowledge in the research, development and use of high-performance computers and networks. The Department of Energy is the Federal agency which makes use of the greatest number of high-performance computers.

High-performance computing and networking is not only essential to our Nation's defense activities, it is also increasingly critical to our economic well-being. Industry is turning to the use of supercomputers for product design, testing and production. I doubt that a decade from now there will be a single product invented or produced—be it a consumer or a military product—without the use of high-performance computers and high-speed networks. The only question in my mind is whether those products will be made here in the United States, or produced abroad.

In the academic and research communities, high-performance computing and networking is likewise increasingly important. There is not a line of scientific inquiry that is either not now using supercomputers, or could not benefit from their use.

Mr. President, it is for these reasons that I am today cosponsoring this legislation. I look forward to working with them and the distinguished chairman of the committee, Senator JOHNSTON, in moving high-performance computing legislation through the Senate.●

By Mr. ROTH:

S. 344. A bill to establish the Northern Yukon-Arctic International Wildlife Refuge; to the Committee on Environment and Public Works.

NORTHERN YUKON-ARCTIC INTERNATIONAL WILDLIFE REFUGE ACT

● Mr. ROTH. Mr. President, I rise today to address our needs as well as our opportunities for international cooperation to protect our world's circumpolar region.

During my years in the Congress I have expressed my sincere ideology concerning mankind's responsibility to the environment. Simply stated, it is that man is bound to serve nature through an environmental ethic. Mankind has the responsibility to pass on a life-giving—life-sustaining—environment to future generations. Our natural and cultural heritage rank high among our most priceless and irreplaceable possessions. To loose any of these possessions would be a loss to all of mankind.

It is often exhibited that all ecosystems—from Alaska to Africa, South America to Saudi Arabia—are inextricably connected. Not only can destruction in one small area bruise the conscience of man, but it can affect the fragile ecological balance of a tiny world appear more vulnerable with each passing day. Perhaps this environmental transcendentalism is nowhere more apparent than in the circumpolar region which serves as a sink for global pollution. It gathers the wastes and fallout from all that surrounds it, and we all know the tragic consequences befalling the fragile ecosystem and biosphere. The wind, water, fish, fowl, caribou, and other animals and plants know no political boundaries. Whether the pollution that threatens their pristine and fragile environment comes from the Soviet Union, Brazil, Eastern Europe, or the United States is of little consequence—especially when the contamination begins to affect the native peoples who depend on the ecosystem.

Likewise, the contamination of this precious international resource poses a threat to the Arctic region as a scientific laboratory for comparisons of the Earth's health. As someone recently put it: "If the Arctic Systems fail, the health and the understanding of the health of the entire planet fails." It is for those and other reasons that I commend proposals that encourage international cooperation to protect the precious Arctic area. The Finnish and Pisces Initiatives and the Beringia Cooperative Agreement are very important steps in this process. Likewise, I'm proud to announce my own piece of legislation, that I am introducing today.

Mr. President, today I am introducing legislation to establish a Northern Yukon-Arctic International Wildlife Refuge. It's purpose is to bring these two great nations together in historic cooperation to permanently protect the last complete Arctic ecosystem in North America, North America's Serrengethi, to fulfill our responsibility as stewards of our land, its resources and the life that depends on it.

This effort will protect all shared wild bird resources native to North America that are in an unconfined state and that are protected under the Migratory Bird Treat Act. Likewise, it protects wetlands, marine mammals—including seals, walruses, whales, and polar bears; and it maintains our commitment to the principles of caribou management as prescribed under the Porcupine Management Agreement. And it provides for continued protection of marine and anadromous fish species that inhabit the coastal waters of the Beaufort Sea. Finally, it reaffirms the commitments we made to the residents of these lands, to continue to provide them with the opportunity for subsistence uses for the resources of these lands.

Each of these objectives is worthy, and this bill is an important step toward caring for our stewardship in the entire Arctic National Wildlife Refuge as it is currently administered under the National Wildlife Refuge Administration Act. However, most important is that this bill demonstrates the willing spirit and many opportunities nations can take advantage of toward the objective of protecting our environment. It is a first step—an important first step. But it is my hope that it serves as an example of what nations can do with shared objectives, a spirit of cooperation, and little bit of effort.

It is also my hope that we can build on this effort to actively pursue Arctic agreements that lead to an Arctic refuge protection plan. Such a plan should include international protection for shared lands and waters, cultural and historical sites, and management of fish, birds and wildlife, as well as international cooperative efforts to control the sources of pollutants that affect this fragile environment. The legislation that I am introducing today should be one of the building blocks for this effort.

I ask unanimous consent that a copy of this legislation be placed in the RECORD in its entirety at the conclusion of my remarks.

There being no objection, the bill was ordered to be printed in the RECORD, as follows:

S. 344

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Northern Yukon-Arctic International Wildlife Refuge Act".

SEC. 2. ESTABLISHMENT OF INTERNATIONAL WILDLIFE REFUGE AREA.

(a) ESTABLISHMENT.—

(1) Effective as of the date the conditions stated in subsection (b) are met, there is established an international wildlife refuge area to be called the Northern Yukon-Arctic International Wildlife Refuge, which shall include the entire Arctic National Wildlife Refuge administered under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee).

(2) The Northern Yukon-Arctic International Wildlife Refuge is established—

(A) for the purpose of permanently commemorating the long-existing relationship of peace and good will between the people and Governments of Canada and the United States;

(B) for the purpose of permanently protecting in an undisturbed condition the only remaining complete spectrum of Arctic ecosystems in North America;

(C) in fulfillment of our serious responsibility as stewards of our land, its resources, and the life that depends on it;

(D) for the purpose of permanently protecting all shared wild bird resources native to North America that are in an unconfined state and that are protected under the Migratory Bird Treaty Act (16 U.S.C. 703 et seq.), including ducks, geese, and swans of the family Anatidae, species listed as threatened or endangered under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), species defined as nongame under the Fish and Wildlife Conservation Act of 1980 (16 U.S.C. 2901 et seq.), and wetlands listed as protected under the Convention on Wetlands of International Importance, especial-

102D CONGRESS
1ST SESSION

H. R. 656

To provide for a coordinated Federal research program to ensure continued United States leadership in high-performance computing.

IN THE HOUSE OF REPRESENTATIVES

JANUARY 28, 1991

Mr. BROWN of California (for himself, Mr. VALENTINE, Mr. BOEHLERT, Mr. MINETA, and Mr. BROWDER) introduced the following bill; which was referred to the Committee on Science, Space, and Technology

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A BILL

To provide for a coordinated Federal research program to ensure continued United States leadership in high-performance computing.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "High-Performance Computing Act of 1991".

SEC. 2. FINDINGS AND PURPOSE.

(a) FINDINGS.—The Congress finds the following:

(1) Advances in computer science and technology are vital to the Nation's prosperity, national and economic security, and scientific advancement.

(2) The United States currently leads the world in the development and use of high-performance computing for national security, industrial productivity, and science and engineering, but that lead is being challenged by foreign competitors.

(3) Further research, improved computer research networks, and more effective technology transfer from government to industry are necessary for the United States to fully reap the benefits of high-performance computing.

(4) Several Federal agencies have ongoing high-performance computing programs, but improved interagency coordination, cooperation, and planning could enhance the effectiveness of these programs.

(5) A 1989 report by the Office of Science and Technology Policy outlining a research and development strategy for high-performance computing provides a framework for a multiagency high-performance computing program.

(b) PURPOSE.—It is the purpose of Congress in this Act to help ensure the continued leadership of the United States

in high-performance computing and its applications through—

(1) the expansion of Federal support for research, development, and application of high-performance computing in order to—

(A) establish a high-capacity national research and education computer network;

(B) expand the number of researchers, educators, and students with training in high-performance computing and access to high-performance computing resources;

(C) develop an information infrastructure of data bases, services, access mechanisms, and research facilities which is available for use through such a national network;

(D) stimulate research on software technology;

(E) promote the more rapid development and wider distribution of computer software tools and applications software;

(F) accelerate the development of computer systems and subsystems;

(G) provide for the application of high-performance computing to Grand Challenges; and

(H) invest in basic research and education; and

(2) the improvement of planning and coordination of Federal research and development on high-performance computing.

SEC. 3. DEFINITIONS.

As used in this Act, the term—

(1) "Council" means the Federal Coordinating Council for Science, Engineering, and Technology;

(2) "Director" means the Director of the Office of Science and Technology Policy; and

(3) "Grand Challenge" means a fundamental problem in science or engineering, with broad economic and scientific impact, whose solution will require the application of high-performance computing resources.

SEC. 4. MISCELLANEOUS PROVISIONS.

(a) NONAPPLICABILITY.—Except to the extent the appropriate Federal agency or department head determines, the provisions of this Act shall not apply to—

(1) programs or activities regarding computer systems that process classified information; or

(2) computer systems the function, operation, or use of which are those delineated in paragraphs (1) through (5) of section 2315(a) of title 10, United States Code.

(b) ACQUISITION OF PROTOTYPE AND EARLY PRODUCTION MODELS.—Where appropriate, and in accordance with Federal contracting law, Federal agencies and departments shall procure prototype or early production models of new high-performance computer systems and subsystems to stimulate hardware and software development.

SEC. 5. NATIONAL HIGH-PERFORMANCE COMPUTING PROGRAM.

The National Science and Technology Policy, Organization, and Priorities Act of 1976 (42 U.S.C. 6601 et seq.) is amended by adding at the end the following new title:

"TITLE VII—NATIONAL HIGH-PERFORMANCE COMPUTING PROGRAM

"NATIONAL HIGH-PERFORMANCE COMPUTING PLAN

"SEC. 701. (a)(1) The President, through the Federal Coordinating Council for Science, Engineering, and Technology (hereafter in this title referred to as the 'Council'), shall, in accordance with the provisions of this title—

"(A) develop and implement a National High-Performance Computing Plan (hereafter in this title referred to as the 'Plan'); and

"(B) provide for interagency coordination of the implementation of the Plan.

The Plan shall contain recommendations for a 5-year national effort and shall be submitted to the Congress within 1 year

after the date of enactment of this title. The Plan shall be resubmitted upon revision at least once every 2 years thereafter.

"(2) The Plan shall—

"(A) establish the goals and priorities for a Federal high-performance computing program for the fiscal year in which the Plan (or revised Plan) is submitted and the succeeding 4 fiscal years;

"(B) set forth the role of each Federal agency and department in implementing the Plan; and

"(C) describe the levels of Federal funding for each agency and department and specific activities, including education, research activities, hardware and software development, establishment of a national multi-gigabit-per-second research and education computer network, to be known as the National Research and Education Network, and acquisition and operating expenses for computers and computer networks, required to achieve the goals and priorities established under subparagraph (A).

"(3) The Plan shall address, where appropriate, the relevant programs and activities of—

"(A) the National Science Foundation;

"(B) the Department of Commerce, particularly the National Institute of Standards and Technology,

the National Oceanic and Atmospheric Administration, and the National Telecommunications and Information Administration;

"(C) the National Aeronautics and Space Administration;

"(D) the Department of Defense, particularly the Defense Advanced Research Projects Agency;

"(E) the Department of Energy;

"(F) the Department of Health and Human Services, particularly the National Institutes of Health and the National Library of Medicine;

"(G) the Department of Education;

"(H) the Department of Agriculture, particularly the National Agricultural Library; and

"(I) such other agencies and departments as the President or the Chairman of the Council considers appropriate.

"(4) In addition, the Plan shall take into consideration the present and planned activities of the Library of Congress, as the Librarian of Congress considers appropriate.

"(5) The Plan shall identify how agencies and departments can collaborate to—

"(A) ensure interoperability among computer networks run by the agencies and departments;

"(B) increase software productivity, capability, portability, and reliability;

"(C) expand efforts to improve, document, and evaluate unclassified public-domain software developed by federally funded researchers and other software, including federally funded educational and training software;

"(D) cooperate, where appropriate, with industry in the development and exchange of software;

"(E) distribute software among the agencies and departments;

"(F) distribute federally funded software to State and local governments, industry, and universities;

"(G) accelerate the development of high-performance computer systems, subsystems, and associated software;

"(H) provide the technical support and research and development of high-performance computer software and hardware needed to address Grand Challenges in astrophysics, geophysics, engineering, materials, biochemistry, plasma physics, weather and climate forecasting, and other fields;

"(I) provide for educating and training additional undergraduate and graduate students in software engi-

neering, computer science, and computational science; and

"(J) identify agency and department rules, regulations, policies, and practices which can be changed to significantly improve utilization of Federal high-performance computing and network facilities, and make recommendations to such agencies and departments for appropriate changes.

"(6) The Plan shall address the security requirements and policies necessary to protect Federal research computer networks and information resources accessible through Federal research computer networks. Agencies and departments identified in the Plan shall define and implement a security plan consistent with the Plan.

"(b) The Council shall—

"(1) serve as lead entity responsible for development of the Plan and interagency coordination of the implementation of the Plan;

"(2) coordinate the high-performance computing research and development activities of Federal agencies and departments and report at least annually to the President, through the Chairman of the Council, on any recommended changes in agency or departmental roles that are needed to better implement the Plan;

"(3) review, prior to the President's submission to the Congress of the annual budget estimate, each agency and departmental budget estimate in the context of the Plan and make the results of that review available to the appropriate elements of the Executive Office of the President, particularly the Office of Management and Budget; and

"(4) consult and coordinate with Federal agencies and departments, and academic, State, industry, and other appropriate groups conducting research on high-performance computing.

"(c) The Director of the Office of Science and Technology Policy shall establish a High-Performance Computing Advisory Panel consisting of prominent representatives from industry and academia who are specially qualified to provide the Council with advice and information on high-performance computing. The Panel shall provide the Council with an independent assessment of—

"(1) progress made in implementing the Plan;

"(2) the need to revise the Plan;

"(3) the balance between the components of the Plan;

"(4) whether the research and development funded under the Plan is helping to maintain United States leadership in computing technology; and

"(5) other issues identified by the Director.

"(d)(1) Each appropriate Federal agency and department involved in high-performance computing shall, as part of its annual request for appropriations to the Office of Management and Budget, submit a report to the Office identifying each element of its high-performance computing activities, which—

"(A) specifies whether each such element (i) contributes primarily to the implementation of the Plan, or (ii) contributes primarily to the achievement of other objectives but aids Plan implementation in important ways; and

"(B) states the portion of its request for appropriations that is allocated to each such element.

"(2) The Office of Management and Budget shall review each such report in light of the goals, priorities, and agency and departmental responsibilities set forth in the Plan, and shall include, in the President's annual budget estimate, a statement of the portion of each appropriate agency or department's annual budget estimate that is allocated to each element of such agency or department's high-performance computing activities.

"(e) As used in this section, the term 'Grand Challenge' means a fundamental problem in science or engineering, with broad economic and scientific impact, whose solution will re-

quire the application of high-performance computing resources.

"ANNUAL REPORT

"SEC. 702. The Chairman of the Council shall prepare and submit to the President and the Congress, not later than March 1 of each year, a report on the activities conducted pursuant to this title during the preceding fiscal year, including—

"(1) a summary of the achievements of Federal high-performance computing research and development efforts during that preceding fiscal year;

"(2) an analysis of the progress made toward achieving the goals and priorities of the Plan;

"(3) a copy and summary of the Plan and any changes made in such Plan;

"(4) a summary of appropriate agency and departmental budgets for high-performance computing activities for that preceding fiscal year; and

"(5) any recommendations regarding additional action or legislation which may be required to assist in carrying out this title.".

SEC. 6. NATIONAL RESEARCH AND EDUCATION NETWORK.

(a) ESTABLISHMENT.—In accordance with the Plan developed under section 701 of the National Science and Technology Policy, Organization, and Priorities Act of 1976, as added by section 5 of this Act, the National Science Founda-

tion, in cooperation with the Department of Defense, the Department of Energy, the Department of Commerce, the National Aeronautics and Space Administration, and other appropriate agencies, shall provide for the establishment of a national multi-gigabit-per-second research and education computer network by 1996, to be known as the National Research and Education Network (hereafter in this Act referred to as the "Network"), which shall link government, industry, and the education community.

(b) ACCESS.—The Network shall provide users with appropriate access to high-performance computers, computer data bases, other research facilities, and libraries.

(c) NETWORK CHARACTERISTICS.—The Network shall—

(1) be developed in close cooperation with the computer, telecommunications, and information industries;

(2) be designed and developed with the advice of potential users in government, industry, and the higher education community;

(3) be established in a manner which fosters and maintains competition and private sector investment in high speed data networking within the telecommunications industry;

(4) be established in a manner which promotes research and development leading to deployment of commercial data communications and telecommunications standards;

(5) be designed to ensure the continued application of laws that protect copyright and intellectual property rights or that control access to data bases;

(6) where technically feasible, have accounting mechanisms which allow, where appropriate, users or groups of users to be charged for their usage of the Network and copyrighted materials available over the Network; and

(7) be phased into commercial operation as commercial networks can meet the networking needs of American researchers and educators.

(d) DEPARTMENT OF DEFENSE RESPONSIBILITY.—The Department of Defense, through the Defense Advanced Research Projects Agency, shall be lead agency for research and development of advanced fiber optics technology, switches, and protocols needed to develop the Network.

(e) NATIONAL SCIENCE FOUNDATION RESPONSIBILITY.—Within the Federal Government, the National Science Foundation shall have primary responsibility for connecting colleges, universities, and libraries to the Network.

(f) ROLE OF THE COUNCIL.—(1) The Council, within 1 year after the date of enactment of this Act and consistent with the Plan developed under section 701 of the National Science and Technology Policy, Organization, and Priorities Act of 1976, as added by section 5 of this Act, shall—

(A) develop goals, strategy, and priorities for the Network;

(B) identify the roles of Federal agencies and departments implementing the Network;

(C) provide a mechanism to coordinate the activities of Federal agencies and departments in deploying the Network;

(D) oversee the operation and evolution of the Network;

(E) manage the connections between computer networks of Federal agencies and departments;

(F) develop conditions for access to the Network; and

(G) identify how existing and future computer networks of Federal agencies and departments could contribute to the Network.

(2) The President shall report to Congress within 1 year after the date of enactment of this Act on the implementation of this subsection.

(g) USE OF GRANT FUNDS.—The National Science Foundation, the National Aeronautics and Space Administration, the Department of Energy, the Department of Defense, the Department of Commerce, the Department of the Interior, the Department of Agriculture, the Department of Health and Human Services, and the Environmental Protection Agency may allow recipients of Federal research grants to use grant funds to pay for computer networking expenses.

(h) REPORT.—Within 1 year after the date of enactment of this Act, the Director, through the Council, shall report to the Congress on—

(1) effective mechanisms for providing operating funds for the maintenance and use of the Network, including user fees, industry support, and continued Federal investment;

(2) plans for the eventual commercialization of the Network;

(3) how commercial information service providers could be charged for access to the Network;

(4) the technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks;

(5) how Network users could be charged for such commercial information services;

(6) how to protect the copyrights of material distributed over the Network; and

(7) appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks.

SEC. 7. ROLE OF THE NATIONAL SCIENCE FOUNDATION.

(a) GENERAL RESPONSIBILITIES.—The National Science Foundation shall provide funding to enable researchers to access high-performance computers. Prior to deployment of the Network, the National Science Foundation shall maintain, expand, and upgrade its existing computer networks. The responsibilities of the National Science Foundation may include promoting development of information services and data bases available over such computer networks; facilitation of the documentation, evaluation, and distribution of research software over such computer networks; encouragement of continued development of innovative software by industry; and promotion of science and engineering education.

(b) INFORMATION SERVICES.—The National Science Foundation shall, in cooperation with other appropriate agencies and departments, promote the development of information services that could be provided over the Network established under section 6. These services shall include the provision of directories of users and services on computer networks, data bases of unclassified Federal scientific data,

training of users of data bases and networks, access to commercial information services to users of the Network, and technology to support computer-based collaboration that allows researchers around the Nation to share information and instrumentation.

(c) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the National Science Foundation for the purposes of this Act $46,000,000 for fiscal year 1992, of which $15,000,000 shall be for purposes of section 6; $88,000,000 for fiscal year 1993, of which $25,000,000 shall be for purposes of section 6; $145,000,000 for fiscal year 1994, of which $55,000,000 shall be for purposes of section 6; $172,000,000 for fiscal year 1995, of which $50,000,000 shall be for purposes of section 6; and $199,000,000 for fiscal year 1996, of which $50,000,000 shall be for purposes of section 6.

SEC. 8. ROLE OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.

(a) GENERAL RESPONSIBILITIES.—In accordance with the Plan developed under section 701 of the National Science and Technology Policy, Organization, and Priorities Act of 1976, as added by section 5 of this Act, the National Aeronautics and Space Administration shall conduct basic and applied research in high-performance computing, particularly in the field of computational science, with emphasis on aeronau-

tics and the processing of remote sensing and space science data.

(b) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the National Aeronautics and Space Administration for the purposes of this Act $22,000,000 for fiscal year 1992, $45,000,000 for fiscal year 1993, $67,000,000 for fiscal year 1994, $89,000,000 for fiscal year 1995, and $115,000,000 for fiscal year 1996.

SEC. 9. ROLE OF THE DEPARTMENT OF COMMERCE.

(a) GENERAL RESPONSIBILITIES.—The National Institute of Standards and Technology shall adopt standards and guidelines, and develop measurement techniques and test methods, for the interoperability of high-performance computers in networks and for common user interfaces to systems. In addition, the National Institute of Standards and Technology shall be responsible for developing benchmark tests and standards for high–performance computers and software.

(b) STUDY OF IMPACT OF REGULATIONS.—(1) The Secretary of Commerce shall conduct a study to evaluate the impact of Federal procurement regulations which require that contractors providing software to the Federal Government share the rights to proprietary software development tools that the contractors use to develop the software, including a determination of whether such regulations discourage devel-

opment of improved software development tools and techniques.

(2) The Secretary of Commerce shall, within 1 year after the date of enactment of this Act, report to the Congress regarding the results of the study conducted under paragraph (1).

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JOINT HEARING ON H.R. 656, THE

HIGH-PERFORMANCE COMPUTING ACT OF 1991

THURSDAY, MARCH 7, 1991

U.S. House of Representatives,

Subcommittee on Science,

Subcommittee on Technology and Competitiveness,

Committee on Science, Space and Technology,

Washington, D.C.

The subcommittees met, pursuant to notice, at 9:37 a.m., in Room 2318, Rayburn House Office Building, Hon. Rick C. Boucher [chairman of the Subcommittee on Science] presiding.

Mr. BOUCHER. This joint meeting of the Subcommittee on Science and the Subcommittee on Technology and Competitiveness will come to order.

Today we receive testimony on H.R. 656, authored by the chairman of our full committee, Representative Brown, which embodies the high-performance computing initiative long advocated by Representative Brown, and by Senator Al Gore of Tennessee, from whom we will be pleased to hear this morning.

It's also satisfying to note the strong support of the Administration for this effort, and we welcome as another of our witnesses Dr. Allan Bromley, the President's science advisor, who will elaborate on the Administration's position.

High-performance computing, which comprises large capacity data networks and supercomputers and the software to exploit the capabilities of both, is evolving into a powerful engine of scientific and technological progress. Ever more capable networks connect scientists and engineers with one another and with special research facilities and data bases. The future points toward information superhighways with applications for commerce, education, and research, limited only by our imaginations. Supercomputers play an increasingly prominent role in science and engineering

research. In some research fields, they are auxiliary aids; in others, they are the only means through which progress can occur.

The opportunity now exists to accelerate development of all aspects of high-performance computing so that we can successfully confront the most difficult problems that currently serve as barriers to scientific and technological progress and to the future well-being of society. These problems often are referred to as ''grand challenges'' and include the modeling of climate to assess the consequences of human activities on the environment, detailed analysis of the structure of materials to allow development of better high- temperature superconductors, better understanding of turbulent combustion processes that would lead to highly fuel efficient and less polluting vehicles, and determination of the function of biologically important molecules to unlock the secrets of cell biology and thereby make enormous strides in the cure of disease.

Our witnesses today will comment on the proposal to develop and implement a national high-performance computing program that will build on existing R&D activities of the Federal Government to achieve orders of magnitude improvements in network capacity and computing performance. The bill calls for an interagency initiative that places responsibility for planning and coordinating with the White

House Office of Science and Technology Policy. The principal agencies contributing to the initiative--the National Science Foundation, the Defense Advanced Research Projects Agency, the Department of Energy, and the National Aeronautics and Space Administration--are all represented here this morning.

The bill authorizes the development of a multi-gigabyte national research and education network, development of new classes of supercomputers, development of the software that is needed to fully exploit the capabilities of the most powerful computers, and the vigorous basic research and education program in computer and computational sciences. The four components of the high-performance computing program will help consolidate and focus research and development activities so as to capitalize on our lead over international competitors in some areas and accelerate developments in other areas where the competition is tighter.

This morning we are seeking the views of a broad range of witnesses on the specific provisions of H.R. 656. We hope to discover how the bill might be improved to help us achieve its legislative objectives. We will welcome each of our witnesses and look forward to their presentations.

It's now my privilege to recognize the co-chairman for this hearing, the chairman of this committee's Subcommittee

on Technology and Competitiveness, the gentleman from North Carolina, Mr. Valentine.

[The prepared statement of Mr. Boucher follows:]

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Mr. VALENTINE. Thank you very much, Mr. Chairman.

I am extremely pleased to have the opportunity to chair jointly with Mr. Boucher this hearing on high-performance computing, and I will make these opening remarks very brief.

Over the past few years, there have been tremendous advances in computer hardware, networking, and computational technology. These advances have resulted in an exponential increase in scientific communications and computing that has had a positive impact on the way universities and industry and Government interact in research.

These interactions have encouraged interdisciplinary research that is necessary to solve the extremely difficult scientific problems facing our country today. However, we must continue to move forward in the area of high-performance computing. Advances in interactive communications could provide a virtual proximity for conducting meetings, workshops, and educational activities. Time and money could be saved in the way we conduct our business, and resources could be shared across multiple institutions to enhance the capabilities of those who are at the low end of the scale.

Cooperative efforts must be encouraged and supported to explore and exploit parallel computing. Both hardware and software technology advances are needed to process and

access the tremendous data bases that will be generated in projects like the human genome research and Mission to Planet Earth.

There are many other areas that I could talk about, but for the sake of brevity, I shall not. Let me conclude by saying that America must maintain its leadership in high-performance computing, and high-performance computing enhances basic scientific research and the transfer of this research into technologies and products that support our competitiveness in the global marketplace.

I'm encouraged that the President has proposed a high-performance computing and communications program. I am pleased that there is legislation in the Senate introduced by Senator Gore similar to H.R. 656. I look forward to hearing the testimony of Senator Gore and Dr. Bromley and the other distinguished witnesses. I'd like to especially welcome Mr. Larry Lee, the Director of the North Carolina Supercomputer Center, which is in our district.

I look forward to working with Mr. Boucher and other members of the Science Committee in the passage of this legislation, and I yield back the balance of my time.

[The prepared statement of Mr. Valentine follows:]

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Mr. BOUCHER. The Chair thanks the gentleman and now recognizes the ranking minority member of the Science Subcommittee, the gentleman from California, Mr. Packard.

Mr. PACKARD. Thank you, Mr. Chairman.

Welcome, Senator Gore. We appreciate you being here and certainly are looking forward to your testimony regarding the bill that you've introduced as S. 272 and its companion bill, H.R. 656.

I would like also to welcome Dr. Bromley, whom we've heard before before this committee, our science advisor to the President and the Director of the Office of Science and Technology Policy.

High-performance computing and computer communication networks are becoming increasingly important to the advancement of scientific research and economic competition. This act has the potential to extend U.S. technology leadership in high-performance computing. It will also spur U.S. productivity and international competitiveness and enhance the Nation's educational infrastructure.

The United States currently reigns as the world leader in high-performance computing; however, aggressive steps must be taken to maintain that dominant position. Certainly, Japan and Europe are both rapidly gaining ground on the international race for superiority in high-performance

computing. This interagency initiative will work to ensure America's preeminence in this technology.

At this point, one of my major concerns is the extent of the Federal Government's involvement in developing the national research and education network. I look forward to testimony which will clarify the exact role of the Federal Government.

Future goals for the initiative include developing the hardware and the software to such a level that the so-called ''grand challenge'' problems can be tackled. Key to solving these grand challenges will be utilizing--or rather the utilization of--the five NSF supercomputer centers, of which the San Diego Supercomputer Center, located at the University of California at San Diego, is a shining example. This center provides access to leading edge supercomputing and visualization, extensive application software, and comprehensive user service. I fully anticipate that the San Diego Supercomputer Center will play a vital role in this initiative.

I will conclude my statement at that point but certainly look forward to the testimony of all of the witnesses, and I want to thank the chairmen of both of the subcommittees for this joint hearing.

[The prepared statement of Mr. Packard follows:]

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Mr. BOUCHER. The Chair thanks the gentleman and recognizes Mr. Lewis from Florida, the ranking minority member of the Subcommittee on Technology and Competitiveness.

Mr. LEWIS. Thank you, Mr. Chairman, and thank you, my chairman, for holding this hearing, and thank you for coming over, Senator Gore, and discussing the merits of your bill.

Few areas in the United States' technology are recognized as having been developed here first and in which we are still the world's leader as the area of high-performance computing. The benefits of this U.S. position have been taken to make contributions both to our economy and to our advances in other fields of technology. The question is: how can we maintain our status as number one in the world?

Before us are two initiatives. One is the high-performance computing legislation, H.R. 656, and the second one is the Administration's high-performance computer initiative. Which is best? Maybe neither but a combination of both. I look forward to today's testimony, and we have a sterling list of witnesses who are going to help us make those decisions.

Thank you, Mr. Chairman.

Mr. BOUCHER. The Chair thanks the gentleman and is now pleased to recognize the chairman of the full Committee on Science, Space, and Technology and the author of H.R. 656,

the gentleman from California, Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman.

Last night the President, in a moving and excellent speech, indicated that our highest priority in this post-Gulf war period was to restore America's economic leadership, and he challenged us to pass enabling legislation to do that and accomplish other high priority items within 100 days. I think we ought to accept that challenge. This is a crucial item in restoring America's competitive leadership in the world.

This committee has for many years had on a bipartisan basis a strong interest in this kind of legislation, exemplified by the leadership of Mr. Boehlert and others on the minority side as well as those on the majority side. I would like to have this committee accept as a goal to move this legislation, and I hope Senator Gore can make the same commitment in the Senate within that 100-day period and get this effort to restore America's economic leadership off to a good start, and I very much appreciate the contribution of the witnesses here this morning in helping us do that.

Thank you.

Mr. BOUCHER. The Chair thanks the gentleman and recognizes the gentleman from Maryland, Mr. Gilchrest.

Mr. GILCHREST. Thank you, Mr. Chairman.

They say this is the information age, and I come before

this hearing to listen to the witnesses as someone who knows very little about computers--even home computers--so I will be, I'm sure, fascinated with the testimony, and I look forward to it.

We hear a great deal about infrastructure. I think probably the most--in my judgment, anyway--important infrastructure in the United States and probably the world is education, and the way education is successfully completed or is successful is through the continuing flow of information. So if we can provide this flow of information to our public schools, our research facilities in a networking fashion to enhance the quality of life for people through our constant improvement of competitiveness with the rest of the world, then we will have completed our task, and we can turn it over to the next generation to improve upon it some more.

So I look forward to the testimony this morning.

Mr. BOUCHER. The Chair thanks the gentleman and recognizes the gentlewoman from Missouri, Mrs. Horn.

Ms. HORN. Thank you, Mr. Chair.

I have no opening statement. I do look forward to listening to our illustrious guests. Thank you.

Mr. BOUCHER. The gentleman from Florida, Mr. Bacchus.

Mr. BACCHUS. Thank you, Mr. Chair.

I'd just like to say a personal word of welcome to Senator

Gore. His family and mine hail from the same part of the back woods in Tennessee. My grandmother has been voting for people named Gore for about half a century. I was born in Nashville and went to Vanderbilt, as he did, and Senator Gore's father was one of my professors during my senior year at Vandy after I worked in his last campaign as a volunteer.

One of the reasons I came to Congress was to work with people like Al Gore. I'm very glad especially that he has taken the time so often to come over to our side. I think that's one of the reasons he's done so well on the other side is that he has learned from us as well.

I'm a very strong supporter of this legislation, and again, sir, welcome.

Mr. BOUCHER. The gentleman from Michigan, Mr. Henry.

Mr. HENRY. Well, thank you, Mr. Chairman.

I don't have an opening statement, but I do have an issue I would like to be raised in my absence, since I have a markup which begins in another committee in about five minutes, and it picks up on a comment of Mr. Gilchrest's which I think is very central to part of this debate.

I wanted to acknowledge Chairman Brown's, Mr. Boehlert's, and Senator Gore's leadership on this. These are not sunshine patriots that jumped on an issue because it became popular; they're the people who made it popular by pushing the issue long before it was. I recognize their leadership

on this and commend them for the fact that this is now central to the issue of the debate on America's technological competitiveness, the issue of technology development, technology transfer, technology adaptation, and competitiveness in the truest sense of the word. They're tough issues because they're vanguard issues.

Senator, I'm very genuine in expressing my appreciation for what you've done.

Part of that leadership reflected itself in fighting for and celebrating victories over the years in establishing the superconducting centers through the National Science Foundation and the NSF net programs, which went on-line about three years ago. I just want to put on the agenda my concern that as we move forward on this new initiative we not lose sight of what is there in place and to keep that educational networking vital and strong.

And I mention it only because, to the best of my knowledge in a preliminary and rather rudimentary looking at the budget, we have a Presidential initiative, which I commend -- I think which we all commend--we're trying to shape and fine tune it, but it leaves the NSF net flat, and I think that has created some concern in the university community and some of the research community, and I just want to be sure we not lose sight of that component as we address the grander whole.

Thank you very much, Mr. Chairman. Please excuse my absence.

Mr. BOUCHER. The Chair thanks the gentleman and recognizes the gentleman from Illinois, Mr. Costello.

Mr. COSTELLO. Mr. Chairman, I have an opening statement, but out of respect for Senator Gore's schedule, I would ask that it be entered into the record at this time.

Mr. BOUCHER. Without objection, it will be made a part of the record.

[The prepared statement of Mr. Costello follows:]

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Mr. BOUCHER. The Chair recognizes the gentleman from New Hampshire, Mr. Swett.

Mr. SWETT. Thank you, Mr. Chair.

I just wanted to say that I have a meeting coming up that organizes the Economic Development Subcommittee on the Public Works and Transportation Committee so I won't be able to attend the hearing, but I appreciate the work that you're doing, Senator Gore, and I just wanted to add that my experience on the infrastructure issue from highways, bridges, and intermodal transportation is not unlike the kind of issues that we're dealing with here on this subcommittee, and I appreciate that work, I applaud it. My computer experience is extensive, and I understand the great power and wealth that can be derived from a better intermodal connection of our informational system.

I look forward to your testimony, and I look forward to success in this committee.

Thank you very much.

Mr. BOUCHER. The Chair thanks the gentleman and recognizes the gentleman from Arkansas, Mr. Thornton.

Mr. THORNTON. Thank you, Mr. Chairman.

We have a rare moment of opportunity in this country with the events that have been transpiring over the past year and a half and this initiative by our own chairman, minority

leader, minority representatives, and by my distinguished former colleague, great friend, and neighbor, Senator Gore.

It's a pleasure to welcome you. I'm looking forward to your testimony.

Mr. BOUCHER. The gentleman from Indiana, Mr. Roemer.

Mr. ROEMER. Thank you, Mr. Chairman.

As Mr. Swett said, I, too, have an Education Subcommittee hearing to go to. In terms of brevity, I will just say that we're delighted to have you here. I've heard a lot about you, Senator Gore, being a freshman here, that you got your start on this committee. I'm anxious to work with you from the Senate side and with the chairman on this committee to forge a relationship for our new domestic agenda, combining education and technology--an opportunity that I have as a freshman on these two very exciting committees--and the exciting challenges we face as a country coming up into a new century, and I look forward to working with you.

Thank you.

Mr. BOUCHER. The Chair thanks the gentleman.

It is a particular pleasure this morning to welcome our first witness, Senator Al Gore from Tennessee, who has long been the leading advocate in the Congress for the development of a high-performance computing and networking program.

Senator Gore, we congratulate you on the success that you

have had in bringing the initiative to this point, and we note with satisfaction the strong support now offered by the Administration for that initiative.

So with those comments, it is a pleasure to welcome you this morning, and we'll be very pleased to receive your testimony.

STATEMENT OF HON. ALBERT GORE, JR., A UNITED STATES SENATOR FROM THE STATE OF TENNESSEE

Senator GORE. Thank you very much, Mr. Chairman.

As a neighbor, I'm especially grateful to you for your courtesy in inviting me this morning, and, Congressman Valentine, thank you for co-chairing this hearing and for your friendship as well.

We worked recently on the Carnegie Commission Panel on Science in the Congress together, and Congressman Boucher and I have worked on a number of initiatives together over the years, and I have previously come to express my heartfelt joy that Congressman Brown is chairman of this committee now. You may get tired of hearing that, but we're really excited at the dynamism and leadership that is already evident here.

May I express my thanks to Mr. Packard and Mr. Lewis for convening this hearing as well and to Congressman Sherwood Boehlert and to all members of the committee. I appreciate your invitation to be here.

As a former member of this committee, I note with pride that this whole endeavor that we're discussing here today began about 12 years ago in this very committee room. As a new member of this committee, I began exploring the areas of computational science, what the implications were for our

country, what our Nation's capacity was to make good use of computers and how we might deal with the information revolution, and in that connection I would like to thank the staff of this committee on both sides, the present staff and their predecessors, for the help that I have had over the years, and I include Dave Clement in this. I don't see him here today, but it has been a bipartisan working relationship from the very beginning, and I am grateful for that.

You have a great witness list today, Mr. Chairman, and I will ask your consent to put my full formal statement in the record and just talk about why I think this initiative is so important, and in the course of my remarks, I will attempt to briefly address some of the questions and inquiries that came out in the opening statements.

One other introductory comment. Several people here have already noted the key role played by Dr. Allan Bromley in bringing us to the point we're at here today. If I might add to those words briefly my own personal statement of what a joy it is to work with Dr. Bromley on an issue like this, it took very little time for him, after coming into the Administration, to take command of a whole series of issues. I've had my disagreements with him on a few of those issues, but I have strongly agreed with him on most of them, and this is one where we really see eye-to-eye, and there is

very little difference between the Administration's plan and H.R. 656 and S. 272.

That's not by accident, incidentally. Several years ago, this committee and the Senate Commerce Committee, and then subsequently the House and Senate, passed legislation called the Supercomputer Network Study Act. It directed the Administration of then-President Reagan to conduct a full and extensive study of what should be done here. We made specific suggestions on the direction we thought it ought to move in.

Well, they undertook that study, and after several years they came back and said, ''You know, we agree with you. This is something that ought to be done. This is in the best interest of our country.'' And we worked together with the Administration to develop the details of how this ought to proceed. It is not an accident that these plans are moving in parallel here in the House and in the Senate and in the Administration.

Of course, any Administration would like us to appropriate all the money we appropriate each year and never give any guidance as to exactly how it should be spent, but we take that with a grain of salt. The details of the plans are really in conformity, and that is partly due to Dr. Bromley's leadership and his powers of persuasion within the Administration. He used them, incidentally, in a hearing

Tuesday on the Senate side, and we have very strong bipartisan support over there.

You know, I was thinking listening to your statements this morning about the celebration we all shared in last night, and I don't think it's stretching things too much to say that one of the principal reasons our military coalition was able to win such a decisive victory was that we had a superior command of information in all its forms. One of the media focuses of this war was the smart bomb and the technology that made it possible for those bombs to avoid civilian casualties and go right to the military targets, the information management involved in the massive logistics effort--the list of examples is virtually endless, and I'll not even start going through more of them, but the point is we had a superior command of information. Our ability to win the economic battles of the future with Japan and a unified Europe, for example, will also depend on whether or not we develop a superior command of information of the kind directly relevant to success in the world economy.

The word ''infrastructure'' has already been brought up here this morning. Let's think about that word because it represents an important focal point for national unity of purpose. Democrats and Republicans have arguments from time to time, especially about the role of Government in moving our country forward. One thing Democrats and Republicans,

conservatives and liberals have always been able to agree on is that infrastructure, which empowers individuals and empowers companies and empowers the whole Nation to perform more efficiently and to reach toward more of our potential--infrastructure represents one of those tasks appropriately assigned to Government. It's one of the ways we can work together as a country through Government to build a brighter future for all of our citizens.

The future is arriving more quickly these days. It becomes a cliche to talk about how fast things are speeding up. Members of this committee know that better than members of any other committee in Congress. But still it sometimes leaves us behind, and in the debate about infrastructure, that's true, because even though we agree on infrastructure, we still think of it in terms of roads and bridges, deep water ports, railroad lines, and the like. But, Mr. Chairman, look at the dramatic success of some of these newly emerging countries in the world economy that have practically no natural resources, practically nothing to work with except the ingenuity of their people and their ability to use knowledge and information.

Clearly, we have to think of our national infrastructure in broader terms, newer terms, and define it in ways that include our ability to use information. We're now part of a global civilization. It has been prematurely heralded and

announced several times in this century since the days of Woodrow Wilson, but now it is here, partly due to the electronic media that lets us sit in our living rooms and watch the bombs dropping in Baghdad, that lets people everywhere in the world hear music recorded in Nashville, Tennessee.

The world is being brought together, and this global civilization and this global marketplace is based on shared knowledge in the form of digital code. Digital code is now the lingua franca of global civilization, and those nations best able to use knowledge and information in the form of digital code will be those nations best positioned to better the lives of their people and compete successfully in this new global civilization. We have a lead in network technology, but it's generally assumed to be about 18 months over the Japanese, and if we sit on our lead, we'll lose it the way we have in some other critical areas.

I want to make it possible for a school child in Tennessee or Arkansas or Virginia or the other States represented here to come home after school and, instead of playing Nintendo, plug into the Library of Congress with a device that looks very much like a Nintendo machine and no more expensive. We know exactly how to do that today. All the technologies are available today. What's missing? The political imagination and willpower. It's present in this committee.

Now, we do have some problems. This information revolution has created fantastic new abilities to shape the world around us, to unlock the secrets of nature, and all the rest, but it has resulted in the accumulation of more data than we can possibly absorb. It's just stacking up unused. We don't take advantage of it. It reminds me of the way we used to approach agricultural policy. We had these huge silos of grain rotting while people starved to death by the millions. We're trying to work our way away from that. Well, now we have these silos of data rotting, sometimes literally, while the hunger for information on how to solve these unprecedented problems is more severe now than at any time in the history of humankind.

Take the LANDSAT program, just as one example, capable of taking a complete photograph of the earth's surface every 18 days. It's been up there taking pictures for almost 20 years. Ninety-five percent of those pictures have never fired a single neuron in a single human brain. They just sit there stored in digital form in Sioux Falls, South Dakota, in that case, because we don't use them. That problem is going to get a lot worse before it gets better.

Look at the Mission to Planet Earth Program, which both of our committees are looking at. When it's up there operating, it will send information equivalent to the entire Library of Congress every five days. A little bit less than

that. Well, if we can't even use the LANDSAT photos, how are we going to use that? Well, if you look at our ability to learn and to deal with information and analyze our brains in the terms that might be applied to a computer, you'd say that we have a low bit rate but very high resolution. The telephone company years ago decided that seven numbers was the most we could remember, and then they added three. Bit by bit, information cannot be absorbed in great quantities.

But we also have high resolution. What that means very simply is that if we're presented with a billion or a trillion bits of data all arrayed in a mosaic pattern, such as a picture, we can absorb it just like that. Supercomputers make two unique contributions to our ability to deal with information. The first is it gives us the ability to take massive amounts of information and configure it into patterns or pictures or three-dimensional moving graphics, mosaics of meaning which enable us to absorb lots of information quickly.

The second thing supercomputers enable us to do is to go into a vast ocean of information and quickly pick out those particular scattered bits which are necessary to make up one of those patterns. We're doing that now with great success. Unfortunately, our infrastructure needed to enable us to share those pictures, those patters, those graphics is not capable of doing it. In order to use one of these new

machines, you almost have to be in the same building with it because our network of communications lines has been driven by supply and demand forces responding mainly to the demand for voice communication and streams of numbers--bit, bit, bit.

We face a chicken-and-egg dilemma, a very classic problem, and I would say this especially in response to Mr. Packard's query about--a very sincere question--what exactly is the Government's role here? Well, the marketplace is not conveying to us the demand for these new kinds of information services because the network to deliver them is not in place. The market is not conveying to us the demand for this new network because the information services which will be delivered over it are not yet being offered to the public. It's a chicken-and-egg dilemma.

How do we get over that hurdle? We get over it the same way we built the interstate highway system. No private company could have gone to the capital markets and raised the money to capitalize the interstate highway fund. The Government did it. Then user fees were available to keep it going on an ongoing basis. This network should be and will be privatized as soon as it is feasible to do so. You know, the NSF net, which was referred to earlier, is now contracted out to private companies. This will operate the same way. More than that. The unique physical

characteristics of this network offer tremendous opportunities. Let me explain briefly what I'm talking about there.

Fiber optic cable is the first communications media which can have its capacity greatly upgraded without putting more cables in the ground or on the poles. All you have to change is the electronics at either end--the switches, the software, the algorithms. So as the Government stimulates the development of the new switches, et cetera, necessary to upgrade the capacity of the fiber already there to build this backbone network, that technology will become available to the private sector to quickly expand the reach of the network. The same switches will be able to expand the capacity of other fiber optic cables already in place. The demand will grow. We'll unleash the forces of supply and demand in a way that will quickly expand this network far beyond the backbone pattern that will be authorized in this legislation and in the President's plan. We need to do more. We need to create digital libraries, which will also be done in this legislation, to get started on the task of configuring the information so that it is accessible through the network.

Scientists are now saying that this development, our ability to use supercomputers in this form and share the data, is so important that it has actually led to a third

branch of knowledge creation, the first two being, of course, inductive reasoning and deductive reasoning. You have a theory, you test it out. You look at the world and gather facts and try to explain it. Computational science is a third entry on that very short list. We can model versions of the way the world can work and learn from it.

Some of you witnesses will explain this far better than I can, but, members of the committee, we've got the first two branches of knowledge creation handled pretty well, but this third one is going to determine the future of the world economy and the future of virtually every business in America. We need to empower our businesses and our individuals to participate fully and to compete more effectively than the peoples of any other nation on Earth.

Now, in conclusion, I will cover a lot of things in my prepared statement that I did not cover here, including the specifics of H.R. 656 and S. 272, rather, which I should be talking about, but I've worked very closely with Congressman Brown and am very proud to be his partner and Congressman Boehlert's partner and the others here who are working on that. I'm beginning to feel I've spent so much time on the generalities that I haven't gone through the specifics, but maybe since I've consumed the time I have I'll just leave that for the record and respond to any questions you might have about it.

667 Thank you very much, Mr. Chairman.

668 [The prepared statement of Senator Gore follows:]

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Mr. BOUCHER. The Chair thanks the Senator for that very well stated view of the need for the high-performance computing and networking initiative. What I think we all agree on is the need for the initiative. What perhaps there is not total agreement on is the need for the legislation itself, and what I would ask the Senator is perhaps to share with this committee some of the specific reasons that we should pass legislation in order to provide a framework into which this high-performance computing initiative can fit.

Senator GORE. Well, let me just give one example. The Administration's plan does not include the concern expressed earlier by Mr. Gilchrest about education. Not intentionally; it was an understandable oversight which they will remedy next year, I'm sure. But that's an example of how Congressman Brown's bill and its companion in the Senate can supplement what the Administration has done, just as they have supplemented some of the things that we started here.

Dr. Bromley has done well in getting a commitment from OMB to support this initiative. But you know what? That commitment is only for one year. This is a five-year program. This committee has the power with the concurrence of the Congress to authorize a program for five years and to send a clear and unmistakable signal to the private sector

that this is going to happen. And it will happen, and I have great confidence in Dr. Bromley, but I also understand that any Administration--and we Democrats have certainly been guilty of this just as much as Republicans as they've had the White House--whenever we've controlled the Presidency, our President has often stated a preference to have the Congress just appropriate the money and get out of the way. ''Just give us the money and don't worry about how we spend it. Trust us, we'll do it.''

Well, I trust them, but the conditions that led OMB to sign off on this this year could potentially change next year. I've known Offices of Management and Budget to suddenly do irrational things and say, ''Well, yes, we liked that program last year, but we've got some hard choices, and we're just going to have to cut it out this year.'' We ought to be willing to say here in this Congress, ''This is important to the future of this country, and we want to get on with it.''

You know, there's a private company already looking at what we're doing based in Michigan. I know Congressman Henry had another hearing to go to, but the Merit Company in partnership with MCI and IBM have already announced a non-profit corporation in the private sector to say, ''As soon as this network is up and going, we're going to commit a lot of money privately to quickly expand it as far as we can.''

So that's yet another reason why we need that multi-year commitment.

Now, finally, in response to your question, we've spent a lot of time in Congress, especially in this committee, looking at exactly how this should be done, and the Congress must be an integral part of this whole initiative, as it has been from the start.

Mr. BOUCHER. The Chair thanks the gentleman and recognizes the gentleman from North Carolina, Mr. Valentine.

Mr. VALENTINE. Thank you, Mr. Chairman.

I must say, Senator, that I'm proud to have known you when you served on this committee. I don't mean to suggest that you have become better at expressing yourself since I first admired that quality here, but I want to compliment you on the job that you have done here. You have succeeded, I think, in translating a lot of very complicated scientific words into language that is easy, relatively speaking, to understand.

I want to ask just a couple of questions, and maybe both of them have some parochial basis. Our district includes--the Second District in North Carolina is very much like many others but very different in many ways in that it has Duke University and the major developed part of the Research Triangle Park, and then it has a lot of rural, isolated areas in the eastern part of our State. Let me comment

before coming to my question. It is certainly hoped that when we develop the ability to plug in these small, isolated high schools into the Library of Congress, and even the homes, that we can also do something about the motivation to cause that plug to be utilized rather than some other electronic devices that will be in those places.

I understand how this legislation will apply to places, certain parts of our district, but what are your ideas as to how this can assist your constituency in the hills of eastern Tennessee and my folks in Vance County, North Carolina, which is a relatively remote agricultural area?

Senator GORE. Well, that's probably the best question of all because it strikes right at the heart of what my concern is all about. I want children in Carthage, Tennessee, population 2,000, to be able to get the educational advantages that will come from these stunning developments. I don't think it is feasible for the Federal Government--and I know you're not suggesting this; this is a way of leading into my answer--I don't think it's feasible for the Federal Government with taxpayer money to build a network reaching into every home in the country. Everybody realizes we can't do that, shouldn't try to do that. But it is possible for us to demonstrate what can be done and unleash forces within the marketplace which will inevitably lead precisely to that result.

Now, as an aside, let me say that I've supported, along with Congressman Boucher, a very controversial bill which we're not discussing here today that would allow cable television--I mean telephone companies to get into the cable television business, and that's another way to unleash market forces to put fiber to the home. But that bill has uncertain chances of passage, and we understand that, but that is an example of unleashing the forces of supply and demand.

Let's assume that bill doesn't pass. Let's assume it does not pass. I believe that when graduates of the University of North Carolina have the experience of dealing with knowledge in this revolutionary form and then go to a community that's just five miles off the trunk line, and the other businesses and people in that community begin to share the understanding of how important it is for their community to have that, there will be a number of private companies interested in extending that fiber to that community.

You know, my home town is not on the interstate highway system like a lot of cities are not, but once it was built, States and localities and, in some cases, even private turnpike companies built access roads to get to it because it was there. I went to Research Triangle recently to talk with the scientists there who are pioneers in this new computer display technology called ''virtual reality.''

Very, very exciting. It's got a lot of attention in the press, and it really is one of the most powerful ways to present information that's ever been created. That can be taken by fiber out to schools in the rest of your district and in the rural areas of my State.

Mr. VALENTINE. One final question. Thank you. Give us the prospects for this legislation in the Senate. You know, the Senate to most of us is a strange and unusual place.

[Laughter.]

Senator GORE. I don't know how you could get that impression, Mr. Valentine.

[Laughter.]

Mr. VALENTINE. What do you think the prospects are? How long will it take, if you can say?

Senator GORE. Well, this is on the priority list and on the listing by the majority leader of our priority measures this year. It was listed as one of the high priorities, and the notation afterwards was ''minimal controversy.'' We passed it unanimously last year. There are disagreements with the Energy Committee about the role that the Department of Energy will play in the network.

Dr. Bromley has had similar controversies with the Department of Energy in his efforts to get the Administration all unified. The Department of Energy has agreed to the plan that Dr. Bromley has presented, and that

is the bureaucratic relationship which is encompassed in H.R. 656 and S. 272. We anticipate that that remaining controversy will be resolved quickly this year and that we will pass this legislation early on, and I welcome the challenge of 100 days that Congressman Brown laid down.

Mr. BOUCHER. The Chair thanks the gentleman.

The gentleman from Oregon--California, Mr. Packard.

Mr. PACKARD. Thank you very much.

I appreciate you addressing briefly the concern that I expressed relative to the role that Government would play. I'd like you to elaborate, if you would, Senator, briefly on how your legislation--what role in terms of ownership, in terms of operation of the network after it's implemented, and how that will articulate with the private sector and the university systems as it moves from a Government program to a private program.

Senator GORE. Mr. Packard, those are questions I've spent a lot of time on. Let me begin my response by saying I believe it's noteworthy that the private companies which one might expect to be most concerned are supporting the legislation. MCI, Sprint, AT&T, et cetera, are supporting the legislation. One of the reasons is that all of the principal sponsors have said from the very beginning and reaffirmed at every occasion our full and unqualified intent to transition this into the private sector as soon as it

becomes feasible to do so. Also, the NSF net model provides reassurance because a transition has taken place there on terms satisfactory to companies like Sprint, MCI, AT&T.

This network will present some unique challenges. We do not yet know how to answer all of the questions encompassed in your query, but the old saying ''Where there's a will, there's a way'' certainly applies here, and the close consultation and communication with those companies that are naturally involved in this debate will continue. The NSF net model presently serves as the model of choice with whatever wrinkles are necessary as we discover that it doesn't exactly apply. I could just say we'll do it that way, but I want to tell you I'm convinced there are differences, and we need to just acknowledge that we don't know all those answers yet.

Mr. PACKARD. Well, I certainly don't disagree with the role that Government needs to play initially. I think, though, one of my concerns not only in this program but in many of our Government programs--NASA as well as many of our other science research programs--is that the transition-- we will never really remain competitive internationally until we allow--unlock the private sector to do what Government can often provide the seed money as well as the ingenuity initially, but until the private sector really becomes a part of it, we just simply cannot remain competitive.

That's true on our launch services, it's true in many of our space programs, it will be true in this case, and that's, of course, the reason for the question. I certainly applaud the efforts that the legislation lends itself to.

Senator GORE. Mr. Chairman, at the risk of taking too much time in response to this, please allow me to answer your question on another level. The reason capitalism has routed communism in the philosophical war of this last half-century can be seen partly in information terms as well. Capitalism allows control over the information about supply and demand, the decisions over the future course of our economy, to be dispersed as widely as possible among the people who are closest to the information. That's one of the main reasons capitalism is superior. Communism failed because it relied on a single processor of economic information, and it's inefficient. It doesn't work, and it doesn't unlock the higher fraction of human potential in creativity.

The same thing is true with computer science. We need to give this country the advantages of--we've already given it the advantages of capitalism and democracy, or our founders did. We need to make sure that our approach to computers is the same way and not just have them in these single institutions that people have to go to, but disperse it widely with this network.

Mr. PACKARD. Thank you very much.

Mr. BOUCHER. The Chair recognizes the gentleman from California, Mr. Brown.

Mr. BROWN. Mr. Brown is going to pass.

Mr. BOUCHER. All right.

The gentleman from Maryland, Mr. Gilchrest.

Mr. GILCHREST. I almost feel like I should pass, too, but I'll ask my question. Sometimes I feel I should pass because I'm inadequate as far as my knowledge is concerned toward these fantastic and wonderful things. I will say that the spread of information, I think, has continued this experiment called democracy because people have access to it, and maybe we should put a television in everybody's home in Iraq and show them ''Family Ties'' and gradually they'll evolve into our democratic philosophies. But the spread of information is paramount. I don't mean to make light of that because I couldn't agree with you more on that particular topic.

This is a more mundane question, I suppose. Some of the problems in developing this network perhaps will be managerial problems, finding the right facility for connecting the network of these supercomputers, and so on. Is there any thought given to--we are now in the process across this Nation of closing bases and military facilities and labs, and many of these military labs have the infrastructure that might be needed in connecting some of

these--making it possible for this network to work. Would it be possible to consider some of those military labs that are on the docket to be consolidated or closed to be turned over to a research university to be used--or they could take it over, in other words--the private sector could take over some of these military labs where the infrastructure is already established to be a part of this network of supercomputers.

Senator GORE. That's a very interesting idea, Mr. Gilchrest. I'd like to reflect on it. Just briefly, one of the theorists in this area, Dr. William Wulf, has long talked about a national co-laboratory because the definition of laboratory really changes with this network, and people in locations like the ones you mentioned could have upgraded capacity because they could share with the people in other locations in a co-laboratory where the work exists within the network. So it's something that is worth exploring, and I'd like to reflect on it.

Mr. GILCHREST. Thank you, Senator Gore.

Thank you, Mr. Chairman.

Mr. BOUCHER. The gentleman from Arkansas, Mr. Thornton.

Mr. THORNTON. Thank you very much.

I do want to again express my appreciation for the splendid work that has been done in bringing this forward. I sometimes wonder if we're not perhaps at the stage where the automobile once was as an early developing instrument of

transportation and communication, and highways had to be built for those automobiles to travel. And I wonder if the possibility of home computers using digital codes and fiber optics as a means of communication may not really be at the stage of early automobiles. And are you describing the need to develop a transportation system, a highway system, so that these private uses may be employed?

Senator GORE. That's right on the money. Just exactly right, as far as I'm concerned. In fact, the interstate highway analogy was the way I first started thinking about this, and I think that's most appropriate.

Mr. THORNTON. In the interest of your time, I'm not going to pursue further, but I would be delighted to add my support to this legislation and also to work with you and the Chairman on your fiber optics program.

Senator GORE. Congressman Thornton, it's a great thing for this committee and all of us to have your services back here in the Congress. It's a great pleasure to serve with you again.

Mr. THORNTON. Thank you very much.

Mr. BOUCHER. The Chair thanks the gentleman.

The gentleman from California, Mr. Rohrabacher.

Mr. ROHRABACHER. Thank you, Mr. Chairman.

Senator, there are some people who I've heard-- especially out in California--who actually don't like the highway system

and think that the U.S. highway system screwed things up.

[Laughter.]

Mr. ROHRABACHER. In fact, some people and a lot of environmentalists in California have made these arguments in our universities that--and I'm not making them necessarily; I mean, I think some of the points that you've made are interesting, and I'm going to watch this legislation very closely, and I have not really made up my mind as to which way to go on this--

Senator GORE. Well, commuting by wire as an alternative to the clogged highways has been much discussed and will become more of a reality with this.

Mr. ROHRABACHER. Well, and there is some argument that perhaps other modes of transportation might have been developed that might have been better for the environment had we not put the money in, and sometimes when the Government starts directing the future rather than leaving it up to the people, sometimes it makes mistakes, and when it makes mistakes it really makes big mistakes.

For example, also--another example might be the railroad system where when the Government was deeply involved in the railroads, compared to those railroads which were just totally private operations, the Government-directed railroads where we helped them out actually cost a lot of money and there was a great deal of corruption back in the

last century.

Let me just ask you some specific questions, and again, I'm not really stating a position on this because I don't have a position on it yet, and I'm fascinated by some of the points you've made today, and I think you've made your case very well. But does your legislation envision that the Government will be buying and owning supercomputers, high end switches, fiber optic cable, and other hardware? Do you envision that the Government is actually going to own this hardware?

Senator GORE. For the backbone network, the Government will do this, but it will be transitioned into the private sector as soon as it is feasible to do so. Just as the Government stimulates the development of new technologies on a demonstration basis and they become available in a lot of different fields, that would be the case here, and the switches that would be a part of the backbone network would then be available to anybody in the private sector who wanted to buy them.

Mr. ROHRABACHER. Could you please, as you see it, tell us the difference between what your approach is and what Dr. Bromley will tell us is the approach of the Administration?

Senator GORE. The approaches are--

Mr. ROHRABACHER. The central difference.

Senator GORE. They're very, very close because of the

reasons I outlined earlier. We've worked together for a long time now. The central--we have education as a major component of ours, and they don't disagree with that. They think that that ought to be added. But the major difference, I guess, is the often-stated preference by Administrations controlled by both parties that the Congress simply appropriate money and not give any direction as to how to spend the money. That's really the only remaining difference, and they're not going to war over that one.

Mr. ROHRABACHER. All right. Just one note. Your approach to fiber optics in terms of deregulating certain elements of the telecommunications industry I believe is an approach that we could afford now in terms of solving a certain problem without using Government funds, and many times instead of appropriating hundreds of millions of dollars some of the things might be accomplished by giving tax incentives or clearing away regulation, and I will be looking at this issue very closely to see if this approach is necessary in terms of the allocating of funds or if there could be another approach with actually deregulation and tax incentives.

Senator GORE. Let me clarify, if I might. The entrance of telephone companies into the cable TV industry would be useful, in my opinion, to get that last mile to the home of fiber, but that development, as unlikely as it is to occur,

if it did occur, that would not stimulate the development of the switches and the software and the algorithms and the national network involved here, nor would it establish the digital libraries or the educational component of this legislation or the other features of it.

I might also say that in connection with the concerns about the private sector, again it is noteworthy that the private companies with the most at stake in this whole field and all the related fields are almost unanimous in their support of this initiative. Many of them have made statements like ''This is the single most important thing this country can do for our future.'' It has attracted very broad support within the private sector.

Mr. ROHRABACHER. Well, I appreciate your testimony, and we'll look very closely at the legislation.

Senator GORE. Thank you.

Mr. BOUCHER. The Chair thanks the gentleman.

The gentleman from Illinois, Mr. Bruce.

Mr. BRUCE. Good testimony, great questions, and I will yield to another member. Thank you.

Mr. BOUCHER. The Chair thanks the gentleman.

The gentleman from Oregon, Mr. Kopetski.

Mr. KOPETSKI. Thank you, Mr. Chair.

Senator Gore, I'm very impressed with your testimony as well. I represent part of Oregon where we have Hewlett-

Packard and Mender Graphics and part of Techtronics, some of the leading edge companies in the world in some of their technologies that they have developed, and our State is also developing an education network as a State resource for providing education and seminars throughout the State using computer technologies. We also know from the high-definition television issue that Japan, for example, decided 10 years ago or 15 years ago to get into HDTV. We didn't. Now we're trying to catch up.

My question to you is what if we don't do this? What does this mean in terms of Japan and Germany? What are they doing? What are the consequences for the United States if we don't have a coordinated approach?

Senator GORE. First, as an aside, we have an opportunity to blow Japan out of the water on HDTV because they have gone with the analog approach, and we are demonstrating now something called VHDTV--very high- definition television--based on the digital technology, which this very network and related developments will make it possible for us to exploit to the detriment of these analog investments by the Japanese. But if we do not have the boldness to take advantage of the areas where we do have a lead, then we'll watch that lead go over to the Japanese and others who do have that boldness. We have about an 18-month lead here.

The Japanese are now at work trying to put in place a

fiber network linking every significant factory on all the islands of Japan in a grid that will enable them to shift work around to computer-controlled machines that have slack capacity among the other things they're planning. They're also planning to take fiber to every home. So if we don't move to exploit the advantage we have, then we'll lose the advantage. It's a simple as that.

Mr. KOPETSKI. Thank you.

Thank you, Mr. Chair.

Mr. BOUCHER. The Chair recognizes the gentleman from Indiana, Mr. Roemer.

Mr. ROEMER. Thank you, Mr. Chairman.

Thank you, Senator, for taking time out of your schedule, too, and coming over here. I know that there are other freshmen on this committee. Given the prominence that you have gained from your hard work on this committee, we take a lot of energy and skill in following your example here.

One of the questions I have for you, Senator, is in looking at section 5 of H.R. 656, we see all the different agencies that are coordinating together. Let me just name a couple of them: the National Science Foundation, the National Aeronautics and Space Administration, the Department of Energy, the Department of Defense, and other relevant agencies, and then they are coordinated through the Federal Coordinating Council for Science Engineering and

Technology.

Following up on my colleague from Oregon's question, and not in terms of emulating the Japanese--I don't think that many of our solutions in education or trade are in emulating the Japanese--but do we need to get some other way within the Department of Commerce or some other agency to better coordinate our trade in long term development of getting our products from the research and development stage to the commercial application stage, whether it be fiber optics, high-definition television, superchips, magnetic levitation trains?

Senator GORE. Well, Congressman, thank you first for your kind words, and your question is a broad one and a very appropriate one. I personally support some kind of civilian DARPA. I don't have specific suggestions for you here this morning about how to do that. I recognize there would be a lot of concerns about it, and I'd want to reflect on those concerns. But I think we do need an American model for competing more effectively.

Now, where that relates to this project--I want to come back to this for a minute in the context of your question--one of the advantages we have with this effort is quite a few years of experience in working out exactly how these agencies can coordinate their efforts, and there is, as Dr. Bromley will tell you, a very impressive working

relationship between all of the departments and agencies involved. You might look at the organizational chart and ask yourself, ''How in the world can this thing operate the way it does?,'' but the fact is it does because all of the key players are making it operate, and they've worked out the thousands of subtle arrangements at a, you know, sub-cabinet level that make the information flow smoothly and make the decisions in a timely way.

This model is one that is proven to be successful. That is why it is in the legislation that Congressman Brown and I have introduced.

Mr. ROEMER. Senator, just to--and I know, you know, maybe there's something that you and I can work on in the future, and if you do have any immediate comments on what kind of role you might see for DARPA, as a staff member on the Senate side, I work closely with DARPA. I know that there has been some ongoing give-and-take and tugs between the Reagan Administration and what role DARPA would play. Do you have any immediate comments? And if not, that's fine, but I would sure like to--

Senator GORE. I'd like to follow up with you.

Mr. ROEMER. Okay.

Senator GORE. Perhaps we could work together on this initiative. I would welcome a chance to do that. We used to have a kind of civilian DARPA in DARPA, but he was fired.

[Laughter.]

Senator GORE. And I regretted that.

Mr. ROEMER. I look forward to it, Senator. Thank you again.

Senator GORE. Very good.

Mr. Chairman, thank you so much. I apologize to the other witnesses for the time I've consumed in my responses, but thank you. Have I forestalled?

Mr. BOUCHER. We have one other member present--

Senator GORE. I'm sorry.

Mr. BOUCHER.--who I'll call on. He's shaking his head, th gentleman from Iowa.

The Chair thanks Senator Gore very much for the enlightening testimony this morning, and I would simply like to underscore a comment by the gentleman from North Carolina that you do have an exceptional ability to take technical concepts, translate them into understandable language, and I think that was a very remarkable presentation this morning.

Senator GORE. Are you getting all this down?

[Laughter.]

Senator GORE. I appreciate it, Mr. Chairman. Thank you.

Mr. BOUCHER. Thank you, Senator.

Mr. BOUCHER. Now we are pleased to welcome to this joint hearing the President's science advisor, Dr. D. Allan Bromley, and we will be very pleased, Dr. Bromley, to hear

your comments concerning the Administration's position with regard to the high-performance computing and networking initiative, and without objection, your written statement will be made a part of the record, and we'll be pleased to hear your summary.

STATEMENT OF D. ALLAN BROMLEY, SCIENCE ADVISOR TO THE PRESIDENT; DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, WASHINGTON, D.C.

Mr. BROMLEY. Thank you very much, Mr. Chairman. It always is a great pleasure--

Am I connected? Okay.

Thank you very much, Mr. Chairman--both Chairman Valentine Chairman Boucher, members of the two subcommittees.

It's a great pleasure on this particular topic to follow Senator Gore, because he has given you a very elegant presentation--a very elegant and eloquent presentation of much of the background that I would otherwise have wished to present. So as Director of the Office of Science and Technology Policy, what I would like to do is simply give you some further detail as to the Administration's initiative, the President's initiative, and I would comment then on two concerns that I have with respect to the legislation under consideration here this morning.

I think that it is important to recognize that the prominence given to high-performance computing and communication in the budget that the President forwarded is a very real indication of the importance that he attaches to it and that we in the Administration attach to this effort. Indeed, personally, I can think of very few other activities

that we collectively in this Nation could take that have the potential for such a great impact on our society, and so it is with very real pleasure that I appear before you this morning, and I want to tell you something about this initiative, how it was developed, and what it contains.

The overall goals of high-performance computing and communication are symbolized in the document that we have made available to you, the document entitled ''Grand Challenges: High-Performance Computing and Communication,'' by problems of very high scientific and social value that we simply can't attack in effective fashion at the present time. These are very important problems, they are within our reach technologically, but in order to make them accessible, we must move forward with the kind of program and the kind of initiative that the President has set forward.

What we have in mind is the full integration of component programs in all of the major Federal agencies, bringing them together into a national program, as distinct from a combination of heterogeneous agency programs, that will move us forward in the directions that Senator Gore described just before me. The initiative proposes that we should increase our support for this activity across the spectrum of the agencies by 30 percent in moving from what was appropriated in 1991 to what we have requested in 1992.

It is also our goal to double the investment in this area over the five-year planning period that is reflected in the document that we have made available to you. During that period, we wish to increase the speed, the memory capacity, and the information transfer rates by factors between 100 and 1,000. Those factors are within reach technologically, and those factors can make not just a quantitative difference in what we can do, they can make a very major qualitative difference as well.

As Senator Gore spelled out for you, this is not a new initiative. The whole high-performance computing and communication initiative dates back to the early 1980s and before. I think originally it was a recognition in the scientific and technological communities that simply they had reached barriers in their approach to the most important problems in field after field and that they could not proceed without substantial improvement in the computational facilities available to them, and it was in 1982, under a request from this committee, that the Federal Coordinating Council examined the status of supercomputing in the United States, reviewed the role of the Federal Government, and there were seven subsequent years of reports and studies and planning, and that culminated in September of 1989 in the issuance of a report by my office entitled ''The Federal High- Performance Computing Program.''

Now, what we have brought forward for you in the 1992 budget is the detailed plan for implementing the program that was discussed in broad outline in that earlier report. Eight major agencies are participating in this program. The program, if implemented, will of course affect all of the Federal agencies. But the thing that I want to emphasize here and pay tribute to is the remarkable level of mutual trust, of cooperation, and of synergism that has been developed among those eight agencies over the period of the last year, two years, as they have worked on a weekly and sometimes daily basis to put together the initiative that we bring to you here.

What has been involved here is not just simply looking at one another's program. What is involved here is actually taking the programs of each agency, looking at them in detail, if necessary taking them apart, rebuilding them, restructuring them so that they fit into a coherent whole so that we get the maximum impact for every dollar that we can invest in this area, every dollar that you gentlemen can make available to us. And I think that we have here an example of participation and cooperation that is unique both within and outside of Government. It is, I think, also an indication of what we can accomplish under the new and restructured Federal Coordinating Council where the members are now cabinet secretaries, deputy secretaries, and the

heads of the independent agencies so that once decisions are made in the committees of the FCCSET and are approved by this group of members, then the decisions remain intact through all subsequent budget negotiations, and this gives me a much greater degree of confidence that this program will in fact move forward as it is presented to you and as it has been agreed to by all of these FCCSET members.

Now, there are four specific components in the program that we are proposing, and there has been some confusion, I believe, as to what those components comprise, and I want to take just a moment to run through the four.

The first has to do with high-performance computing systems, and you will note, ladies and gentlemen, that I do not use the word ''supercomputer.'' We are talking here not only about supercomputers but about high-performance computers of all sizes and kinds because on our ultimate network we will have a great many different kinds and sizes of computers, and in the final system the user should not either care or know what computer is actually doing work for him or for her because it is one of the fundamental truths of computer science, computational science, that different problems require quite different architectural structures in the computers that work on them if they are to be done with maximum efficiency. So one of the goals is to demonstrate the working of a complex system that involves a great many

kinds of high-performance systems.

Another part of the program is to make sure that we use the purchasing power of the Federal Government in a coherent way to provide for a viable domestic industry on a continuing basis to maintain our leadership and our innovative potential in the development of this kind of hardware on the leading edge of computer science. We have a leadership role, and it's one that we can keep. It is also one that we can easily lose.

The second component of our program recognizes that no matter how powerful is the computational system, if the software--if the actual interface with the user--is not friendly, then it isn't going to work. And the one thing you can say about supercomputers and high-performance computer software is that in general it is not user friendly. It has been developed by mavens who work on nuclear weaponry and on high-performance aircraft, and the average individual would have a rough time getting these programs to perform. So we have a real challenge here. This again is an area where we have international leadership, but an area of leadership that we could easily lose.

Thirdly, the area where there is the greatest perhaps misunderstanding and potential for confusion is that relating to the information highway that Senator Gore just

discussed. The idea here is clearly in the end to make the kind of power that I've been discussing and the kind of software for use of that power available across the Nation to any citizen who wants it, to any home that wants it, to any school, to any small industry, as well as to the major industries and the major laboratories that now have it. But it is important to realize that the Government is not going to provide that; we are not suggesting that.

What we are suggesting is that we develop here a national research and education network--that's what NREN stands for -- and I would simply emphasize that education has been part of our program from the very beginning. We did not amplify to a great extent in this report on the educational potential of this, although I would be happy to do it in response to questions, because in parallel with this activity--and I hope that many of you gentlemen have already seen the report -- the FCCSET organization was producing a report on education and human resources that was highlighting that particular role, and we did not wish to duplicate between the two reports. Rather, we are focusing again on maximizing the coordination not only among agencies in a particular area of activity like high-performance computing but rather among agencies in a great many areas which overlap and which have common links, and this is just an example.

What we have--and this is important to understand--is a

system that began with networks that were within single agencies. DOE had a net, the Department of Defense had a net, NSF had a net. These were all pulled together to become Internet. Internet was managed by NSF. And what we propose is that that Internet be expanded, expanded substantially, in terms of what it has in the way of hardware to provide capacity, what it has in the way of off-ramps to make capacity available to a great many organizations and institutions that don't now have it. But it is important to recognize that even in this network the Government does not own the fiber, that we have gone to the commercial carriers, and they have the fiber, and it would be my hope and certainly the plan that we outline here that in the ultimate system it would be a public utility in exactly the same sense that the telephone system is a public utility; not only that, it would be as commonplace, as natural to have in your home and to use in your home as the telephone. That is the only way, ladies and gentlemen, that we can be truly competitive in the world that we face as we move into the next millennium, and we have the opportunity to move into that millennium with real leadership.

The fourth component of our program is no less important than the first three, and that has to do with the people who will not only move this area forward, who will be the leaders in computer science not only nationally but

world-wide, the leaders in computational science, but equally important and all too frequently forgotten in our entire approach to science and technology is the forgotten middle--the technicians, the folk who come usually from two-year colleges who actually operate the network, who maintain the network, who maintain the computers that are on the network--and unless we act aggressively to improve our rate of production of people in that category and unless we give them more prestige, a greater reward structure, more recognition, we will in fact have a major gap in the program that we are bringing to you. So this is a very important part of the initiative.

Now, what we seek--just to give some specific goals, we seek 1,000-fold improvement in useful computing capacity, and we seek that within the next five years. That means that we will be doing one trillion operations per second, and the focus we would like to see is on generic technologies that are applicable not specifically to this program but to a great many programs but also happen to be crucial to this one. And from the very beginning, we want to see the private sector involved to the maximum possible extent. This is important for two reasons. One, because they bring their own experience, expertise, leadership to bear on the initiative, and secondly, because if they are involved from the beginning, I believe that we can move this

entire program into the public utility that I foresee in the future on a much more rapid basis than would otherwise be the case.

In software development, we're going to focus on these grand challenges because by doing so I think we will be able to demonstrate in a way that is quite unique--I wish I had the opportunity to show you this morning some films made in some of the Nation's supercomputer laboratories showing the totally new capacity that becomes available with this high-performance systems, because we can demonstrate to the entire Nation that there are a great many things that they can do that they can't have right now, and this is what we need to get public support for the entire program.

I've said that we're going to try and expand the Internet to a national research and education net, and the goal there is to get a 100-fold increase in the rate at which data can be transmitted. We want to have levels of gigabits per second. Obviously, we have to expand the number of on- and off-ramps so that a great many more people get access to the system.

Small businesses, in my view, are one of the most important groups to consider because they are the ones who can probably use this with the highest effectiveness in creating new jobs, in moving forward the innovation that they already demonstrate to a very high degree in this

country. Second most important area, as far as I'm concerned, is the secondary and elementary schools of the Nation because, as Senator Gore touched on, a single fiber entering a school room makes it possible for every student in that room to receive individualized, self-paced instruction in any topic with reinforcement where appropriate, with repetition where necessary, and with the kind of new graphic presentations that can really grasp the enthusiasm and interest of youngsters, and that in the long run is probably the most important thing we can possibly do.

And I would have to say that no plan of this kind is any better than its execution, and the execution of this plan, I believe, will rely very heavily on the synergy that's been developed between the agencies that are involved in its creation. What we have tried to do is allocate the responsibilities in this program so that each agency is responsible for the area in which it has the greatest experience, an area in which it does best, and that is the sort of thing we have tried to do in all of the FCCSET activities, namely to maximize the critical effectiveness of our activities by drawing on the special expertise of each of the participating agencies.

Now, I don't think I have to recite for you again the long list of ''hope for'' benefits that we foresee; ''hope for'' is far too pessimistic. I am absolutely confident that the

benefits will arise that Senator Gore spelled out for you, and I will not attempt to do that. I think it is important also to mention that although the numbers are very crude, back in 1989 we contracted with Los Alamos to do a study to try to give us some feeling for the economic benefit that would be reflected if you gentlemen were to agree to support the program we're talking about here, and I emphasize that this kind of economic modeling is open to considerable question and error, but it is important to note that the result that has come out of this study is that the payback is in the range-- according to the group that studied it--is in the range from $170 billion to $500 billion over the next decade. And those, despite the fact that they may be wrong by significant factors, are still very impressive numbers and represent a very significant payback.

Now, with respect to the legislation both in the Senate and here in the House, I would say, first of all, as Senator Gore said in response to some of your questions, that the goals that are outlined are goals that we fully share, that the programs are remarkably similar. I have, however, two concerns, and let me be very candid and explicit about those concerns.

The first concern is that this is an area perhaps par excellence in the whole field of technology that is moving very rapidly. It is the intention of our Administration

group to revisit this plan on at least an annual basis and change it as appropriate to the changing technology and to the experience we have gained up to this point. If that flexibility for change along the way is not retained, then I am concerned because we will not be able to move forward in the optimal fashion to use what technology can make available to us. And I register that simply as a concern, and it's something that we must, I hope, address jointly to make sure that we don't lose that flexibility.

The second concern I have reflects the simple fact that the major players in this program come before different committees of the Congress, and we have spent a year hammering out differences among the agencies and have arrived at a point where all of the participating agencies and their senior personnel--their secretaries, their administrators, whatever is appropriate--have agreed to participate in the program as indicated. Now, should it turn out that for whatever reason different committees choose to act differently on various components of this, the cohesion that is all important in the program that we bring forward could very rapidly disappear, and it would require the group to go back and rework the plan essentially from scratch to maintain the maximum benefit under new conditions and perhaps new assignments of responsibility.

So I would raise that only as a concern, and I would hope

that working together with you gentlemen and your colleagues in other committees that we can hope to get the kind of cooperation and coordination that now exists in the agencies in bringing forward the plan.

And so, Mr. Chairman, let me conclude my remarks at that point. My formal testimony contains considerably greater detail, but I would welcome your questions.

Thank you very much, Mr. Chairman.

[The prepared statement of Mr. Bromley follows:]

********** INSERT **********

Mr. BOUCHER. Thank you very much, Dr. Bromley. We appreciate your attendance here this morning and those very well expressed views.

I wonder at the outset if you would take just a moment to comment on the potential and the time frame against which we could expect to see a commercialization of this network following the investment by the Federal Government in jump-starting the system.

Mr. BROMLEY. Well, I think it is important, sir, to begin by noting that, as Senator Gore mentioned earlier, we already have Advanced Network Services--a not-for-profit organization that has been set up--supported by but independent of IBM, MCI, and the Merit operation out of the University of Michigan originally--that is being set up already and poised to begin to commercialize, to begin to work toward this utility starting as soon as we start. So it's not going to be a process of the Government working for a time and then industry coming in. I think that it has been critical to have industrial participation all the way through the planning, and we have vehicles already in place that are ready to move as soon as we get started.

So I would see that essentially simultaneously with action--and action, I may say, sir, is already under way. It should not be forgotten that the Federal Government is

already investing just about half a billion dollars a year in high-performance computing in the various agency programs, so there's a great deal of work already in place. What this initiative does is to bring it together in a coherent fashion and move it all forward, hopefully in a better and more productive fashion. But a lot is under way.

The ties with industry are already very strong, and in the Administration, in parallel with the FCCSET activity, we have activity in the President's Council of Advisors in science and technology. We have a panel on high-performance computing and communication chaired by Dr. Soloman Buxbaum of AT&T, and that is very important to bring the private sector input into all these discussions from the very outset.

Mr. BOUCHER. Would you care to make just a comment perhaps to expand a bit upon what Senator Gore said about the need for this initiative at the outset in order to jump-start the process? To state that question a different way, why can't we simply at this point leave it entirely to the private sector? Why is the Government role really necessary?

Mr. BROMLEY. I think there are several reasons, sir. Perhaps one of the most important is that this half billion dollars that we are spending now has created centers of excellence in our national laboratories, in the supercomputer centers, in the major research universities,

but these have been isolated, and the access to those centers of excellence by the industrial sector, with the exception of some very large industries that you could easily name, has been rather small. And so what I see as perhaps the greatest need for Federal action at this time is simply the bringing together of the excellence that we already have into a critical mass that will move us forward then in a defined direction with a coherent input from all the players.

It's the problem we face in area after area. We have here in the U.S. the innovative skill, the know-how, frequently the technology, but we tend to ride off in all directions, and the major role I see for this initiative is the focusing of the activity and then the augmenting of that activity by coherent action by the Federal Government.

Mr. BOUCHER. Thank you very much.

The Chair's time has expired, and in the interest of moving the hearing along, I'll just make one further comment, and that is this. I, for one, very much welcome your suggestion that we need to work in partnership in ensuring that as we structure this legislation it not serve as a restriction or create some inflexibility on the part of the various agencies that will be coordinating the initiative, and I give you that pledge on the part of this member and would very much welcome any recommendations that

you care to make on amendments that we should make to the bill at this point that would be in furtherance of that objective.

The Chair recognizes the gentleman from North Carolina.

Mr. VALENTINE. Thank you, Mr. Chairman.

Dr. Bromley, I want to say also that we from my part welcome you here. I know you think that you work for the Congress almost, you're down here so often, but that is some indication of how bad we need you.

Mr. BROMLEY. It's a pleasure, sir.

Mr. VALENTINE. What role do you foresee in the Administration's high-performance computer initiative for existing supercomputer centers such as those supported by NSF, DOE, and NASA?

Mr. BROMLEY. I see a very crucial role for them, Mr. Valentine, because they have already, in the fields in which they have been operating, demonstrated where the frontiers are and even more important where the frontiers can be, and so they are the sort of point institutions as we move forward in this initiative. So I see a very important role for them.

Mr. VALENTINE. One of the witnesses who will testify with panel four, Dr. Larry Lee, Executive Director of the North Carolina Supercomputer System, is here today. I mentioned his name earlier, but he wasn't here to hear it. I want to

be sure he understands that I welcomed him, and I welcome him again. We're very proud of him and his institution.

How will non-Federally funded supercomputer centers such as the North Carolina Supercomputer System fit into this initiative?

Mr. BROMLEY. We have in the Nation, sir, a very tightly knit community of the people at the forefront of computer science and computational science. These are bonds of personal friendship, institutional relations that are already very strong, and so I have no question whatsoever but what we will be drawing on a great many centers that are not at this moment necessarily part of any Federal program. We will be drawing on expertise wherever we can find it in the Nation, and the fortunate thing is, typical of our structure and the way science is done in this country, all the leading people know all the other leading people and know where to get the expertise when it's required.

And so if someone has something to contribute to this program and is not already part of it, one of the early moves that we foresee is bringing them into the activity and taking advantage of their experience, giving them the advantage in turn of what we're trying to put together. I look on this as a very highly cooperative activity.

Mr. VALENTINE. Thank you, Doctor.

Thank you, Mr. Chairman.

Mr. BOUCHER. The Chair thanks the gentleman.

The gentleman from California, Mr. Packard.

Mr. PACKARD. Thank you.

You alluded, Dr. Bromley, to the changes in the request from the 1991 appropriations versus the 1992 request and the five-year, but you didn't mention any figures. What are the figures?

Mr. BROMLEY. We are requesting this year, sir, $638 million.

Mr. PACKARD. And last year?

Mr. BROMLEY. Last year we were just under $500 million. We're talking about a 30 percent increase.

Mr. PACKARD. And the five-year plan? What does it call for, about?

Mr. BROMLEY. The total of the five-year plan?

Mr. PACKARD. Yes.

Mr. BROMLEY. We're talking about doubling it, bringing it up to $1 billion at the end of the five years.

Mr. PACKARD. Okay. And Senator Gore referred to very modest, almost insignificant differences between S. 272 versus H.R. 656 and the President's proposal or your proposal. What are the differences, in your view?

Mr. BROMLEY. Well, to take a very minor difference first, I think between S. 272 and the bill we're considering here there really are very small differences. There is only the

one section having to do with the protection of intellectual property, so there really is no major difference there.

Mr. PACKARD. Is the protection adequate, in your judgment, in both pieces of legislation?

Mr. BROMLEY. No, I think it's an area--I think that your bill here raises a very important issue, and it's one that merits consideration and thought because this is an area where as we move into the international marketplace and interact with our competitors abroad, the question of protection of intellectual property, particularly in the software area, becomes a significant one. So that's an important point.

In the other Senate bill that is under consideration, S. 343, there are substantial differences because that bill does not have the coordination among the agencies that is in your bill and in S. 272 and in the President's initiative. Those are the primary differences.

Mr. PACKARD. Thank you. Does the President's initiative require the authorizing committee?

Mr. BROMLEY. Does it require it? No, sir.

Mr. PACKARD. So what role do you see this committee having in moving the President's initiative?

Mr. BROMLEY. I believe, sir, that if this committee could provide authorizations in a timely fashion and work with us and the Administration and with your colleagues in the

appropriation committees and subcommittees to move forward an appropriation bill that maintains the cohesion that we're talking about in this initiative that that would be enormously helpful.

Mr. PACKARD. If S. 272 and H.R. 656 were rolled into one, would the Administration be satisfied to see that one piece of legislation move?

Mr. BROMLEY. I would simply have to repeat the Administration concerns that I mentioned earlier. First, we want to be sure that flexibility is maintained so that we don't freeze a rapidly moving technology for a five-year period when we really should be changing it on an annual basis. That's the prominent concern I have. A secondary concern is this one about losing the hard won coherence and integration that we have because of different actions by different subcommittees.

Mr. PACKARD. Last year there were disputes concerning the Department of Energy's involvement in the legislation, and that, I think, led to the demise of the legislation in the last session. Are there any conflicts in the Executive Branch at the present time concerning DOE's role, and is the Administration solidly behind the NSF taking the leading role versus DOE?

Mr. BROMLEY. I have spoken with Admiral James Watkins, the Secretary of Energy, who is a member of FCCSET, and I've

been assured by him that the Department of Energy stands fully behind the commitment made in moving forward this initiative in the 1992 budget. In fact, the same is true of the Department of Defense, which is one of the other major players in this that falls in another--

Mr. PACKARD. So at the present time you see no major impediments from different agencies within the Government?

Mr. BROMLEY. I have been assured by the highest level personnel in all the agencies that they have in good faith signed off on this initiative and their participation in it.

Mr. PACKARD. It's a pleasure to have you with us, Dr. Bromley. It always is.

Mr. BROMLEY. Thank you.

Mr. PACKARD. Thank you very much, Mr. Chairman.

Mr. BOUCHER. The Chair thanks the gentleman and recognizes at this time the gentleman from Arkansas, Mr. Thornton.

Mr. THORNTON. Thank you, Mr. Chairman.

It's a great pleasure to see you, Dr. Bromley.

Mr. BROMLEY. Thank you.

Mr. THORNTON. I noticed in your testimony that you do think it is very important to have the Congressional support and endorsement of this program, and I would like to get a clearer understanding of what form that support might take.

Mr. BROMLEY. Well, I think--in two sentences, sir, I think that it is very important for any of these major initiatives

of major national importance to be carried forward with the highest possible degree of cooperation between the Administration and the Congress. I think that in your committee, in the authorizing committees,and in the appropriations committees we have, I think, work to do to make sure that we don't lose the kind of cohesion, the kind of integration that has been built in where each agency is by design playing a role that compliments and adds to those of all the other agencies.

If agencies are moved out independent of any suggestion of this initiative, then we lose the whole coherence and would essentially have to start over again. So the support here, I think, is crucial to moving this in a reasonable fashion.

Mr. THORNTON. Would you not agree that in addition to coherence among agencies, continuity over time is also a very important function for that?

Mr. BROMLEY. I would indeed, sir.

Mr. THORNTON. I'm recalling the circumstances in which I found myself on this committee a few years ago where the President had eliminated the Office of Science Advisory to the President, and the idea was that it really wasn't needed to have that coherent and that continuing idea, and yet out of that came the initiative that there should be a statutory base for this in order to provide for continuity but also to provide for flexibility and for the advice to be given not

only to the President but, as you so ably do, to this committee and to the Congress, and it just seems to me that statutory language does provide for continuity that may not be available without some written basis. Would you agree with that, sir?

Mr. BROMLEY. I would find it somewhat difficult to disagree with you in this particular instance. It demonstrates how ephemeral life really is.

[Laughter.]

Mr. THORNTON. Well, I'm very glad that we have a statutory base for the science advisor to the President, and I hope that we'll give careful thought to that lesson from the past as we consider whether or not the support that Congress can give to this might indeed be in the form of legislation.

Mr. BROMLEY. Mr. Chairman, if I might just add a clarification, one of my staff has just reminded me that in fact North Carolina is a part of the network already, and so I'm delighted that we already have your constituents and colleagues firmly aboard.

Mr. BOUCHER. The Chair recognizes the gentleman from Maryland, Mr. Gilchrest.

Mr. GILCHREST. Thank you, Mr. Chairman.

Dr. Bromley, could you make a distinction between the thrust with the President's initiative for education and Senator Gore's idea that his plan or his initiative

emphasized a much greater amount of--his plan proposed to do more for education than the President's plan? And the other question is could you tell us how H.R. 656 in its present form, if it were passed, in your opinion, could hinder the creative natural flow of pure research?

Mr. BROMLEY. Could hinder?

Mr. GILCHREST. Hinder, yes.

Mr. BROMLEY. Let me respond to the first part of the question about education. I think frankly that there is a little misunderstanding here because in the document that we have sent forward, the grand challenges, we do in fact list education as one of the four major components of our program, and we have not amplified that in major sections of the document because, as I mentioned earlier, at the same time that this document was being prepared by a committee under the Federal Coordinating Council we were also doing one that was specifically on education, and in that document we cross reference this one.

And so, quite frankly, I don't see that there's any difference at all in the amount of potential educational impact, educational opportunity, in S. 272 and in the President's initiative. They really both recognize this as one of the extremely important areas but an area that has not been much explored yet. That's the important thing. An area where we have a tremendous opportunity that hasn't yet

been realized. But there really is no difference between the two in that respect.

In terms of your second question, I frankly see no way in which H.R. 656 would hinder research and development at all. I think it would certainly move it forward without question.

Mr. GILCHREST. I'm trying to understand. The only real difference, then, as I see it, between the President's initiative and H.R. 656 is if we went through the statutory route, then there would be a--we would be covering the same ground again, and as we went through various committee hearings, the splintering up of the program could be caused?

Mr. BROMLEY. Two things, sir, if I may. The first is that the legislation is talking about taking a five-year look at the system and in a sense specifying a five-year program. My concern, and I raise it only as a concern, is that in an area where the technology is changing by orders of magnitude per year, I am concerned that we, in specifying a five-year program, may regret that as we, each year of that five, discover that we really would like to make some major changes in the program as we go along. That's the first concern.

The second concern is the one you mentioned, that of trying to maintain the coherence and integration in the various agencies that are being considered by different committees.

Mr. GILCHREST. Thank you, Dr. Bromley.

Thank you, Mr. Chairman.

Mr. BOUCHER. The Chair thanks the gentleman and recognizes the gentleman from Indiana, Mr. Roemer.

Mr. ROEMER. Thank you, Mr. Chairman.

Good to see you again, Dr. Bromley, and your testimony last time before the committee was one of the first testimonies that I had heard, and it was very, very articulate and visionary, and I have to admit even with an advanced degree, I'm a little lost in some of the technical terms today, and my constituents are always interested in what I'm doing in my committee assignments, so please bear with my naivete in terms of some of the science.

If I could, what are the implications here in the supercomputers and the communications for trade and for our domestic industry? If you could answer specifically that. Also, did I hear you correctly in your payback numbers of someplace between $170 billion and--

Mr. BROMLEY. Yes, $170 billion and $500 billion.

Mr. ROEMER. And then in terms of tying this all in, too, if you could give me specific examples in energy and environment and national security, that would be very helpful.

Mr. BROMLEY. Let me attempt to do that. First of all, in the environment--let me take that as an example--the major

problem facing us at the present time is being able to make predictions of what climate will be like in particular regions of our Nation or of the globe over extended periods. There are currently in the world six independent so-called global circulation models that are run on very large supercomputers. When asked at this time what the future holds for the American Midwest, three of them tell us that it will be hotter and dryer, and three say it will be colder and wetter. On that basis, it is extraordinarily difficult to make reasonable policy--at least, policy that I would recommend to anybody.

Mr. ROEMER. It's like our local weather stations, right?

Mr. BROMLEY. So what we recognize very early in the game is that in order to improve that situation, in order to be able to do better than just make predictions as we now can for global averages of various things like temperature and precipitation and so on, in order to be able to make it for a region like the American Midwest, we need these large factors of improvement in speed and memory capacity to do the calculations. Then we need the speed in information transfer to be able to take this flood of data that will be coming in from the senses that we will both be flying in space and have on the ground.

As Senator Gore said, we're going to get the equivalent of the Library of Congress in 4.8 days from the one EOS

platform alone in Mission to Planet Earth, and to bring all that together to allow us to discern patterns, to make predictions, we require absolutely the kind of power we're talking about here.

In the military, obviously, one of the areas that is still of importance to us is the design of advanced weaponry. There supercomputers got their birth. We are very much interested in advanced aerodynamics, the design of new plane geometries. There you must have the supercomputers. But perhaps the most interesting example I can think of in the military is one that was demonstrated dramatically--but very few people know about it--in Desert Storm, and that is the fact that because our pilots and our tankers and our military personnel had in almost every case been able to run their mission--whether it was with a plane, with a tank, with a helicopter--had been able to run their mission in a simulator driven by a very powerful computer so that they could practice their run, see their target, see what the surroundings of the target looked like as they came in on it, that had an enormous impact on the rather dramatic successes that all of us witnessed on our televisions, and that's the kind of thing that is going to be increasingly important in the military. It's the training that can be done with simulation of real world situations, making that available to everybody in the military rather than just to a

few people who are going to fly shuttle flights, for example.

In energy, we have, again, a tremendous research program that requires the best possible computational tools and, more important, the best possible intercommunication of laboratories. We have in this Nation in the national laboratories supported by the Department of Energy one of the world's major resources in terms of technology, know-how, but they're relatively isolated. What we need is to have a transparent connection between workers in the labs so that an individual sitting in Argonne could be working with someone in Oak Ridge or in Berkeley or in Brookhaven as easily as with the person next-door. That, too, is possible.

And so we can go through any of those particular fields you care to mention, but to answer the first part of your question about what's the impact on industry, the biggest impact, I believe, sir, will be on small industry, industry that hires less than 500 people. History has shown us over the last decade that those are the industries that have really produced the most innovative new products, services, they are the industries that have created a lion's share of the new jobs.

Up to now, they have had to do without the power that major companies have been able to afford. The major

companies have their own supercomputers. We want to make the same kind of power available to the person with 20 employees who is trying to design something absolutely new that he would like to see designed in detail in all possible aspects but none of his computational capacity is up to the task. We would like him to be able to pick up his interface in his office just as easily as he picks up the telephone and get that capacity.

Mr. ROEMER. Could you talk a little bit more about how that relates to education with the fiber optics coming into the classroom? And after both chairmen from North Carolina and Virginia, maybe we could do an experiment in Indiana on my schools to get that fiber optic going into Indiana school children.

Mr. BROMLEY. The technology, both hardware and software, sir, are now available, and demonstrations can be arranged that we'd be happy to do for you if you are interested in it, where a single fiber optic comes into the classroom, and each student in the classroom has his own small terminal with a display panel and a keyboard. The software that's running on this system, depending on whatever subject you select, takes the student through whatever section of the material is appropriate for that time, that period in his exposure, and presents concepts in a very attractive, graphic fashion, then asks questions. If the youngster

responds correctly, he gets a starburst and all sorts of things that reinforces it and comments saying, ''Well done,'' and so on.

If he doesn't get it and doesn't understand it, then the system quietly takes him back through it and keeps doing it in slightly different ways until all at once the youngsters realize, ''I understand it,'' and then the system gives them a tremendous award, and the important thing is that it's self- paced. It isn't the way it is in ordinary school rooms where if a kid misses it when the teacher presents it, the chances of the teacher knowing that he has missed it and coming back to fix that on the spot is very small. And having missed one thing, it's then much easier to miss the next one. And after you've missed a whole series of concepts, you're lost.

Mr. ROEMER. How can I get an example either in person or by film or--

Mr. BROMLEY. If you would simply call my office, we will take care of arranging one for you.

Mr. ROEMER. Great. How far away are we from commercially developing that and getting that into many of our schools?

Mr. BROMLEY. These systems are now commercially available. These are commercial companies that make these now available. The situation we face now is simply convincing school districts, States that this is a good investment at a

time when investments in new hardware and software are difficult for obvious budgetary reasons.

Mr. ROEMER. And finally, Dr. Bromley, your payback figure of $170 billion to $500 billion, what kind of time frame is that based on?

Mr. BROMLEY. Ten years:

Mr. ROEMER. Ten years. Thank you.

Mr. BOUCHER. The Chair thanks the gentleman and at this time would recognize the gentleman from California, Mr. Mineta.

Mr. MINETA. Thank you very much, Mr. Chairman. I'd like to submit a statement for the record and ask unanimous consent for its inclusion.

Mr. BOUCHER. Without objection, so ordered.

[The prepared statement of Mr. Mineta follows:]

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Mr. MINETA. Dr. Bromley, we all admire your work and appreciate very, very much your efforts there. I'm wondering what is it about H.R. 656 that seems to give you heartburn about this whole issue about flexibility? What is it that you're afraid that this legislation, as you keep reiterating the word ''inhibit''--inhibit what?

Mr. BROMLEY. Well, sir, we have come up with--we have taken a snapshot, if you will, of the computer and computational science of today, and this program that we present is the best program we can put together that we base on a five-year plan knowing what we know today, making the decisions that are the most sensible ones based on that information for the next five years.

But we fully anticipate that a year from now we will have made enough progress so that we'll want to change those directions for the next four years or the next five and that each year as we go along we'll want to make substantial change in the program to take advantage of new things we've learned, new technology that's been developed, and so on. And I registered the concern that if we freeze in a specific program over a five-year period, then it may well be difficult to make the changes that would be most appropriate in view of the technology and in view of the developments that have taken place. That's all.

Mr. MINETA. Well, it seems to me the legislation, though, does speak to that in the sense that it says, ''Even though there shall be a five-year plan, the plan shall be resubmitted upon revision at least once every two years thereafter.''

Mr. BROMLEY. That's in the right direction.

Mr. MINETA. Isn't that the kind of flexibility--I mean, yo know, coming from Silicon Valley, I know that the obsolescence--you sort of work on a three-year obsolescence cycle--

Mr. BROMLEY. That's right.

Mr. MINETA.--so, you know, it is something that you sort o build in knowing that you're going to have to fine- tune it, even though it may be a five-year plan. Any plan, whether it's a capital improvement program when I was mayor for the city of San Jose or any other program, you have a five-year plan. As my dad said when we were in business, he said, ''Plan your work and work your plan.'' I think that's what we're saying in this legislation, and to reiterate again what my colleague, Congressman Thornton, said, you have backsliding, and so what you need is a backstop to backsliders, and I think that's what this legislation does, is to keep that from becoming abandoned in terms of whatever good that comes out of this.

So it seems to me that flexibility is something that is

inherent in this legislation and that there is recognition that, as you say, if there are orders of magnitude of change that that will be reflected in this and that we aren't engraving something in some marble for ever and ever.

Mr. BROMLEY. If I could--I understand your point, sir.

Mr. MINETA. Please.

Mr. BROMLEY. If I could just extend my slightly, one of the things that your bill does is to define the roles of the agencies, and again, part of my concern is that it may well be that we will want to change the relative roles of agencies as we go forward. Now, if we can arrange to do these things, then my concern, of course, gets very much less.

Mr. MINETA. I wonder to what extent the change in the missions of those agencies become legislative and wouldn't be superseded in any event by that change rather than what's held here in H.R. 656?

Mr. BROMLEY. I would simply say, sir, that we would welcome the opportunity to work with you because what we--I think we share the same goals here in great detail, and I am simply registering concerns that I have, that my colleagues have having spent the last year pulling this together and trying to make all the pieces fit. We would be, as you can imagine, very distressed if something happened to take that apart before we really got off the mark.

Mr. MINETA. And when you spoke earlier, you used the phrase ''critical mass,'' and I'm wondering what is the critical mass in this instance? Is that the fiscal year 1991 sum, fiscal year 1992, and what you envision by the fifth year, or are you talking about the technology within the industry, or--

Mr. BROMLEY. I'm talking about a different dimension, sir. What I'm talking about in critical mass is bringing together enough good people to work on a focused, directed program with a specific set of goals in mind so that their activities and their innovative skills are brought together and focused so that the sum is vastly greater than you would get just by adding up the individual efforts. It's in that sense rather than a financial or funding sense.

Mr. MINETA. In that sense, what about the--is the emphasis on the technology part of it, or to what extent do you bring along the human factors aspect of it as well?

Mr. BROMLEY. Your point is very well taken. The program has four components, sir. One has to do with the hardware where we want to maintain our leadership, the high-performance hardware itself; the second has to do with the software that makes it possible to communicate with that hardware; the third has to do with the networking that makes it possible for many people to get access to the system, use the software and hardware; and the last and certainly not

least important is the people who will not only do the frontier development in computer science and engineering but also those people who will maintain and operate the systems and networks and make that power available to the users on demand. So that's a very important part.

Mr. MINETA. And given those four factors, have you apportioned the amounts of money that you have envisioned here to those efforts?

Mr. BROMLEY. Yes, we have, sir.

Mr. MINETA. And roughly what would be the breakdown?

Mr. BROMLEY. Well, I don't have that specific number, but if you look on page 26 of the document ''The Grand Challenges'' that I believe you have, pages 26 and 27 show you the breakdown, first of all, of activity among the participating agencies, and page 24 gives you a detailed breakdown which shows you down at the bottom of the page--you see ''Basic Research and Human Resources,'' and if you look at the chart, 20 percent of the 1992 initiative is devoted specifically to that component whereas, for example, high- performance computing systems--that's the hardware part-- gets 25 percent, and so on. But the little pie chart in the inset on the bottom of page 24 probably is the most concise statement of how that breakdown is recommended.

Mr. MINETA. Now, is your only concern about this legislation this inhibition of flexibility?

Mr. BROMLEY. No, there are two. First is the potential inhibition of flexibility, and the second is that we have devoted an enormous amount of effort to getting all the agencies to agree to accept the specific responsibilities laid out in this table, and if it should turn out that--some of the major players here in particular report to different Congressional committees, and if the action of those committees was not coordinated, then we might find that it would be quite impossible to move forward with the kind of participation that we envisage in putting the plan together. So I'm simply registering a concern and asking for your help to ensure that since the agencies within the Administration have signed off that this is what they want to do, are prepared to do, we need your help in making it possible for them to in fact do that.

Mr. MINETA. Very well. Dr. Bromley, I assume that your testimony here has been cleared by OMB prior to its submission.

Mr. BROMLEY. Oh, indeed it has. Indeed it has.

Mr. MINETA. Well, I'm just going to make an editorial comment and let it go at that, and that is that we, I think--and especially the gentleman from California--at the time of your appointment were very happy that the President made your selection, and frankly I think a lot of times you're inhibited, your flexibility is inhibited, by idealogues

somewhere else. Now, I know that sometimes for you your job is like shoveling sand against the tide, and I recognize that, and so I just want to commend you for what you're doing down there, and I know that our committee will continue to work with you to make sure that we do things that are in the best interest of the country regardless of idealogues. Thank you very much, Doctor.

Mr. BROMLEY. Thank you, sir.

Mr. MINETA. Thank you, Mr. Chairman.

Mr. BOUCHER. The Chair thanks the gentleman and recognizes once again the gentleman from California, Mr. Packard.

Mr. PACKARD. I apologize for coming back, but the question was asked Senator Gore, and I think it reflects the concern certainly on this side of the aisle, one of the concerns of the legislation, and that is that will the Government end up owning and operating in perpetuity a system, wonderful as it may be, and his answer was that in the initial stage they will develop and operate and own, but the goal is to have a transition to the private sector.

In your strategy, in your proposal, it mentions that the Government would become a prototype user for early commercial high-performance computing and communication products. You have inserted that transition, I believe, conceptually into your proposal. How can we ensure that that transition will take place with legislation?

Mr. BROMLEY. Let me begin, if I may, sir, by just reviewing what I see as the transition. At the beginning, we're going to start off with a series of major pieces of hardware--supercomputers, high-performance computers--that are presently owned by educational institutions, by the Federal Government, in national laboratories, and we're going to tie those together with a network of fibers that are owned by the common carriers--by AT&T, by Sprint, by MCI, whoever. The Government isn't going to own that at all. The Government will own some of the hardware that's on the system.

Mr. PACKARD. The high-end switches and the supercomputers.

Mr. BROMLEY. That's right. That's correct. But as we move forward, we already see these organizations like Advanced Network Services being crafted by the private sector, ready to move in to expand the network, first of all, so that more people have access to this hardware that is already available, and I would anticipate fully that within a very short time we're going to find private sector organizations buying in, providing pieces of major hardware that will be connected into the network, but I emphasize that the network we're talking about here, the national research and education network, is not the network that we envisage as coming hopefully toward the end of this decade. That one is one that we would see completely put together by private sector organizations.

We would certainly want to have interconnects so that that particular system could talk to our test bed. That's really what the NREN is is a test bed to figure out how to make all these things work so that they're transparent to the user, so that the guy sitting down in his office at his work station has a particular problem. We want to have the system sufficiently smart so that when it sees what this problem is, it will simply take the problem and direct it to the appropriate hardware somewhere on the net. It could be on the West Coast, the East Coast, it could be anywhere, and you don't want to know what piece of hardware is doing your work for you because when it's finished, something sends you back your answer, and that's all you need to know.

Now, as we progress, I see that system probably continuing its role as a test bed for the really advanced frontiers of computational science, attacking the grand challenges, and so on, and in parallel with this, the public utility that will draw on this NREN for its architecture, for a lot of its software, and that we will interconnect them so that on some appropriate basis--there will obviously be regulatory questions, just as in the telephone system--but on some appropriate basis, just as you pay for your telephone, you pay for connection to a system that has a certain capability, and you pay appropriate to whatever the capability is.

Mr. PACKARD. Thank you very much.

Mr. BOUCHER. Dr. Bromley, we greatly appreciate your attendance here this morning and your lengthy and informative testimony, and I want to commend you once again on the foresight that you've demonstrated in bringing this initiative forward. This subcommittee will look forward to working very closely with you as the initiative advances, and again I would underscore our willingness to receive from you any recommendations that you now have or will have over the next several weeks or months in terms of how this legislation might be restructured to resolve the problems with potential inflexibility that you've demonstrated and stated here today.

Mr. BROMLEY. Well, I would thank you, Mr. Chairman, and if I might first of all say that my colleagues will welcome the opportunity to work with you because, as I say, we share common goals, and secondly, if I might in closing take the opportunity again, Mr. Chairman, to express to you my appreciation of the remarkable job that has been done by the agency representatives who have worked long and hard during this past year in putting this document together and in putting the program together. It does represent, I believe, a new high in cooperation and mutual trust across the whole spectrum of the agencies. Thank you, sir.

Mr. BOUCHER. Thank you very much, Dr. Bromley.

Mr. BOUCHER. We will welcome now our third panel of the morning, and I would ask each of these panelists to come forward now: Dr. Kenneth King, the President of EDUCOM; Dr. Glenn Ricart, the Director of SURAnet; Mr. Jim Young, the Vice President for Regulation and Industrial Relations for Bell Atlantic; Dr. George Johnston, Research Scientist, the Plasma Fusion Center for MIT; and Dr. Stewart Personick, the Assistant Vice President for Information Networking as Bell Communications Research.

Gentlemen, we welcome you here this morning. Without objection, your written statements will be made a part of the record. The subcommittee has a five-minute rule with regard to opening statements, and in view of the hour, I would ask the panelists to please adhere to that rule and summarize your testimony within that five-minute period, and the subcommittee will withhold questions until all of the panelists have delivered their opening statements.

We welcome you here this morning, and, Dr. King, let's begin with you. We'd be happy to hear your testimony.