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Report to Congressional Committees

August 2002

EXPORT CONTROLS

More Thorough Analysis Needed to Justify Changes in High Performance Computer Controls

G A O

Accountability ★ Integrity ★ Reliability

GAO-02-892

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Abbreviations

MTOPS millions of theoretical operations per second

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Accountability * Integrity * Reliability

United States General Accounting Office
Washington, D.C. 20548

August 2, 2002

The Honorable Carl Levin
Chairman
The Honorable John W. Warner
Ranking Minority Member
Committee on Armed Services
United States Senate

The Honorable Paul S. Sarbanes
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The Honorable Phil Gramm
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The Honorable Robert Stump
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The Honorable Ike Skelton
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Ranking Minority Member
Committee on International Relations
House of Representatives

The United States controls the export of high performance computers for national security and foreign policy reasons. U.S. export control policy seeks to balance U.S. economic interests in promoting high technology exports with national security interests in maintaining a military advantage over potential adversaries. High performance computers have both civilian and military applications, operate at or above a defined performance threshold (measured in millions of theoretical operations per second [MTOPS]), and require an export license to particular destinations such as China, India, and Russia. The President has periodically changed, on the basis of technological advances, the threshold above which licenses are required.

In January 2002, the President announced that the control threshold above which computers exported to countries such as China, India, and Russia would increase from 85,000 MTOPS to 190,000 MTOPS. When the President changes the threshold, the National Defense Authorization Act of 1998[1] requires that the President provide a justification to Congress. The justification should, at a minimum, address the extent to which computers capable of performance between the established and newly proposed level of performance are available from other countries, address all their potential military uses, and assess the impact of such uses on U.S. national security interests. A related law also requires that we assess the executive branch's proposed changes.[2] The justification for the President's January 2002 change to the control threshold for high performance computers was presented in a December 28, 2001, report to Congress. Thus, we (1) assessed the President's justification for the decision as presented in the December 2001 report and (2) identified other issues relevant to the decision to change the control threshold.

To address these issues, we reviewed the statutory requirements for the justification, the documentation used by executive branch officials to support the conclusions presented in the report, and export control regulations pertaining to high performance computers. In addition, we obtained information from the 10 manufacturers listed in the President's report on the availability of high performance computers having the specifications described in the report. The information obtained from the manufacturers was supplemented with additional information obtained from a leading information technology industry market research organization. We also interviewed officials from the Departments of Commerce, Defense, and State who were responsible for producing the President's report.

Results in Brief

The report justifying the changes in control thresholds for high performance computers focused on the availability of high performance computers. However, we found that the justification did not fully address the requirements of the National Defense Authorization Act of 1998.

[1]Public Law 105-85, sections 1211, 111 stat. 1932-35.

[2]Public Law 106-554, appendix B, section 314, 114 stat. 2763A-123.

- The report's prediction that computers capable of performing at the new threshold will be widely available through foreign and domestic companies by early 2002 has not materialized. We found that only 1 of 10 companies cited in the report produces computers with this capability. Other companies do not plan to do so until 2003, or later, and some do not plan to do so at all. The President's report was not supported by an assessment of foreign availability of high performance computers.

- The report contains little relevant analysis of the potential military uses of computers with performance capabilities between the old and new thresholds.

- The report does not adequately address what impact computers that perform at levels between the old and new thresholds would have on national security. The report states that high performance computers would be of little or no value to countries of concern not having the requisite knowledge and experience in using these computers to advance their military capabilities. However, the report did not discuss the usefulness of these computers to countries such as China and Russia that have already demonstrated the ability to use high performance computers. Finally, the report lacks potentially valuable information on the national security impact of the new threshold because the executive branch has not completed mandated national security assessments of the impact of the transfer of technology, including high performance computers.

Although not required by law, the December 2001 report did not address several key issues related to the decision to raise the threshold.

- The report did not mention that the unrestricted export of computers with performance capabilities between the old and new thresholds will allow countries of concern to obtain computers that they have had difficulty constructing on their own.

- The report also did not mention that the United States has been unable to monitor the end-uses of many of the computers that it exports to destinations such as China. Consequently, the true end-uses and end-users of these computers and their impact on U.S. national security are unknown.

- The inadequacies of the report are further compounded by continued use of a flawed measure, MTOPS. As noted in our prior report,[3] U.S. government officials and industry officials said this measure is outdated and does not adequately account for the performance capability in today's computers.

- The report does not acknowledge the multilateral process used to make prior changes in high performance computer control thresholds. Changes in control thresholds on dual-use goods (that is, goods with both military and civilian uses) are coordinated through the Wassenaar Arrangement—a voluntary forum of 33 countries established to reach multilateral agreements about which dual-use goods merit special scrutiny and reporting.[4] Since the United States unilaterally raised the control threshold without obtaining the consensus of other Wassenaar Arrangement members, State Department officials said it may become more difficult in the future to reach multilateral consensus on other important export control issues.

In responding to our draft report, the Department of Commerce disagreed with our findings and conclusions and stated that the administration conducted a thorough review prior to raising the licensing thresholds on high performance computers. We disagree and note that the President's justification focused on only one of three elements required by law—the market availability of high performance computers. Further, we found that the market availability assessment was not adequate since only 1 of 10 companies capable of producing high performance computers at the higher threshold planned to market such computers in 2002. More importantly, the justification did not address the two remaining elements required by law—an analysis of all the potential military uses of high performance computers and the impact of such uses on U.S. national security interests.

The Department of State agreed that several shortcomings exits in the President's justification. However, State said these shortcomings do not

[3]See U.S. General Accounting Office, *Export Controls: System for Controlling Exports of High Performance Computers Is Ineffective*, GAO-01-10 (Washington, D.C.: Dec. 18, 2000).

[4]The 33 participating states of the Wassenaar Arrangement are Argentina, Australia, Austria, Belgium, Bulgaria, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, the Republic of Korea, Romania, the Russian Federation, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, Ukraine, the United Kingdom, and the United States.

invalidate the key finding that high performance computer can no longer be effectively controlled because countries can cluster or link computers together to achieve higher capabilities. State's position, which was not reflected in the President's report, contrasts with an October 2001 Department of Defense analysis that concluded that a clustered system does not provide comparable capabilities as a stand-alone high performance computer.

The Departments of Commerce, Defense, and State did not comment on our draft report recommendation that they comply with existing statutes and complete a thorough assessment of availability, military significance, and the national security impact of the changes to high performance computer controls. The Department of Commerce did not respond to our recommendation. The Department of Defense did not address our findings or conclusions but stated that its ongoing study of export control issues was consistent with our recommendations. The Department of State said it did not agree with certain recommendations but did not specify which of our recommendations it agreed or disagreed with. The departments have also not complied with similar recommendations made in prior GAO reports.[5] Accordingly, in the report, we have included a Matter for Congressional Consideration. To help ensure that a thorough assessment of these issues is completed, Congress may wish to consider requiring that the executive branch fully comply with existing statutes before the executive branch alters or eliminates the export control threshold for high performance computers.

Background

The United States controls high performance computers and related components (for example, microprocessors) through the Export Administration Act of 1979 and the implementing Export Administration Regulations.[6] The act authorizes Commerce to require firms to obtain licenses for the export of sensitive items that may be a national security or foreign policy concern. The Departments of Defense, Energy, and State

[5]See U.S. General Accounting Office, *Export Controls: Inadequate Justification for Relaxation of Computer Controls Demonstrates Need for Comprehensive Study*, GAO-01-534T (Washington, D.C.: Mar. 15, 2001) and GAO-01-10.

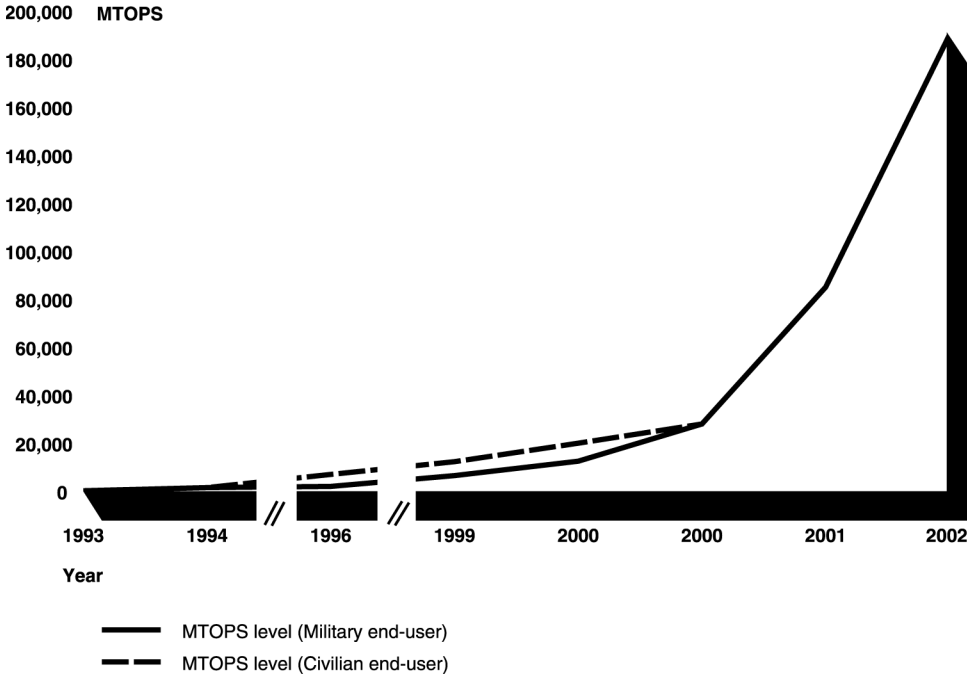
[6]50 U.S.C. appendix sections 2401 and 15 C.F.R. sections 730. Since it was terminated on August 20, 1994, several executive orders and one law have extended application of the Export Administration Act of 1979. Most recently, application of the act has been extended by Executive Order 13222, August 17, 2001 (66 Fed. Reg. 44025).

assist Commerce, which administers the act, by reviewing export applications and supporting Commerce in its reviews of export control policy.

Since 1993, the President has revised U.S. export control levels for high performance computers seven times, including the revisions announced in January 2002. These revisions have resulted in a nearly thousandfold increase in the export control threshold over the 8-year period; most of these changes have occurred over the last 2 years (see fig. 1). The latest effort to revise the threshold was initiated in response to a letter from the Computer Coalition for Responsible Exports.[7]

[7]The Computer Coalition for Responsible Exports is an alliance of American computer companies and information technology associations established to inform policymakers and the public about the nature of the computer hardware industry—its products, market trends, and technological advances. The cochairmen of the coalition are the Director of Government Affairs for Unisys Corporation and the President of the Information Technology Industry Council. The council represents the leading U.S. providers of information technology products.

Figure 1: Changes in the U.S. Export Control Threshold for High Performance Computers, 1993-2002 (Measured in MTOPs)



Note: The use of separate MTOPS levels for military and civilian end-users was discontinued in 2000.

Sources: GAO analysis of prior reports used to justify changes in the control threshold and U.S. Export Administration Regulations.

Beginning in 1996, the executive branch organized countries into four computer "tiers," with each tier above tier 1 representing a successively higher level of concern related to U.S. national security interests. Current U.S. export control policy places no license requirements on tier-1 or tier-2 countries, primarily those in Western Europe, Japan, Asia, Africa, Latin America, and Central and Eastern Europe.[8] Exports of computers above a specific performance level to tier-3 countries such as China, India, Israel, Pakistan, and Russia require a license. Exports of high performance computers to tier-4 countries such as Iran, Iraq, and North Korea are essentially prohibited.

[8]In 2001, tiers 1 and 2 were merged. This report refers to tier-3 countries as "countries of concern."

To help inform congressional decision makers about changes in U.S. export controls on computers, the National Defense Authorization Act of 1998 requires that the President report to Congress the justification for changing the control threshold for exports of high performance computers to certain sensitive countries.[9] The report must, at a minimum, (1) address the extent to which high performance computers with capabilities between the established level and the newly proposed level of performance are available from foreign countries, (2) address all potential uses of military significance to which high performance computers between the established level and the newly proposed level could be applied, and (3) assess the impact of such uses on U.S. national security interests.

In addition, section 1402 of the National Defense Authorization Act of 2000 requires the President to annually assess the cumulative impact of licensed transfers of military-sensitive technologies to countries and entities of concern and possible countermeasures that may be necessary to overcome the use of such technologies. Section 1406 requires the President, in consultation with the Secretaries of Defense and Energy, to conduct a comprehensive review of the national security implications of exporting high performance computers to China with annual updates through 2004.[10] In January 2000, the President delegated the responsibility for producing these reports to the Secretaries of Defense and Energy.[11]

As required by law, we reviewed prior justifications for changing the export control thresholds on high performance computers. We found that the changes were not adequately justified. For example, previous reports failed to address all uses of military significance to which high performance computers could be applied at the new thresholds, or the impact of such uses on national security, as required by law. In response to these deficiencies, we recommended that the Secretary of Defense report on the

[9]The Departments of Defense, Commerce, State, and Energy prepare the President's report under the coordination of the National Security Council.

[10]Public Law 106-65, 113 stat. 798, 801.

[11]The Department of Defense is responsible for producing the section 1402 report. The section 1406 report is to be prepared jointly by the Departments of Defense and Energy.

national security threat and proliferation impact of U.S. exports of high performance computers to countries of concern.[12]

Report Does Not Adequately Justify Changes in Control Threshold

The Department of Commerce stated that the December 2001 decision to raise the control threshold for high performance computer exports was based on thorough analysis. However, we found the justification did not adequately meet the three criteria required by law. First, the report stated that computers based on Intel Corporation's Itanium processor and capable of performing at the 190,000 MTOPS level would be widely available in early 2002.[13] This assertion was not based on any formal analyses and has proven to be inaccurate. Second, the report provided little analysis of all the potential military uses of these computers. Third, the report did not assess the impact of the uses of these computers on U.S. national security. Although the report asserts that high performance computers would be of limited value to countries of concern not having the demonstrated knowledge and experience in using these computers, the report did not discuss the national security implications of exporting computers to countries of concern, such as China and Russia, that have a demonstrated ability to use them. Further, several laws and a Defense Department directive have mandated other studies that could be used to better understand the national security implications of the export of high performance computers and other technologies; however, the Department of Defense has not completed such studies.

190,000 MTOPS Computers Are Not Widely Available

The December 2001 report inadequately addressed the first criterion of the National Defense Authorization Act of 1998 in its discussion of the extent to which high performance computers with capabilities between the established level and proposed level of performance are available from other countries. The executive branch's report stated that the decision to raise the licensing threshold level to 190,000 MTOPS was based on the wide availability by early 2002 of new computer servers containing 32 Intel

[12]See U.S. General Accounting Office, *Export Controls: Information on the Decision to Revise High Performance Computer Controls*, GAO/NSIAD-98-196 (Washington, D.C., Sept. 16, 1998).

[13]The term "widely available" is not defined in the President's report or in the Export Administration Regulations.

Corporation Itanium processors.[14] Such servers approach a composite theoretical performance of 190,000 MTOPS. Contrary to assertions made in the report, however, Itanium-based computers with performance capabilities in the 190,000 MTOPS range are not widely available. We found that the report's finding of availability was not based on an independent analysis but rather on information provided by industry. According to Defense officials responsible for producing the report, industry representatives told them that (1) the market would be flooded with 32-way, Itanium-based servers in early 2002, (2) the People's Republic of China is the long-term market of importance, and (3) U.S. industry is concerned that, if the threshold is not raised, foreign competitors will capture the market.

Although not required by law, Commerce could have independently verified industry's assertions as to the availability of the servers by conducting foreign availability assessments. Foreign availability assessments identify foreign sources of items subject to U.S. national security export controls, such as high performance computers, and are the principal mechanism recognized in the U.S. Export Administration Regulations for determining the availability of controlled items. These assessments determine whether items of comparable quality are available in quantities from non-U.S. sources that would render U.S. export controls on the items ineffective.[15] Commerce officials stated that no foreign availability study was conducted because industry had made its case informally.[16] Instead of conducting a study to establish that these servers would be widely available by early 2002, Commerce stated that it conducted interagency meetings and discussions with industry as well as an analysis of the worldwide availability of high performance computers. Commerce stated that it also reviewed the Internet sites of the computer manufacturers mentioned in

[14]Intel Corporation produces the Itanium processor. A server is a computer that manages information resources. For example, a computer network server is a computer that manages the flow of transactions over a network. The term "32-way" refers to the number of microprocessors that can be linked within a given computer server.

[15]50 U.S.C. app. section 2404 (f); 15 C.F.R. section 768.2.

[16]While conducting related studies of export control issues, we found that the semiconductor equipment industry had made a similar case about foreign availability. Commerce did not accept its findings, even when industry representatives provided evidence that proved that foreign competitors were selling equipment to controlled destinations. See U.S. General Accounting Office, *Export Controls: Rapid Advances in China's Semiconductor Industry Underscore Need for Fundamental U.S. Policy Review*, GAO-02-620 (Washington, D.C.: Apr. 19, 2002).

the report. In commenting on a draft of our report, the Department of Commerce asserted that it completed a market analysis of the worldwide availability of high performance microprocessors and computer clustering capabilities, and held discussions with other executive branch agencies and foreign governments. However, the President's report did not cite or include this market analysis nor did the department provide additional information to document this completed analysis in response to our request.

We reviewed the documentation that Commerce obtained from the Internet and other sources and found little additional evidence about the availability of 32-way, Itanium-based servers beyond the information contained in the Computer Coalition for Responsible Exports' August 2001 letter requesting a change in the export control threshold. The information provided did not indicate that the 10 companies listed in the President's report planned to introduce 32-way servers or that the servers would be widely available in early 2002. We also contacted the companies listed in the report and found that, as of May 2002, only one of the companies—Unisys Corporation—was producing a 32-way, Itanium-based server (see table 1).

Table 1: Companies Cited by the President's December 2001 Report as Producing 32-way, Intel Itanium-based Servers in Early 2002

Company	Country	Is the company producing a 32-way, Itanium-based server?
Bull	France	No
Compaq	United States	No
Dell	United States	No
Fujitsu-Siemens	Japan/Germany	No
Hitachi	Japan	No
Hewlett Packard	United States	No
IBM	United States	No
Mitsubishi	Japan	No
NEC	Japan	No
Unisys	**United States**	**Yes**

Sources: President's December 2001 report to Congress and GAO analysis.

Information obtained from the companies listed in the President's report contradicts the assertion that 32-way, Itanium-based servers will be widely available in early 2002. Representatives we interviewed stated that their companies would not introduce these servers in 2002 or had no plans to manufacture these servers due to the lack of software and a market for such powerful servers. An official from a leading information technology market research firm stated that Itanium-based technology is far too new to allow a reasonable determination of its impact on the server market. Furthermore, according to the research firm's information, no 32-way, Itanium-based servers were shipped in the first quarter of 2002.

Finally, the report noted that a significant market exists for high-end servers of up to 32 processors. However, Commerce data indicate that the market for computers with performance capabilities in the 190,000 MTOPS range in countries of concern is small and that the loss of sales in these countries should not materially affect U.S. manufacturers. In 2001, Commerce received 16 export license applications for computers with performance capabilities at or above 85,000 MTOPS; all but one was approved. Six of the approved applications were for sales to China. Moreover, Japan—the other leading exporter of high performance computers—did not sell any of these systems to China, Russia, or India in 2001, according to the Department of Defense.

Report Did Not Assess All Potential Uses of Military Significance

As in previous reports used to justify changes in the control threshold, the December 2001 report did not meet the second criterion of the National Defense Authorization Act of 1998: to address all potential uses of military significance to which computers with performance capabilities between the old control threshold and the new threshold could be applied. The report stated that the U.S. government uses computers in virtually all military and national security applications, including the design, development, and production of weapon systems, military operations, cryptoanalysis, and nuclear weapons design and simulation. Defense officials to whom we spoke stated that Defense does not maintain an inventory of all U.S. national security-related computer applications, that the value of such a list is questionable, and that it may be impossible to construct such a list. The President's report provides little information about which military applications can be run on computers with capabilities between the old and new threshold. The report pointed out that the majority of U.S. military and national security applications are run on computers below 190,000 MTOPS. Using information provided by Defense, we found that computers operating at or below 190,000 MTOPS meet

98 percent of Defense's military computational requirements. Defense officials responsible for preparing the report said that the level of control selected—190,000 MTOPS—was driven by the market and what the administration believes it can control, not by the military and national security applications that could be run on high performance computers.

Assessment of Impact on National Security Not Conducted

The President's report did not discuss the impact on U.S. national security of countries such as Russia and China obtaining high performance computing power up to the new control threshold, as required by law. Such a national security assessment has been a long-term, executive branch requirement. For example, section 1402 of the National Defense Authorization Act of 2000 requires the President to annually assess the cumulative impact of licensed transfers of military-sensitive technology to countries and entities of concern and to identify possible countermeasures that may be necessary to overcome the use of such technologies. In addition, section 1406 of the act requires assessments of the national security implications of exporting high performance computers to China with annual updates through 2004. In addition, a 1985 Department of Defense directive requires annual assessments of the total effects of technology transfers.[17] We found that Defense had not completed the studies required by the law or its directive. Moreover, Defense has not yet implemented our prior recommendation to report on the national security threat and proliferation impact of U.S. exports of high performance computers to countries of concern.[18] Although the Departments of Defense and Commerce stated that they are already engaged in reviews of similar issues, the agencies could not furnish plans or other documentation on how they are implementing our recommendation.

Instead of addressing the national security implications associated with the export of high performance computers, the President's report simply stated that high performance computers would be of little or no value to countries of concern not having the requisite knowledge and experience in using

[17]The 1985 Defense directive states that the department shall assess annually the total effect of transfers of technology, goods, services, and munitions on U.S. security regardless of the transfer mechanisms involved. (Department of Defense Directive 2040.2, sections 5.1.7 and 7.1.15, January 1984, reissued incorporating change 1, July 5, 1985.)

[18]See U.S. General Accounting Office, *Export Controls: Inadequate Justification for Relaxation of Computer Controls Demonstrates Need for Comprehensive Study*, GAO-01-534T (Washington, D.C.: Mar. 15, 2001) and GAO-01-10.

these computers to advance their military capabilities. However, the report did not discuss the usefulness of these computers to countries such as China and Russia that have demonstrated the ability to use high performance computers. The report's assertion that countries of concern will not benefit from the acquisition of high performance computers also contradicts statements made in other reports published by the executive branch and statements made by Defense officials responsible for producing the President's report, as indicated in the following examples.

- Reports published in 2000 that were used to justify previous increases in the export control threshold for high performance computers stated that Russia and China have the expertise necessary to use these computers for national security applications such as the construction of submarines, advanced aircraft, composite materials, or a variety of other devices.[19]

- A 2001 report by the Department of Energy's National Nuclear Security Administration concluded that the availability of overall computing power to a nuclear weapons design program is critical.[20] Acquisition of computers with higher performance levels allows a nuclear weapons program to conduct studies faster and enables studies that cannot be conducted on systems of lower performance, thus shortening the time for design and development to full-scale testing. The report further concludes that computers with an effective performance of 10,000 MTOPS or greater would be of significant use to China's designers in examining likely gaps in their nuclear weapons programs.

- A 2001 executive branch assessment concluded that the increased use of high performance computers in the weapons of mass destruction programs of countries of concern could severely complicate U.S. efforts

[19]Summary of Findings with Respect to Criteria Set Forth in Subsections 1211(d) and (e) of the National Defense Authorization Act for Fiscal Year 1998 (P.L. 105-85) (Washington, D.C. February 2000). Summary of Findings with Respect to Criteria Set Forth in Subsections 1211(d) and (e) of the National Defense Authorization Act for Fiscal Year 1998 (P.L. 105-85) (Washington, D.C. August 2000).

[20]U.S. Department of Energy, *National Security Implications of Exporting High Performance Computers to the People's Republic of China: Nuclear Weapons Review, Report Submitted to Congress Pursuant to Section 1406 of the National Defense Authorization Act for Fiscal Year 2000* (Washington, D.C.: Office of Arms Control and Nonproliferation, National Nuclear Security Administration, U.S. Department of Energy, April 2001).

to monitor and assess such programs.[21] The use of these computers can reduce and even eliminate many traditional observable weapons production activities such as large manufacturing operations and live weapons tests.

According to the Defense officials responsible for preparing the December 2001 report, the level of computing power used to solve a particular problem is based on the level of computing power available. If more powerful computers are available, they are used. The greater the power of the available computer, the faster the problem can be solved. Consequently, the computers exported under the new threshold will allow countries of concern to solve more quickly more complex problems in weapons systems design.

Other Key Issues Relevant to the Decision to Raise Control Thresholds Not Addressed in the Report

Although not required by law, the President's December 2001 report did not address several key issues related to the decision to raise the threshold. These issues include the ability of countries of concern to construct high performance computers on their own, U.S. government difficulties in monitoring the end-use of computers exported to countries of concern, the use of MTOPS as a measure of individual computer performance, and the impact of establishing a new licensing threshold outside the Wassenaar Arrangement process.

The report did not acknowledge the difficulty that some countries of concern have encountered in clustering smaller machines together to achieve greater computing power. However, as we have reported before, it may be more difficult to operate custom-built clustered systems than to build them, according to experts.[22] For example, without vendor-supplied software to automate key functions on a clustered system, everything must be done manually, making computing labor intensive and less reliable than if it were performed on a vendor-manufactured system. With the higher

[21]Defense Intelligence Agency High Performance Computer Assessment (Washington, D.C., 2001).

[22] GAO-01-10.

thresholds, countries of concern will not have to rely on more inefficient clustered systems to obtain greater computing capabilities.[23]

- The report did not address the difficulty that the U.S. government has had in effectively monitoring the high performance computers that are exported to countries of concern.[24] Monitoring exported equipment for proper use is a key element of the U.S. export licensing process. Approved export licenses for high performance computers typically stipulate conditions, such as where the computer must be located and how it should be used. The conditions are designed to deter the end user from using the computer inappropriately or from transferring the computer to another location. Monitoring of these conditions is to be accomplished through required end-use checks conducted by U.S. government personnel.[25] In our prior report, we found that U.S. government personnel in China tasked with this job have been unable to conduct many checks.[26] In testimony before the U.S.-China Security Review Commission on January 17, 2002, Commerce's Assistant Secretary for Export Enforcement stated that the Chinese government dictates the schedule for conducting end-use checks.[27] As a result, more

[23]Officials within the Defense Department disagree over the extent to which clustering has rendered current export controls on high performance computers ineffective. Officials in the Department of Defense's Offices of the Deputy Under Secretary for Science and Technology and the Deputy Under Secretary for Technology Security stated that commercially available clustering technology has advanced to the point that it can be used by countries of concern to construct computers with performance capabilities that exceed 190,000 MTOPS, thus making controls on all high performance computers ineffective. Defense Intelligence Agency and Defense Technology Security Administration officials disagree with this view and believe that countries of concern still face significant obstacles in clustering computers, making controls on high performance computers still effective.

[24]Licenses for exports and reexports of high performance computers for end-users and end-uses—other than nuclear, chemical, biological, missile, or military in countries of concern—will generally be approved. (15 C.F.R. sections 742.12(b)(3)(i)(A) and 742.12(b)(3)(iii)). For the People's Republic of China, the general licensing policy is to approve applications; however, items that would make a direct and significant contribution to electronic and antisubmarine warfare, intelligence gathering, power projection, and air superiority receive extended review or denial. Items may be approved, even though they may contribute to Chinese military development. (15 C.F.R. section 742.4(b)(7)).

[25]Public Law 105-85, section 1213, 111 stat. 1934.

[26]GAO-02-620.

[27]End-use checks in China are conducted on the basis of an arrangement for end-use visits negotiated between the U.S. and the Chinese governments in 1998.

than 700 outstanding checks remain to be completed, according to Commerce.

- The inadequacies of the President's report are compounded by the continued use of MTOPS to determine the performance capabilities of computers. Although industry and government no longer consider MTOPS a valid measure of computer performance, the executive branch continues to use it. In our 2000 report on high performance computers, we recommended that executive branch agencies comprehensively assess ways to address the shortcomings of computer export controls, including the development of new performance measures.[28] The President's December 2001 report stated that the executive branch is conducting a comprehensive review of export controls on computer hardware. According to the report, this interagency review will, among other things, attempt to identify a controllable class of high-end computer systems of greater military sensitivity and alternative metrics for controlling such systems. However, Defense officials stated that the study has no deadline and no formal terms of reference.

- The report did not acknowledge the multilateral process established under the Wassenaar Arrangement—a forum of 33 countries established in 1996 to reach multilateral agreements on which dual-use goods merit special scrutiny and reporting. Changes to control thresholds on dual-use goods are coordinated through the Wassenaar Arrangement. The arrangement uses a consensus-based approach to establish control thresholds on these goods. The United States unilaterally raised the MTOPS licensing threshold to 190,000 without first obtaining the consensus of other Wassenaar Arrangement members. Due to actions taken by the United States, the U.S. licensing threshold is now 190,000 MTOPS, while the control thresholds of other Wassenaar member states remain at 28,000. Consequently, U.S. exporters have a competitive advantage over their international competitors because U.S. exporters are not required to obtain an export license for a wider range of computers. According to State Department officials, the unilateral U.S. action may complicate future efforts to reach consensus in the Wassenaar forum on other important export control issues.

[28] GAO-01-10.

Conclusions

The report justifying the decision to decontrol high performance computers was not based on a thorough analysis and did not fully address the requirements of the National Defense Authorization Act of 1998. Since the report's conclusions are based on inaccurate information provided by the computer industry and an inadequate assessment of national security issues, the decision to raise the export control threshold is analytically weak and appears to be premature, given market conditions. By providing greater access to more powerful computers through the removal of any export-licensing requirement, the United States could allow countries of concern to pursue computer applications having military uses with a greater degree of rigor and reliability. A more thorough analysis of the foreign availability and the national security impact of transferring technology to countries of concern would have provided a better analytical basis for making changes in the control threshold. Given the level of high performance computing power that the United States approves for export, such studies of the cumulative effect of computer and related technology exports will be increasingly important in determining the impact of such exports on U.S. national security and in making future decisions about adjusting export control thresholds.

Matter for Congressional Consideration

In our draft report, we recommended that the Departments of Commerce, Defense, and State comply with existing statutes and complete a thorough assessment of the foreign availability, military significance, and the national security impact of changes to high performance computer controls. Prior GAO reports have made similar recommendations. Since the departments have not responded to our earlier recommendations on this issue or clearly indicated whether they agreed with the recommendations made in our draft report, we have included a Matter for Congressional Consideration.

To help ensure that a thorough assessment of these issues is completed, Congress may wish to consider requiring that the executive branch fully comply with the provisions of the National Defense Authorization Acts of 1998 and 2000 before the executive branch alters or eliminates the export control thresholds for high performance computers.

Agency Comments and Our Evaluation

We received written comments on a draft of this report from the Departments of Commerce, Defense, and State, which are reprinted in appendixes I, II, and III. The Commerce Department disagreed with our findings and conclusions and said that the executive branch conducted a thorough review of U.S. export controls on high performance computers prior to the President's January 2002 decision to raise the licensing thresholds. Commerce stated that this review included significant input from all relevant agencies, consultations with other Wassenaar Arrangement partners, as well as an analysis of the worldwide availability of high performance computers and computer clustering. Commerce also said the United States continues to seek a means to control computers of the greatest strategic importance. The Department of Defense said it is conducting a study of computer export controls consistent with our recommendations and the requirements of law. The Department of State said it agreed that several shortcomings exist in the executive branch's justification to raise the licensing thresholds for high performance computers. While agreeing that there were some gaps in the study, State said it did not believe that these shortcomings invalidated a key finding that high performance computers can no longer be controlled effectively, due to advances in clustering computers together to achieve higher capabilities.

We have added information to the report to more fully describe the information that Commerce gathered from industry. However, we disagree that the administration conducted a thorough review of U.S. export controls prior to the President's January 2002 decision to raise the licensing thresholds. As noted in our report, the President's justification focused on only one of three elements required by law—the availability of high performance computers. Additionally, the availability assessment was not adequate since only 1 of 10 companies capable of producing high performance computers planned to market such computers in 2002. As noted in Commerce Department data, the current market for computers at the 190,000 MTOOPS level is relatively small and is not developing as quickly as anticipated. Accordingly, the disparity between market conditions and industry's assertions about the widespread availability of such computers should have prompted Commerce to conduct an independent foreign availability assessment as allowed by the Export Administration Regulations. However, Commerce did not conduct this important analysis because senior Commerce officials informed GAO that the department did not have the resources to complete such assessments.

The President's report did not fully address the two remaining elements required by law—identifying all potential uses of military significance and the national security implications of high performance computer exports. As noted in our report, Defense Department information shows that computers operating at or below 190,000 MTOPS meet 98 percent of Defense's military computational requirements. Therefore, the President's justification to raise the MTOPS licensing threshold should have included an assessment of the effects on national security.

The State Department's comments clearly articulated the executive branch's position on high performance computers—"high performance computers can no longer be controlled effectively" because high performance computing capacity is widely available. While our report found State's assertion on availability is not supported by current market conditions, State's comments demonstrate that preceived market conditions and related trends in computer clustering served as the primary basis for the decision to raise the control threshold for high performance computers. Regarding State's comments on computer clustering, we note that State's position contrasts with an October 2001 Department of Defense analysis that concluded that a clustered system does not provide comparable capabilities as a stand-alone high performance computer. The State and Commerce Departments cited no analysis as to how these powerful computers could enhance the military capabilities of countries of concern or affect U.S. national security interests. These important analyses are required by law but not addressed in the President's report.

Scope and Methodology

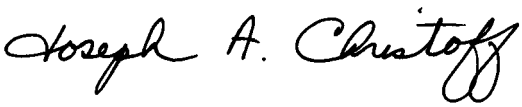
To assess the President's justifications for raising the export control threshold from 85,000 MTOPS to 190,000 MTOPS, we reviewed the statutory requirements related to the President's justification and the regulations that pertain to the export of high performance computers. Further, we reviewed documentation used as the basis for the report's assertions. The documentation included the letter and associated attachments addressed to Commerce from the Computer Coalition for Responsible Exports that prompted the change in the threshold. We also examined information available on the Internet about the computer server products offered by the 10 manufacturers mentioned in the President's report and contacted the manufacturers to obtain additional information. The information obtained from the manufacturers was supplemented with information obtained from a leading information technology industry research organization, including reports pertaining to the availability of Intel Itanium-based servers. Finally, we interviewed Commerce, Defense,

and State officials responsible for producing the report. The National Security Council, which plays a key role in coordinating the interagency process for changing export controls on high performance computers, declined to discuss the President's report with us.

We performed our work from February 2002 through July 2002 in accordance with generally accepted government auditing standards.

We are sending this report to interested congressional committees and the Secretaries of Commerce, Defense, and State. We will also make copies available to other interested parties on request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

Please contact me at (202) 512-8979 if you or your staff have any questions concerning this report. Another GAO contact and staff acknowledgments are listed in appendix IV.



Joseph Christoff, Director
International Affairs and Trade

Comments from the Department of Commerce

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

THE SECRETARY OF COMMERCE
Washington, D.C. 20230

JUL 16 2002

Mr. Joseph A. Christoff
Director, International Affairs and Trade
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Christoff:

Thank you for the opportunity to comment on the draft General Accounting Office (GAO) report entitled *Export Controls: More Thorough Analysis Needed to Justify Changes in High Performance Computer Controls* (Job Code 320102).

See comment 1.

The Bush Administration conducted a thorough review of U.S. export controls on high performance computers (HPCs) prior to the President's January 2002 decision to raise the licensing threshold on HPC exports to Tier 3 countries. This review included significant input from all relevant agencies, including the Departments of State and Defense, on the national security impact of modifying existing controls. The Administration's review also involved consultations with our Wassenaar Arrangement partners, as well as an analysis of the worldwide availability of HPCs, including comparable computing capability based on widespread availability of high performance microprocessors and computer clustering capabilities, and an analysis of the computer industry in the global marketplace.

As President Bush announced in January 2002, the change in the control threshold from 85,000 million theoretical operations per second (MTOPS) to 190,000 MTOPS advances the goal of updating the U.S. export control system so that it protects national security and, at the same time, allows America's high-technology companies to compete in the current global marketplace.

See comment 2.

In addition to this interim step of raising the control level for HPC exports to Tier 3 countries, the Administration is continuing a more comprehensive review of export controls on computer hardware. As you know, however, statutory change is needed to replace or eliminate the MTOPS control metric.

Enclosed are more detailed comments. Thank you again for requesting the Department of Commerce's views on the draft report.

Sincerely,

Donald L. Evans

Enclosures

Department of Commerce Comments on the Draft GAO Report "Export Controls: More Thorough Analysis Needed to Justify Changes in High Performance Computer Controls"

General Comments

The Department of Commerce disagrees with the GAO draft report's conclusion that the Bush Administration's decision to change the threshold for the licensing of High Performance Computers (HPCs) was based on inadequate analysis. Prior to making that decision, the Administration considered the criteria specified in the National Defense Authorization Act of 1998 (NDAA). It also considered additional factors that Commerce believes are also highly relevant in determining the effectiveness of export controls for HPCs.

Over the past three years, Commerce has regularly consulted with an industry advisory panel, the Information Security Technical Advisory Committee (ISTAC), on HPC market and technological developments. We augmented these ongoing consultations with meetings with specific companies, reviews of foreign competitors based on publicly available information, and interagency consultations, including discussions with the intelligence community. In addition, we have continued to consult with our Wassenaar Arrangement partners on the issue of the export licensing threshold for HPCs. The Administration's review of control levels has taken into account these various consultations and additional information.

Commerce's analysis identified a number of emerging trends that are driving the world computer market. Technological factors, such as the ease with which lower performance computers can be clustered together to achieve higher performance and rapid increases in the capabilities of mass produced, off-the-shelf microprocessors, have emerged as key market and technology drivers. The fact that companies can cluster together large numbers of low-level computers to achieve performance above current control levels renders the controls less effective. The GAO recognized this in a recent report, stating that "the current export control system for high performance computers, which focuses on controlling individual machines, is ineffective because it cannot prevent countries of concern from linking or clustering many lower performance, uncontrolled computers to collectively perform at higher levels than current export controls allow." *(Export Controls: System for Controlling Export of High Performance Computing Is Ineffective," GAO-01-10, December 18, 2000, at 5.)* Thus, the ability to cluster low-level computers has had a profound effect on the ability of the United States to effectively control the export of high performance computing power. However, the static review criteria of the NDAA do not address these emerging trends.

See comment 3.

The issue of controllability of computer hardware in today's world of rapid technological advancement and global production is reflected in the fact that the majority of Wassenaar Arrangement participants are in favor of removing computer hardware from the Wassenaar control list altogether. In contrast, the U.S. position has been to continue to seek a means to control computers of the greatest strategic importance.

See comment 4.

Other Comments:

See comment 5.

- The draft report fails to acknowledge a basic premise of the President's report – that the volume production of Intel's 64-bit Itanium processor, coupled with readily available computer clustering equipment and software, provides widespread high performance computing capability. While the market for such products may not have materialized as quickly as anticipated, effective controls must take into account widespread computing capability.

- The draft report states that the executive branch continues to use MTOPS to determine the performance capabilities of computers, despite the fact that MTOPS is no longer a valid measure of computer performance. While the Administration is continuing to explore alternatives to the MTOPS control metric, GAO should note that the use of the MTOPS control metric is statutorily required by the NDAA.

See comment 6.

- The draft report states that the President's report does not acknowledge the process in the Wassenaar Arrangement for revising controls. While there is no statutory requirement to address multilateral controls, it should be noted that the vast majority of Wassenaar participants favor computer decontrol. The draft report also incorrectly states that the United States unilaterally raised its computer control threshold to 190,000 MTOPS, while the Wassenaar control threshold remains at 28,000 MTOPS. In fact, the U.S. control threshold remains consistent with the Wassenaar level, with a license exception available for exports of HPCs of up to 190,000 MTOPS to a certain group of countries (Tier 3). Moreover, at the Wassenaar Plenary in December 2001, the U.S. Government informed its partners that it could not support the European Union proposal to entirely eliminate the MTOPS control parameter for HPCs because, in part, we are required by the NDAA to use MTOPS as the control parameter. Instead, we urged other members to support raising the Wassenaar control level to 190,000 MTOPS.

See comment 7.

- The most recent review of export controls on HPCs was not prompted solely by a request from a trade association representing the computer industry, as stated in the draft report. The review also was prompted by a proposal of a majority of Wassenaar participants to remove multilateral export controls on HPCs and by the Administration's continuing desire to adjust export controls to changing global, economic, and technological circumstances.

See comment 8.

- While the President's report does not mention the monitoring of end users of HPCs, the U.S. Government is committed to such monitoring for HPCs, and other items, that it exports to countries such as China. In fact, Commerce recently conducted post-shipment verifications on several more HPC exports to China.

2

See comment 9.

- More generally, our commitment to monitoring the end-uses of a variety of sensitive items is evidenced by the notice published in the *Federal Register* on June 14, 2002, listing certain persons in foreign countries for which we have been unable to conduct pre-license checks or post-shipment verifications for reasons beyond our control. Identification on this list constitutes a "red flag" that exporters should consider before engaging in business transactions with the persons listed. Nine of the eleven entities on this list are located in China.

- We offer no specific comments on the part of your draft report concerned with the military uses of high speed computers and the impact that such uses may have on the national security, because this topic is more appropriately addressed by the Department of Defense.

3

The following are GAO's comments on the Department of Commerce's letter dated July 16, 2002.

GAO Comments

1. We disagree that the Commerce Department conducted a thorough review of U.S. export controls prior to the President's January 2002 decision to raise the licensing thresholds. As noted in our report, the President's justification focused on only one of three elements required by law—the availability of high performance computers. The justification did not adequately identify uses of military significance or the national security impact of changing the thresholds.

2. We agree that this raises a legal issue, which we mentioned in our testimony on high performance computers on March 15, 2001. Once a new measure is decided upon, the executive branch could work with Congress to allow use of other measures. Section 221 of H.R. 2581, would repeal the National Defense Authorization Act provisions dealing with export controls on high performance computers. These controls are expressed in MTOPS.

3. We agree that countries of concern can cluster or link together lower performance computers to achieve higher computing capabilities. However, clustering still comes at a cost in terms of speed and difficulties in operating the clustered systems. Raising the control threshold to 190,000 MTOPS effectively eliminates these costs and allows countries of concern to easily purchase high performance computers.

4. Defense Department officials stated that high performance computers performing at or below 190,000 MTOPS meet 98 percent of the Department of Defense's computational requirements. Therefore, it is difficult to understand Commerce's assertion that the United States continues to seek a means to control computers of the greatest strategic importance.

5. This comment acknowledges that Commerce used market conditions as the sole criterion for changing the control thresholds for high performance computers. The act also requires an assessment of how these powerful computers could enhance the military capabilities of countries of concern or affect U.S. national security interests. These topics were not addressed in the President's report.

6. We disagree. The practical effect of raising the U.S. license exception level to 190,000 MTOPS is to raise the control threshold to this level since computers below this level (190,000 MTOPS) do not require an export license. Further, according to Commerce officials, not all Wassenaar members have license exception provisions in their regulations. Consequently, a disparity exists between U.S. licensing requirements and the control thresholds used by other Wassenaar member countries, as we noted in our report. Finally, according to State Department officials and official documents we reviewed, other Wassenaar members complained that the United States unilaterally increased its export control threshold by raising the licensing exception level to 190,000 MTOPS.

7. Commerce and Defense officials responsible for preparing the President's December 2001 report confirmed that the effort to formally change the licensing threshold and prepare the justification was prompted by the letter from industry.

8. Commerce data indicate that there are more than 700 outstanding post-shipment verifications that have not been conducted in China.

9. When implemented, the Department of Commerce's effort to "red flag" persons for which it has not been able to conduct prelicense checks or post-shipment verifications may prove to be a useful first step in improving its ability to counter problems associated with conducting checks and verifications.

Comments from the Department of Defense

POLICY

OFFICE OF THE UNDER SECRETARY OF DEFENSE
2000 DEFENSE PENTAGON
WASHINGTON, DC 20301-2000

JUL 8 2002

Mr. Joseph A. Christoff
Director, International Affairs and Trade
U.S. General Accounting Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Mr. Christoff:

This responds to the GAO draft report, "Export Controls: More Thorough Analysis Needed to Justify Changes in High Performance Computer Controls," dated June 25, 2002 (GAO Code 320102/GAO-02-892).

Consistent with GAO's recommendation and the provisions of the National Defense Authorization Act for Fiscal Year 2000, the Department of Defense, in consultation with the Central Intelligence Agency, the National Security Council and others, is conducting a review of computer export controls including evaluating alternative metrics for measuring computer performance.

Thank you for the opportunity to comment on this draft report.

Sincerely yours,

Lisa Bronson
Deputy Under Secretary of Defense,
Technology Security Policy and
Counterproliferation

Comments from the Department of State

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

United States Department of State

Washington, D.C. 20520

JUL 19 2002

Dear Ms. Westin:

We appreciate the opportunity to review your draft report, "EXPORT CONTROLS: More Thorough Analysis Needed to Justify Changes in High Performance Computer Controls," GAO-02-892, GAO Job Code 320102.

The Department's comments are enclosed for incorporation, along with this letter, as an appendix to the GAO final report.

If you have any questions regarding this response, please contact Michael McCamman, International Economist, Bureau of NonProliferation on (202) 647-4724.

Sincerely,

Christopher B. Burnham
Assistant Secretary and
Chief Financial Officer

Enclosure:

As stated.

cc: GAO/IAT - Mr. Bruno
State/OIG - Mr. Berman
State/NP - MS. Burk

Ms. Susan S. Westin,
Managing Director,
International Affairs and Trade,
U.S. General Accounting Office.

Export Controls: More Thorough Analysis Needed to Justify Changes in High Performance Computer Controls (GAO code 320102).

Department of State Comments on GAO Draft Report:

We believe that the GAO report identifies several shortcomings in the analysis substantiating the conclusions of the President's 2002 report to Congress justifying a decision to raise the MTOPS level for export controls. While agreeing that there are some gaps in the study, the Department does not share the evident GAO view that these shortcomings invalidate the key finding that High Performance Computers can no longer be controlled effectively. Nor do we believe that the GAO comments related to "other important issues related to the decision to raise the threshold" fully reflect the factors and the degree to which the capabilities we seek to control for export are in fact now beyond effective control.

The GAO report points out that all but a very small percentage of DOD requirements are met by computers falling below export control limits, but does not proceed from that point to its implications for the nature of any continuing controls.

While GAO correctly points out the important nuclear applications for controlled computers, nuclear applications, and applications such as weapons design, do not require massive real-time processing capability to be accomplished effectively. The vast majority of such applications have been and continue to be do-able on uncontrolled computers, although it may take slightly longer than if a +190,000 MTOP mainframe is used. In this regard, the Los Alamos and Livermore National Laboratories have moved from centralized mainframe computers to distributed networks and are working to implement larger clustered systems, composed of generally-available workstations.

See comment 1.

GAO recommends continued analysis of alternative control metrics other than MTOPS, a matter the Executive Branch agencies and industry groups have been investigating for over 15 years. The general consensus among other experts, both industry and government, is that adjusted Gflops has the same problems as MTOPS. Industry experts state that adjusted Gflops would introduce bias among existing

technical approaches to advanced computing capacity, favoring some vendors over others. For this reason and others, it has already been established that a control approach based on adjusted Gflops would be unacceptable to Wassenaar Arrangement (WA) partners.

GAO points out that some countries of concern have encountered problems in clustering smaller machines together to achieve greater computing power. It is argued that proprietary software and technology are often necessary to aggregate uncontrolled computers to the point where they could be considered directly comparable to a +190,000 MTOPS mainframe. This is true, but does not mean that those seeking to create clustered computing capability to perform tasks for which they cannot import larger machines will not achieve that objective successfully.

It is well established that clustered computers can provide functionally equivalent capabilities to those provided by controlled machines in the vast majority of applications, although there are a few algorithms that do not lend themselves to efficient performance via clustering. Ironically, some countries subject to the existing controls may be among the most adept at developing this type of software and technology.

See comment 2.

In summary, State accepts some of the GAO's critique of the procedures used in the analysis behind the 2002 Report to Congress, and agrees that U.S. law must be enforced. However, it is our view that the GAO's judgments on the substance of the regulatory question do not accurately reflect the reality that effective high performance computers are no longer controllable. The GAO's own examples illustrate this point. For this reason and as noted above, we do not agree with certain of the GAO recommendations.

See comment 3.

The following are GAO's comments on the letter from the Department of State dated July 19, 2002.

GAO Comments

1. We are encouraged that executive branch agencies continue to explore alternatives to the current MTOPS metric. We believe the results of this analysis should be shared with Congress.

2. We agree that some countries subject to the existing controls may be among the most adept at developing clustering software and technology. However, this point was not included in the President's report. The report simply stated that the impact of clustering will be assessed in the course of the executive branch's review of computer export controls.

3. While computer clustering complicates efforts to maintain effective export controls, this point was not used as the basis for raising the export control thresholds for high performance computers. Also, the executive branch continues to debate the extent that clustering has rendered the current export control system ineffective. An October 2001 Defense study found that clustered systems do not match the overall performance capabilities of the stand-alone systems supplied by U.S. vendors. This study concluded that foreign country's use of clustered systems should not be used as a justification for decontrolling all classes of high performance computers.

GAO Contact and Staff Acknowledgments

GAO Contact

Stephen Lord (202) 512-4379

Acknowledgments

In addition to the individual named above, David M. Bruno, Claude T. Adrien, and Lynn Cothern made key contributions to this report.

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