REPORT TO THE PRESIDENT

Review of the Networking and Information Technology Research and Development Program

Executive Office of the President
President's Council of Advisors on
Science and Technology

December 2024

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EXECUTIVE OFFICE OF THE PRESIDENT
PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY
WASHINGTON, D.C. 20502

President Joseph R. Biden, Jr.
The White House
Washington, D.C.

Dear Mr. President,

One of the strongest areas of U.S. leadership is in innovation and commercial growth in computing and communication technology. This broad area of research and development (R&D) has been a driver of our economy—and of striking societal changes—for several decades: consider the impacts of personal computers, the internet, and cellular phones. Investments made by the U.S. government in previous decades provided the foundation for unprecedented commercial investments in networking and information technology (NIT) in the past few years. Federal R&D in NIT is as relevant today as it ever has been with the explosive growth of large language models and artificial intelligence (AI).

The Networking and Information Technology Research and Development (NITRD) Program was established by legislation to foster U.S. leadership in NIT areas over 30 years ago, with the goal of coordinating NIT R&D activities across the Federal Government. Subsequent legislation mandated three-year independent reviews of the NITRD Program to be prepared for Congress by an advisory committee to be established by the President, and since 2005 the President has designated the President's Council of Advisors on Science and Technology (PCAST) to provide these reviews. For the following report, we convened a working group drawn from academia and industry and met with relevant government actors across the agencies as well as within the NITRD coordinating office.

The first question in a review of any 30-year-old program is whether it is still serving an important function and serving it well. We are pleased to be able to report our first finding, that the NITRD program continues to be useful and cost-effective. We are, in fact, impressed by the value that the NITRD program continues to provide. Our report goes on to recommend improvements and updates that can allow NITRD to reach more of the government entities that it should support, and also to play its needed role in the rapid and dramatic developments raised by the current "special moment of AI."

NITRD is playing an invaluable role in one of the more important areas of R&D for our nation. Federal investments are maintaining and building the leadership of the United States in a key component of our collective future. Coordination of the cross-government investments in networking and information technology R&D is essential to ensure that this crucial technology area serves public sector needs while also providing a foundation for future private sector growth. We are enthusiastic about the prospects for NITRD's work, and hope that our report will help inform its next stages.

Sincerely,

Your President's Council of Advisors on Science and Technology

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Executive Summary

In 1991, Congress passed the High-Performance Computing Act (P.L. 102-194) to support national-level R&D coordination in the field of computing and communications technology by establishing what is now known as the Networking and Information Technology Research and Development (NITRD) Program. Current statute (15 USC 5501 et seq.) calls for periodic review of program functions and structure, responsibility for which has been delegated to the President's Council of Advisors on Science and Technology (PCAST). This report constitutes PCAST's independent review of the NITRD Program.

For over three decades, the NITRD Program has played a crucial role in the coordination of networking and information technology (NIT) research and development (R&D). The NITRD Program has remained an exemplar of effective government coordination by serving as a valuable forum for advancing federally funded NIT R&D. NITRD Program entities— including the NITRD National Coordination Office (NCO), the National Science and Technology Council NITRD Subcommittee (SC) and its respective Interagency Working Groups (IWGs)—facilitate interagency convenings and provide central points of contact for agencies to coordinate their NIT-related R&D activities. The NITRD NCO also produces an annual budget report that identifies federal agency R&D investments in various areas of NIT, with budget trends broken down into NITRD Program-specific budget categories (called program component areas) and facilitates the development of strategy documents by NITRD entities.

While the NITRD Program is effective, PCAST sees opportunities to strengthen and improve its activities to provide an even greater positive impact for the Nation in this time of remarkable technological change. PCAST has identified the following nine findings and seven recommendations for revitalizing the Program while continuing to ensure that federal NIT R&D resources are effectively stewarded.

Findings

Finding 1: The NITRD program continues to be useful and cost-effective.

Finding 2: The NITRD NCO's communication strategy, its products, and their cadence, are not always well matched to the existing or potential customer base.

Finding 3: The NITRD NCO has over time become too narrow in its outreach.

Finding 4: The NITRD program and NCO are missing opportunities to:

A. Provide meaningful benefit to a broader customer base of federal officials, including those in the budgeting process and those making informed technology acquisition decisions;
B. Connect a broader set of stakeholders from academia and industry to NIT R&D efforts;
C. Serve as a resource and institutional memory (including across agencies and across administrations) for a broader range of customers and programs than at present.

Finding 5: The inherent inertia of the interagency process leads to PCAs that more resemble the state-of-the-art in information technology a decade ago than what would today best serve the purposes of the NITRD Program's authorizing legislation as forward-looking guidance.

Finding 6: Budget reporting via the PCAs could be made more meaningful by creating sub-categories that clarify different uses of NIT.

Finding 7: The NSTC NITRD IWGs are valuable. They would benefit from greater flexibility in their number, definitions, and lifetimes, more like the present FTACs and CoPs and less tied (even if only implicitly) to the PCAs. This shift would also free up the PCAs for redefinition towards more strategic and modern definitions.

Finding 8: AI's long-term societal significance could be comparable to the invention of the internet, and greater than high-performance computing was in its time—the original impetus for founding NITRD.

Finding 9: We believe an opportunity exists for NITRD to contribute to, and in some cases lead, activities being undertaken government-wide in response to the Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence.

Recommendations

Recommendation 1. The NITRD NCO should undertake a structured review of its existing report products to improve the cadence and level of detail to better match the needs of current and prospective customers.

Recommendation 2. The NITRD NCO should construct and execute a multi-pronged plan aimed at expanding its customer base, by:

A. **Identifying current customers and surveying them as to how NITRD Program convenings and written products can more effectively meet their needs.**
B. **Reaching out to potential new customers and stakeholders, educating them about the NITRD Program, and exploring how NITRD products (existing or new) might help them in meeting their responsibilities.**
C. **Identifying appropriate metrics of success, for example, requests for information/meetings, web hits, etc.**

Recommendation 3. The NCO should develop a list of convenings of executive branch entities (councils, committees, etc.) working in the areas of information technology and data science, and should assess where NITRD might contribute present and future institutional memory and R&D perspective by being, even if silently, "in the room." NITRD should reach out to those entities and propose mutually beneficial interactions.

Recommendation 4. The NITRD NCO should utilize its statutory authority to undertake a zero-base refresh of the PCAs. The new PCAs should be future-looking and encourage agency R&D

both on and using today's and tomorrow's most relevant technologies, while also making PCAs more useful as budget-reporting categories for policymakers.

Recommendation 5. Agencies' budget reporting against the PCAs should, for each PCA, give the breakdown of its dollar amount into four subcategories:

- **A. R&D on that PCA, i.e., advancement of that PCA as a subfield of information and data science and technology.**
- **B. R&D using that PCA to advance the agency's mission.**
- **C. Infrastructure investment, exclusive of operating expenses, that support that PCA.**
- **D. Infrastructure operational expenses that support that PCA.**

Recommendation 6. The NITRD NCO and NSTC NITRD Subcommittee should clearly separate the organization of their convening efforts (IWGs, FTACs, and CoPs) from the definition of the PCAs. The number, definitions, and lifetimes of all the convenings should be flexible, variable, and customer-driven.

Recommendation 7. The activities of NITRD entities should more specifically address the "special moment of AI." The NITRD NCO should reach out to increase its involvement with, and usefulness to, the plethora of new federal activities in AI, augmenting or leading as appropriate.

Introduction

Overview of the NITRD Program

The Networking and Information Technology Research and Development (NITRD) Program is a whole-of-government effort to foster R&D in networking and information technology (NIT) and ensure continued U.S. leadership in NIT. PCAST notes that information technology is as important today as it has ever been and overall has concluded that the NITRD program continues to provide essential coordination of NIT efforts. The NITRD Program exists to provide a coordinated approach to managing the (NIT) R&D activities funded by the Federal Government but largely performed by academic, non-profit, and private sector research organizations that are outside the federal government. The NITRD Program is not funded through a dedicated, direct appropriation. Given the breadth and importance of NIT efforts across federal agencies, NITRD Program R&D activities are instead funded out of agencies' regular appropriations. Agencies determine which of their R&D funding and efforts are part of the NITRD Program, report such funding, and commit proportional amounts to fund the program's administrative costs.[1]

Several entities coordinate NITRD Program activities, including the National Science and Technology Council (NSTC)'s Subcommittee on NITRD (under the Committee on Science and Technology Enterprise) and the NITRD National Coordination Office (NCO). Under this general umbrella, there are also multiple interagency working groups (IWGs), fast-track action committees (FTACs), and communities of practice (CoPs), labeled by NIT focus area.[2]

Collectively, NITRD Program entities provide strategic guidance and management for interagency activities, and implement strategic planning, workshops, and reporting that advance a whole-of-government approach to NIT R&D. The relationships developed through the NITRD Program promote beneficial information sharing and programmatic coordination across NITRD Program participating agencies. NITRD Program entities also track funding in NIT R&D topic areas over time, which enables individual agencies and NITRD Program entities to identify opportunities for cross-agency synergies and potential gaps or duplication in the Federal NIT R&D portfolio. In addition to agencies that are formal members of NITRD (and contribute to its funding), non-member agencies participate in some NITRD activities.

Statutory Authority

The NITRD Program was originally established under the High-Performance Computing Act of 1991 (P.L. 102-194), the first comprehensive U.S. Government plan for coordination of R&D programs in high-performance computing and networking.[3] Subsequent legislation expanded reporting requirements for federal agencies and broadened the NITRD Program's focus to include

[1] Correspondence with NITRD NCO director and U.S. NITRD Program (November 2024). About NITRD.
[2] U.S. NITRD Program (November 2024). Coordination Areas.
[3] U.S. NITRD Program (November 2024). HPCC/NITRD Program Authorizing Legislation. 102nd Congress. (December 9, 1991). Public Law 102-194. High-Performance Computing Act of 1991.

cybersecurity and more clearly defined areas of NIT.[4] PCAST's overall assessment is that the NITRD program continues to add significant value as it has for more than 30 years.

Since 1998, the President has been required by law to establish an advisory committee on NIT to provide "an independent assessment of progress made in implementing the Program; the need to revise the Program; the balance between the components of the Program, including funding levels for the Program Component Areas; whether the research and development undertaken pursuant to the Program is helping to maintain United States leadership in networking and information technology," and other issues. The advisory committee is also charged with evaluating the NITRD Program on areas such as "the funding, management, coordination, implementation, and activities" of the Program, and to report every three years to Congress its findings and recommendations for the Program.[5]

Since 2005, the President has designated the President's Council of Advisors on Science and Technology (PCAST) to serve as the independent advisory committee for NITRD Program reviews.[6] This report fulfills the statutory requirement for independent review of the NITRD Program.

Program Component Areas (PCAs)

Program component areas (PCAs) are the NITRD-defined budget areas used to categorize and summarize Federal R&D investment in NIT. PCAs have been a required feature of the NITRD budget reporting process since program establishment and provide a way to track classes of investment and facilitate cross-agency and longitudinal portfolio comparisons. In comparison, Interagency Working Groups (IWGs) are forums for agency coordination of projects and activities. The PCAs are related to, but do not have a one-to-one correspondence with, the IWG focus areas. This decoupling was recommended by PCAST in its 2010 NITRD Review to enable PCAs and IWGs to evolve independently to best serve their distinct purposes. Prior to 2015, the PCA focal areas had not changed since the establishment of the NITRD Program in the 1990s. Subsequent to PCAST's 2013 and 2015 reviews of NITRD, which recommended updating the PCAs to reflect the contemporary landscape of NIT R&D, several out-of-date PCAs were retired or refocused (and accordingly renamed) and some Federal

[4] 105th Congress. (October 28, 1998). Public Law 105-305, The Next Generation Internet Research Act of 1998. 110th Congress. (August 9, 2007). Public Law 110-69, America COMPETES Act of 2007. 114th Congress. (January 6, 2017). Public Law 114-329. American Innovation and Competitiveness Act of 2017.

[5] 102nd Congress. (December 9, 1991). Public Law 102-194. High-Performance Computing Act of 1991. 105th Congress. (October 28, 1998). Public Law 105-305, The Next Generation Internet Research Act of 1998. 110th Congress. (August 9, 2007). Public Law 110-69, America COMPETES Act of 2007. 114th Congress. (January 6, 2017). Public Law 114-329. High-Performance Computing Act Amended.

[6] 109th Congress. (September 29, 2005). Executive Order 13385. Continuance of Certain Federal Advisory Committees and Amendments to and Revocation of Other Executive Orders.

R&D activities were moved from one PCA to another.[7, 8] In addition, the fiscal year (FY)2025 PCA definitions have a number of intersections with the Artificial Intelligence (AI) PCA.[9]

As of FY 2025, which began Oct. 1, 2024, there are 12 PCAs (also shown below in Figure 1):

1. Advanced Communication Networks and Systems (ACNS)
    a. [Sub-PCA] Advanced Wireless R&D (AWRD)
2. Artificial Intelligence (AI)
3. Computing-Enabled Human Interaction, Communication, and Augmentation (CHuman)
4. Computing-Enabled Networked Physical Systems (CNPS)
5. Cyber Security and Privacy (CSP)
6. Education and Workforce (EdW)
7. Electronics for Networking and Information Technology (ENIT)
8. Enabling R&D for High-Capability Computing Systems (EHCS)
9. High-Capability Computing Infrastructure and Applications (HCIA)
10. Intelligent Robotics and Autonomous Systems (IRAS)
11. Large-Scale Data Management and Analysis (LSDMA)
12. Software Productivity, Sustainability, and Quality (SPSQ)

National Science and Technology Council (NSTC) Subcommittee on NITRD

The NSTC is a Cabinet-level council that serves as a key mechanism for the President to coordinate science and technology policies across the federal government. Appropriately, the NITRD Subcommittee is composed of senior representatives from 25 Federal agencies and departments that conduct or support R&D in advanced NIT.[10] It also includes representatives of the White House Office of Science and Technology Policy (OSTP) and the White House Office of Management and Budget (OMB). While not all federal agencies are NITRD Program members, more than 80 agencies participate in NITRD Program activities.[11] In order to coordinate NIT R&D policy across the Federal R&D enterprise and ensures consistency with the President's stated goals, the NITRD Subcommittee is co-chaired by the Director of the NITRD NCO, who is a member of the OSTP staff, as well as an OSTP-designated representative from among the NITRD member agencies, currently the Deputy Assistant Director of the National Science Foundation's (NSF's) Computer and Information Science and Engineering (CISE) Directorate.[12]

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[7] PCAST Report to the President and Congress. (January 2013). Ensuring Leadership in Federally Funded Research and Development in Information Technology.
[8] PCAST. (August 2015). Report to the President and Congress. Ensuring Leadership in Federally Funded Research and Development in Information Technology.
[9] U.S. NITRD Program (November 2024). Program Component Areas.
[10] Subcommittee on Networking & Information Technology Research & Development and the Machine Learning & Artificial Intelligence Subcommittee. (November 2023). The Networking & Information Technology R&D Program and the National Artificial Intelligence Initiative Office: Supplement to the President's FY 2024 Budget.
[11] Ibid.
[12] U.S. NITRD Program (November 2024). NITRD Subcommittee and Group Co-chairs.

NITRD National Coordination Office (NCO)

The NITRD NCO is the NITRD Program's central point of contact and provides technical expertise, as well as planning, budgeting, and coordination support. The NITRD NCO also oversees development of the annual NITRD supplement to the President's budget, which describes the funding of various R&D initiatives deemed part of the NITRD Program, classified by agency and by program component area (PCA).[13] The NITRD NCO also maintains an array of additional resources, including the AI Research Program Repository, the AI R&D Testbed Inventory, the Federal High End Computing Information Portal, the STEM Portal, and more.[14] As of FY 2025, the NITRD NCO is currently staffed by 17 personnel, including the NITRD NCO Director (appointed by the director of OSTP), program managers, technical coordinators, financial analysts, and other staff.[15] The NITRD NCO is funded through a portion of the individual budgets of NITRD Program participating agencies, calculated using a dedicated formula based on past NITRD Program expenditures.

Interagency Working Groups (IWGs) and Fast-Track Action Committees (FTACs)

The NITRD interagency working groups (IWGs) are the primary mechanism for agencies to coordinate on NIT R&D. IWGs generally meet monthly to share information, coordinate agency R&D activities, and develop technical strategic plans, such as the National AI R&D 2023 Strategic Plan Update.[16] The 11 current IWGs engage the 80 agencies that participate in the NITRD Program.[17] Current IWGs (also shown in Figure 1) include:

1. Artificial Intelligence IWG (initiated in FY2020)
2. Big Data IWG
3. Computing-Enabled Networked Physical Systems (CNPS) IWG
4. Cybersecurity and Information Assurance (CSIA) IWG
5. Digital Health Research and Development (DHRD) IWG
6. High End Computing (HEC) IWG
7. Information Integrity Research and Development (IIRD) IWG
8. Intelligent Robotics and Autonomous Systems (IRAS) IWG (FY2022)
9. Large Scale Networking (LSN) IWG
10. Privacy R&D IWG
11. Wireless Spectrum R&D (WSRD) IWG

[13] U.S. NITRD Program (November 2024). NITRD National Coordination Office.
[14] U.S. NITRD Program (November 2024). NITRD Publications – Reference Materials.
[15] U.S. NITRD Program (November 2024). NITRD Staff and Personnel.
[16] Select Committee on Artificial Intelligence of the National Science and Technology Council. (May 2023). National Artificial Intelligence Research and Development Strategic Plan 2023 Update.
[17] Subcommittee on Networking & Information Technology Research & Development and the Machine Learning & Artificial Intelligence Subcommittee. (November 2023). The Networking & Information Technology R&D Program and the National Artificial Intelligence Initiative Office: Supplement to the President's FY 2024 Budget.

Figure 1. Mapping of NITRD Program Component Areas to NITRD Groups.

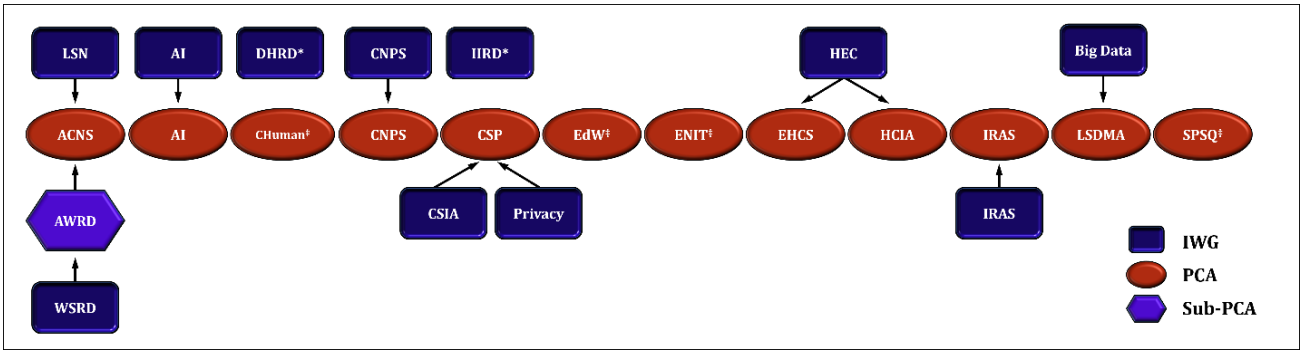

Figure 1. Mapping of NITRD Program Component Areas to NITRD groups as of FY 2024. Although the IWGs are not in one-to correspondence with the PCAs, there is a close relationship. The DHRD and IIRD IWGs are affiliated with multiple PCAs. The CHuman, EdW, ENIT, and SPSQ PCAs do not have coordinating IWGs; agencies that invest in R&D in these areas currently do so within other IWGs.

Fast-Track Action Committees (FTACs) are similar to IWGs but created to streamline an urgent effort.[18] There are currently two active FTACs: Cyber-Physical Systems Resilience and Digital Twins R&D.

Current FTACs:

1. Cyber-Physical Systems Resilience FTAC (CPSR)
2. Digital Twins R&D FTAC (DT)

The NITRD Program also maintains a few Communities of Practice (CoPs) which involve greater multi-sector stakeholder engagement but function similarly to IWGs. There are currently three CoPs.

Current CoPs:

1. Joint Engineering Team COP (JET, affiliated with LSN IWG)
2. Middleware and Grid Interagency Coordination COP (MAGIC, affiliated with LSN IWG)
3. Software Productivity, Sustainability, and Quality COP (SPSQ)

NITRD Funding by Agency

Twenty-four agencies are formal members of the NITRD Program[19] and participate in NITRD budget analyses. The total requested budget for NITRD program activities in FY 2024 was $10.91 billion. PCAST found it instructive to consider the Program Component Areas associated with funding from the five agencies that contribute the core (almost 80%) of NITRD budget, illustrated in Figure 2. PCAST found that it is difficult to differentiate between spending on research *on* a topic area vs. budget spent on research *using* that NITRD topic. Consider, for instance, budget for Large-Scale Data

[18] U.S. NITRD Program (November 2024). NITRD Coordination Areas.
[19] U.S. NITRD Program (November 2024). NITRD About.

Management and Analysis (LSDMA), which is the largest PCA category for the National Institutes of Health (NIH). It is unclear to what extent the NIH investments in LDSMA are primarily R&D that *uses* of large data sets to understand important health trends that impact Americans or R&D on *how to use or design* LSDMA systems. Similarly, it is unclear if LDSMA investments by the National Science Foundation (NSF), a primary funder of basic research in computer science, are primarily directed toward basic research on ways to improve and enhance LSDMA systems.

PCAs have evolved over time, particularly following the PCAST review recommendation in 2015 that they be updated to reflect the contemporary landscape of NIT research. Because PCAs are also a useful tool to track spending allocations over time, the new PCAs have been mapped to what was most similar in the prior set, as shown in Figure 3.

Figure 2: FY 2024 Requested Funding for the Top 5 Member Agencies Contributing to the NITRD Program Connected to their Associated Program Component Areas.

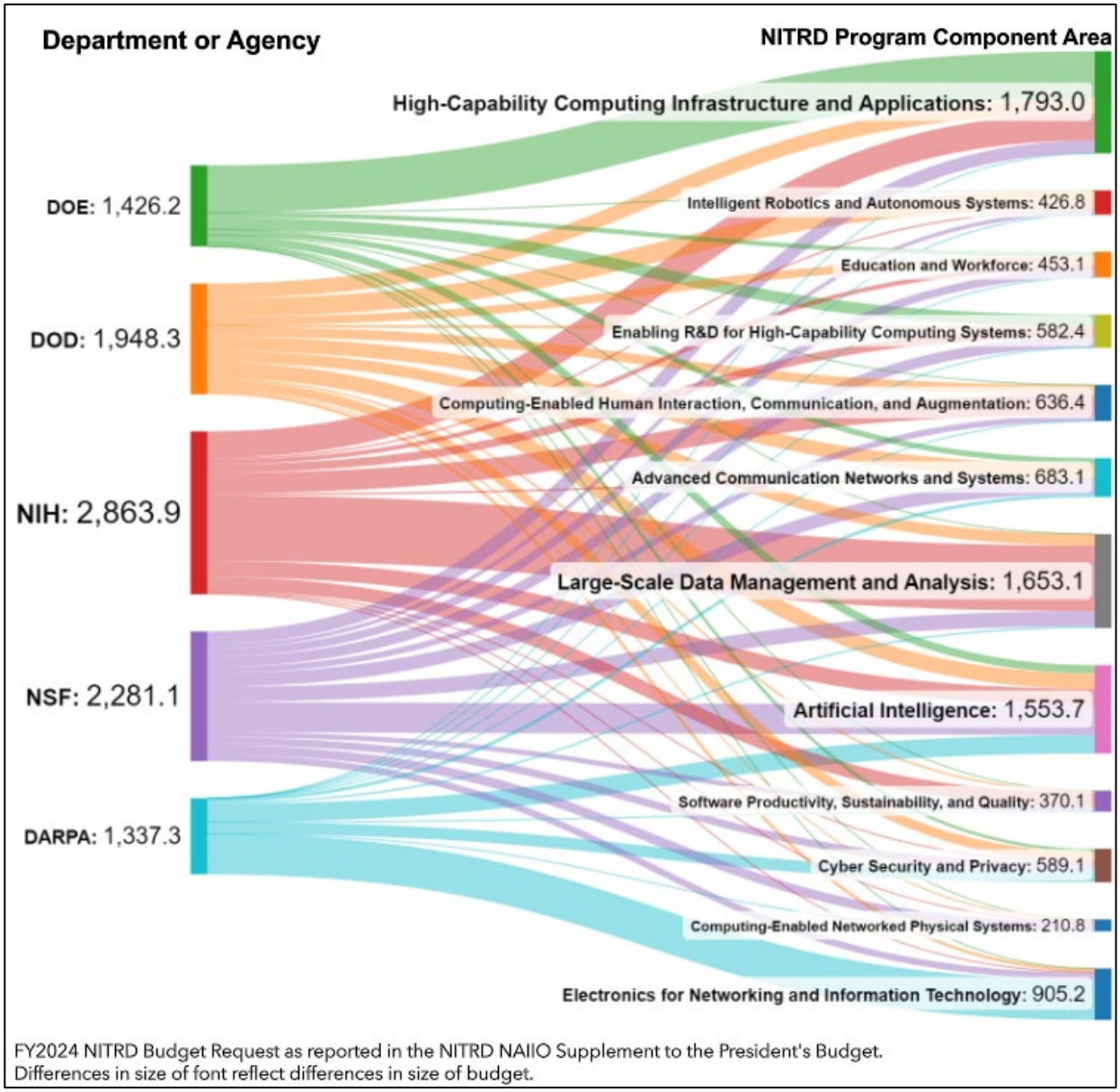

Figure 2: Shown in millions of dollars are the Top 5 member agencies contributing to the NITRD program, connected to their associated Program Component Areas. These agencies contribute the core (almost 80%) of NITRD budget. (DOE levels include the National Nuclear Security Administration.) The total FY 2024 NITRD budget request was $10,900 million.

Agencies listed include: Department of Energy (DOE), Department of Defense (DoD), National Institutes of Health (NIH), National Science Foundation (NSF) and Defense Advanced Research Projects Agency (DARPA)

Figure 3: Budget Allocation by PCA Since 2010 in Millions of Constant FY 2023 Dollars.

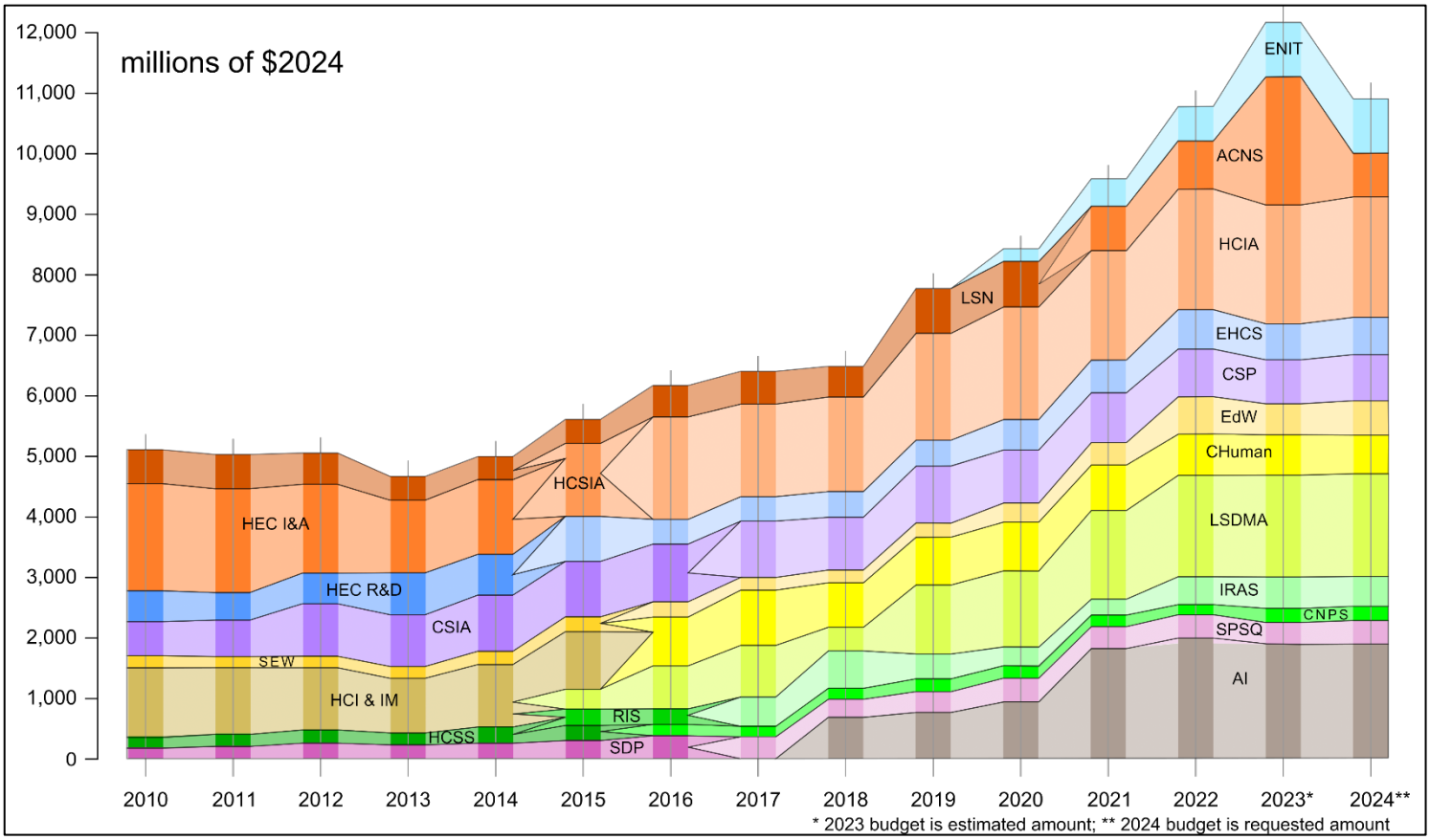

Figure 3: Budget allocation by PCA since 2010 in millions of constant FY 2023 dollars.

Current PCAs: ACNS: Advanced Communication Networks and Systems; AI: Artificial Intelligence; CHuman: Computing-Enabled Human Interaction, Communication, and Augmentation; CNPS: Computing-Enabled Networked Physical Systems; CSP: Cyber Security and Privacy; EdW: Education and Workforce; ENIT: Electronics for Networking and Information Technology; EHCS: Enabling R&D for High-Capability Computing Systems; HCIA: High-Capability Computing Infrastructure and Applications; IRAS: Intelligent Robotics and Autonomous Systems; LSDMA: Large-Scale Data Management and Analysis; SPSQ: Software Productivity, Sustainability, and Quality.

Pre-2016 PCAs: CSIA: Cyber Security and Information Assurance; HCI & IM: Human-Computer Interaction and Information Management; HCSIA: High-Capability Computing Systems Infrastructure and Applications; HCSS: High Confidence Software Systems; HEC I&A: High End Computing Infrastructure and Applications; HEC R&D: High End Computing R&D; RIS: Robotics and Intelligent Systems; SDP: Software Design and Productivity; SEW: Social, Economic, and Workforce.

Observations, Findings, and Recommendations

The NITRD Program's Effectiveness and the Need for Communication Improvements

The NITRD program is a useful, cost-effective mechanism within the Executive Branch, fostering cross-agency intellectual exchange in the rapidly evolving fields of networking and information technology. For over three decades, the program has managed to stay relevant, a testament to the dedication and effective leadership of the NITRD National Coordination Office (NCO). The NCO has consistently maintained the program's momentum, ensuring that it continues to play a valuable role in promoting collaboration and innovation among a broad array of federal agencies.

Finding 1: The NITRD program continues to be useful and cost-effective.

PCAST is impressed by the value that the NITRD program continues to provide, promoting both broad and strategic cooperation among the many agencies responsible for research and development in NIT areas. Agencies report broad satisfaction with the overall coordination efforts and indicate that their financial support for the NCO is valuable. PCAST has been impressed by the staff from many agencies working to develop and implement NITRD efforts and the overall quality of strategic thinking in the NITRD Program's many products. However, despite the Program's overall success, PCAST sees opportunities for it to be strengthened. The NITRD NCO's outward communication strategy has not evolved to fully meet the needs of its current and potential customer base.[20] In any program as longstanding as NITRD, the natural tendency is to develop "templates" for meeting periodic deadlines, such as the preparation of report products. Templates become a status quo that is hard to break out of. Currently, the cadence and level of detail in the NITRD NCO's reporting products are not always aligned with the priorities of federal officials, including policymakers and budget planners, who rely on these reports to make informed decisions. For example, the present cadence of updating strategic plans and corresponding progress reports only every three years is not well matched to the rapid progress of NIT research or the needs of an annual budget cycle. Although the NCO produces many valuable documents, their scope and timing could be improved to provide more actionable and timely insights for those who shape federal policies and allocate resources. This misalignment with customer needs diminishes the impact of NITRD Program activities and NITRD entities' work, limiting its potential benefits for both current users a broader range of federal stakeholders.

Finding 2: The NITRD NCO's communication strategy, its products, and their cadence, are not always well matched to the existing or potential customer base.

To improve their communication strategy, we recommend that the NITRD NCO undertake a thorough review of its reporting products. Such a review should assess the intended audiences of each, the scope of content, the cadence of publication, and the level of detail provided. Based on this review,

[20] Here we use the term customer to include both direct beneficiaries of NITRD products and activities and also other, indirect, stakeholders.

the NCO should make adjustments that would better serve both its existing customers and potential new stakeholders, ensuring that its work is both relevant and timely for those making critical decisions in networking and information technology across the federal landscape.

Recommendation 1. The NITRD NCO should undertake a structured review of its existing report products to improve the cadence and level of detail to better match the needs of current and prospective customers

Some efforts to improve communications between NITRD and relevant stakeholders appear to already be underway, with the NITRD NCO having already identified customer priorities such as shortening the budget supplement document and focusing that document more on outcomes/impacts, coordination activities, and demonstrating alignment with administration and congressional R&D priorities. PCAST is particularly pleased by the NITRD NCOs plan to develop a program inventory for the more in-depth content currently included in the budget supplement. It appears likely that such an online repository can provide better value if it can include more up-to-date information that is easier to search and filter. An additional suggestion would be to provide short, frequent, "at a glance" reports that are stand-alone but supported by the larger, more comprehensive reports.

Expanding the NITRD National Coordination Office's Reach and Role as a Federal Resource

While the NITRD program has long proven its usefulness, the NITRD NCO has, over time, become too confined in its outreach. Its scope has become too narrow, or even insular, limiting its potential to engage with a wider range of federal officials and stakeholders. This narrowing of focus has resulted in missed opportunities for the NCO to broaden its influence and provide more comprehensive benefits to key decision-makers involved in budgeting and technology acquisition. For instance, NITRD insights on high performance computing or AI could more effectively inform acquisition of tools or services in those areas by agencies with less expertise in these topics. By reaching beyond its current customer base, the NCO could enhance its role as a valuable resource across the federal government.

We note also the sparsity of the NCO's outreach, for guidance on NIT R&D priorities, to industry, to academia, to other parts of OSTP, to a relevant subset of OMB examiners, and to other federal computer-related programs. Outreach to participate in workshops and other activities could also include stakeholders such as emerging research institutions, minority serving institutions, early-career researchers, and others not currently well-engaged in NITRD efforts. For this, a relevant point of comparison is the new (and therefore template-free) National Artificial Intelligence Research Resource (NAIRR) pilot, which has been aggressive in outreach to many of these stakeholder constituencies.[21]

[21] Establishment of the NAIRR proposed in legislation: 118th Congress. (July 31, 2024) S.2714. CREATE AI Act of 2023.

Finding 3: The NITRD NCO has over time become too narrow in its outreach.

To be clear, we do not mean that NCO outreach is narrow in the sense of touching too few agencies—the list of participating agencies remains impressively large. Rather, the NCO seems to view its customers within each of those agencies as comprising largely those tasked with the essentially bureaucratic process of providing figures for the PCA budget rollup, plus those serving as agency representatives to the NITRD Subcommittee of the NSTC (including members of IWGs, FTACs, and CoPs).

But a significant missed opportunity lies in the NITRD NCO's potential to provide meaningful benefits to federal officials outside of this immediate circle, especially those involved in budgetary decisions and technology acquisition processes. These officials could gain greatly from the NCO's insights into cutting-edge developments in networking and information technology, aiding them in identifying priorities and timelines for future technology acquisition.

In engineering, a flywheel is a device that maintains the momentum of connected machinery even when the primary source of power fluctuates. In similar fashion, the NITRD NCO could help to stabilize the progress of numerous IT-related programs across federal agencies, across administrations, and through changing leadership. Serving as an active repository of institutional memory, the NITRD NCO could help ensure that lessons learned, best practices, and institutional knowledge are not lost with changes in leadership or policy direction. This important flywheel function exists but could be more fully realized.

PCAST recognizes that the NITRD Program's charter extends to R&D only, while the preponderance of federal computing is operational. However, there is more to this story. The 25 NITRD member agencies, plus many additional agencies that participate, do not all have R&D missions or authorities. It seems safe to say that all federal agencies make IT acquisitions that would benefit from their being "smart buyers" who are informed as to the state of IT R&D (especially the "D"). Indeed, the line between development and operational use can be a blurry one in so rapidly changing a field.

Finding 4: The NITRD Program and NCO are missing opportunities to:

A. **Provide meaningful benefit to a broader customer base of federal officials, including those in the budgeting process and those making informed technology acquisition decisions;**
B. **Connect a broader set of stakeholders from academia and industry to NIT R&D efforts;**
C. **Serve as a resource and institutional memory (including across agencies and across administrations) for a broader range of customers and programs than at present.**

To rectify these shortcomings, we recommend that the NCO adopt a two-pronged strategy aimed at expanding its customer base. First, the NITRD NCO should conduct a survey of its current customers to better understand how its convenings and written products could more effectively serve their needs. By engaging directly with these customers, the NITRD NCO can tailor its offerings to be more relevant and impactful.

Second, the NITRD NCO should reach out to potential new customers, educating them on the benefits of NITRD Program products and convenings, and exploring how these offerings—whether existing or new—can be adapted to support their specific responsibilities. This outreach would not only increase awareness of the NITRD Program and NITRD entities' work, but also help to ensure that its products are as useful and relevant as possible across and beyond the federal landscape.

Inside and outside of government, there are important trends toward greater democratization of science in the sense of more public participation in, and also more public scrutiny of, the established scientific infrastructure. In keeping with PCAST's letter to the President on public engagement with science, we note that this is another direction in which a revitalized NITRD NCO could engage and have positive impact.[22]

Recommendation 2. The NITRD NCO should construct and execute a multi-pronged plan aimed at expanding its customer base, by:

- **A. Identifying current customers and surveying them as to how NITRD Program convenings and written products can more effectively meet their needs.**
- **B. Reaching out to potential new customers and stakeholders, educating them about the NITRD Program, and exploring how NITRD products (existing or new) might help them in meeting their responsibilities.**
- **C. Identifying appropriate metrics of success, for example, requests for information/meetings, web hits, etc.**

Additionally, to strengthen its role as a consistent and knowledgeable presence in the federal information technology ecosystem, the NITRD NCO should assess where it might contribute institutional memory and R&D perspective by being present, even primarily as an observer, in key meetings and discussions. Specifically, the NITRD NCO should develop a list of relevant convenings—such as federal councils, committees, and other decision-making bodies focused on data science and technology—and propose mutually beneficial interactions, including the exchange of information, where NITRD entities' long-term experience and knowledge can offer value.

Recommendation 3. The NCO should develop a list of convenings of executive branch entities (councils, committees, etc.) working in the areas of information technology and data science, and should assess where NITRD might contribute present and future institutional memory and R&D perspective by being, even if silently, "in the room." NITRD should reach out to those entities and propose mutually beneficial interactions.

Examples of convenings known to us that would benefit from NITRD presence include the federal Chief Information Officers' Council, the federal Chief Data Officers' Council, several Government Coordinating Councils (GCCs) of the Cybersecurity and Infrastructure Security Agency (CISA), the

[22] PCAST. Letter to the President. (August 2023). Advancing Public Engagement with the Sciences.

White House AI Council, the Federal Risk and Authorization Management Program (FedRAMP) Joint Authorization Board (JAB), the Office of the National Cyber Director (ONCD), and others. Other Congressionally chartered interagency coordination programs, such as the U.S. Global Change Research Program (USGCRP), are somewhat analogous to the NITRD Program and might also benefit from NITRD NCO outreach or provide advice on engagement strategies.

Define Future-Looking Program Component Areas as Part of an Ambitious NIT Agenda

The PCAs form a critical part of the NITRD framework, serving as the structural scaffolding for research and development in NIT across federal agencies. However, the PCAs appear to not reflect the current ecosystem of R&D in NIT. This could be due to an over-reliance on NSTC input, and the hesitance of NITRD member agencies to disrupt current record keeping processes. NITRD legislation wisely separated using the PCAs as instruments for affecting federal policy overall from requiring the participating agencies "through the National Science and Technology Council" to develop and implement strategic plans.[23, 24] These are closely related functions, but we observe that something valuable is lost if they are conflated.

The PCAs appear not to be as forward-looking as intended, instead reflecting sometimes-outdated priorities rather than serving as a mechanism to promote U.S. leadership in cutting-edge research and development. The major utility of the PCAs in their present form seems to be to provide an opportunity for agencies to highlight their roles in research on, or the use of, current information technology. What we propose is that more forward-looking PCAs could draw the agencies toward more truly cutting-edge technology.

We recommend that the PCAs should more clearly point towards the emerging challenges and opportunities that federal agencies should be preparing for in coming decades, striving to align strategically with future needs. For instance, in the context of artificial intelligence (AI), which has undergone significant transformations in recent years, the PCAs have not kept pace with the rapid development of technologies such as machine learning, computer vision, speech and natural language processing, and robotics, notwithstanding the existence of an AI PCA, and various mentions of AI in definitions of other PCAs. We hope that a more forward-looking set of PCAs could better guide federal investment and ensure that U.S. leadership in these areas is maintained and strengthened.

The PCA categories should clearly reflect the technologies that are shaping the present and future of NIT, offering a more future-focused framework for research and budgetary alignment.

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[23] 112th Congress. (January 7, 2011).15 U.S.C §5511. National High Performance Computing Program. (a)(2)(b): "establish Program Component Areas that implement the goals established under subparagraph (A), and identify the Grand Challenges that the Program should address"

[24] 112th Congress. (January 7, 2011). 15 U.S.C §5511.National High Performance Computing Program. (a)(2)(e): "develop and maintain a research, development, and deployment roadmap covering all States and regions for the provision of high-performance computing and networking systems under paragraph (1)(C);"

We note also the argument for keeping PCAs unchanged; that static PCAs allow better longitudinal tracking of federal spending over time. While that view has merit, history appears to show us that it results in PCAs and funding roll-ups that are less relevant than needed. While discontinuities in established time series should be introduced only rarely, PCAST believes that now is the right time to realign the NITRD PCAs.

Finding 5: The inherent inertia of the interagency process leads to PCAs that more resemble the state-of-the-art in information technology a decade ago than what would today best serve the purposes of the NITRD Program's authorizing legislation as forward-looking guidance.

To better ensure that the PCAs are truly driving progress in critical areas of research and development, we recommend a zero-base refresh of the PCAs without consideration of prior categories. The NCO should take the lead in this effort, focusing on redefining the PCAs to reflect today's most relevant technologies and assist budget-reporting to help policymakers understand where investments are being made and how they align with strategic national priorities.

Recommendation 4. The NITRD NCO should utilize its statutory authority to undertake a zero-base refresh of the PCAs. The new PCAs should be future-looking and encourage agency R&D both on and using today's and tomorrow's most relevant technologies, while also making PCAs more useful as budget-reporting categories for policymakers.

Related recommendations by PCAST in 2013, 2015, and 2021 resulted in some changes to the PCAs, but we judge that a more substantial refactoring is now needed.

We also recommend that NITRD entities reflect on the importance of social science in NIT R&D, both for improving adoption and adaptation of emerging technologies or cybersecurity practices, as well as for providing constructive critique and expanding public participation and scrutiny of technology development. NIT research has always included social science components implicitly, but the centrality of the social sciences to computing has gained increased visibility with advances in computer-mediated communication, big data, and AI. Current PCAs explicitly focus on trustworthy AI research, privacy (although not other social issues of importance, such as inclusion/exclusion and bias) in big data research, and computer-mediated human-human and computer-human interactions.

To achieve PCAs that are aligned with the broader policy objectives of the federal government and targeted toward the types of grand challenges indicated in the authorizing legislation,[25] the approval process for new or updated PCAs should focus more explicitly on keeping pace with technological advancements.

[25] 102nd Congress. (December 9, 1991). Public Law 102-194. High-Performance Computing Act of 1991. 105th Congress. (October 28, 1998). Public Law 105-305, The Next Generation Internet Research Act of 1998. 110th Congress. (August 9, 2007). Public Law 110-69, America COMPETES Act of 2007. 114th Congress. (January 6, 2017). Public Law 114-329. High-Performance Computing Act Amended.

Enhancing Budget Reporting through More Granular Categorization of Program Component Area Activities

The current approach to budget reporting through the PCAs provides a high-level overview of federal investments in NIT. However, this aggregated view often obscures important distinctions among the different types of activities funded under each PCA. As a result, policymakers and other stakeholders can find it difficult to gain a clear understanding of how federal dollars are being allocated and used within each agency and across agencies. More granular budget reporting would significantly enhance the utility of this information, allowing for a more precise alignment of investments with national priorities and help government better serve the public.

Finding 6: Budget reporting via the PCAs could be made more meaningful by creating sub-categories that clarify different uses of NIT.

We recommend that budget reporting for each PCA be broken down into four distinct categories. First, agencies should report on the funding directed toward R&D specifically aimed at advancing that particular PCA as a subfield of information and data science and technology. This would allow for a clearer understanding of the foundational research efforts that are contributing to technological progress in areas like artificial intelligence, cybersecurity, or high-performance computing.

Second, agencies should report on expenditures that apply a given PCA to advance their own specific R&D missions. For instance, research involving high-performance computing might be used by the National Institutes of Health (NIH) to accelerate biomedical discoveries, or by the Department of Defense (DoD) to enhance national security capabilities. This category would highlight the cross-disciplinary applications of NIT R&D.

Third, agencies should report on infrastructure investments related to each PCA, excluding ongoing operational expenses. Such reporting could include investments in major hardware systems, data centers, or other physical and digital infrastructure that support both R&D and operational activities.

Finally, a separate category should be reserved for infrastructure operational expenses. This would include the costs associated with maintaining and running existing infrastructure, distinguishing them from capital investments.

The current aggregation in reporting introduces obscuring distortions and deprives the budget rollups of much, if not most, of its potential usefulness to policy makers and to the budgeting process. As one example, NIH is, by dollars, the largest single member agency of the NITRD Program. This is because a significant fraction of all modern biomedical research utilizes high performance computing and/or big data management, and of course also because the overall NIH budget is so large. Less obviously, it is also because of NIH's effective use of keywords and information technologies to flag intramural and extramural research that fall under the rubric of each PCA. NIH should rightly take pride in both its scope of technology use and its identification of that scope. Nevertheless, it may not be accurate to argue that NIH should be considered by Congress or OMB as the leading agency supporting research and development on new networking and information technology tools. While

NIH undoubtedly has millions of data producers and data users working with the latest technologies, the current roll up does not tell us which agencies are funding research to develop *new* technologies—a role that many knowledgeable observers might assign jointly to a combination of NSF, DOE, and DoD.

Recommendation 5. Agencies' budget reporting against the PCAs should, for each PCA, give the breakdown of its dollar amount into four subcategories:

A. **R&D on that PCA, i.e., advancement of that PCA as a subfield of information and data science and technology.**
B. **R&D using that PCA to advance the agency's mission.**
C. **Infrastructure investment, exclusive of operating expenses, that support that PCA.**
D. **Infrastructure operational expenses that support that PCA.**

If categorizing spending under four sub-categories is too great an administrative burden for agencies initially, we recommend that the budget breakdown focus initially on differentiating between research advancing that PCA, versus spending on infrastructure for, and the use of, the topic of that PCA. PCAST supports the NCO plan to create an online program inventory of the information currently requested in the annual NITRD PCA data call. This planned effort appears likely to make budget data more accessible and useful to stakeholders and we hope will also allow them to be more frequently and rapidly updated.

Increasing Flexibility in Convening Activities and Program Component Area Definitions

The interagency working groups (IWGs), Fast Track Action Committees (FTACs), and Communities of Practice (CoPs) within the NITRD program have proven to be valuable mechanisms for fostering collaboration and coordination across federal agencies. These convenings provide essential forums for exchanging ideas, setting priorities, and advancing research and development in NIT. However, there is an opportunity to enhance the effectiveness of these groups by allowing greater flexibility in how they are organized, defined, and operated.

Currently, the number, topic area definitions, and lifetimes of these convening bodies too often remain tied by procedural inertia to the existing Program Component Areas (PCAs). The historical connection to PCAs limits the adaptability of these groups to evolving agency needs and the dynamic nature of NIT research. Greater flexibility in organizing these groups, similar to the approach used for FTACs and CoPs, would allow them to be more responsive to emerging challenges and opportunities. This, in turn, would free up the PCAs to be redefined in a more forward-looking and strategic manner, rather than remaining tethered to past structures

Finding 7: The NSTC NITRD IWGs are valuable. They would benefit from greater flexibility in their number, definitions, and lifetimes, more like the present FTACs and CoPs and less tied (even if only implicitly) to the PCAs. This shift would also free up the PCAs for redefinition towards more strategic and modern definitions.

We recommend that the NITRD NCO and the NSTC subcommittee take deliberate steps to separate the focus areas of NITRD convening activities—specifically IWGs, FTACs, and CoPs—from the definition of the PCAs. The number, definitions, and lifetimes of these groups should be flexible and variable, allowing them to be more directly driven by the needs of federal agencies and other stakeholders. PCAST appreciates that IWGs do not currently correspond directly to every PCA, but see greater opportunity for decoupling. As part of the assessment of customer needs recommended earlier, the NITRD NCO can identify convenings that will best achieve customer and stakeholder needs and adapt to the rapidly changing technological landscape.

As discussed under Recommendation 4, NITRD entities might also increase the representation of social scientists on the IWGs alongside traditional NIT expertise from participating agencies.

Recommendation 6. The NITRD NCO and NSTC NITRD Subcommittee should clearly separate the organization of their convening efforts (IWGs, FTACs, and CoPs) from the definition of the PCAs. The number, definitions, and lifetimes of all the convenings should be flexible, variable, and customer-driven.

We note that a similar recommendation by PCAST in 2010 resulted in some changes, but conclude that more fundamental change is needed. As defined earlier in this report, the term customer here includes both direct beneficiaries of NITRD products and activities as well as other, indirect, stakeholders.

Addressing the "Special Moment" of Artificial Intelligence

Artificial Intelligence (AI) is not a new field in computer science. Its roots go back to the 1950s, with Alan Turing's "Imitation Game." Over the years it has come to include a number of supporting subfields, some examples of which are:

- Machine Learning (ML), the rubric that provides the mathematical underpinnings of most of the field of AI
- Knowledge Representation and Reasoning, which provides useful information about the world that computers can use successfully to solve complex tasks
- Natural Language Processing, which enables computer systems to interpret and analyze text data so that users can communication with human-language-using machine learning models
- Computer Vision, which enables computer systems to interpret and analyze visual data such as digital images and videos and extract meaningful information
- Speech Production, Recognition and Analysis, which includes Text-to-Speech Synthesis (TTS) of speech from text, automatic speech recognition (ASR), speech translation between languages, and speech analysis
- Robotics, systems that intelligently interact with and adapt to the physical world

Some would add to this list, Artificial General Intelligence (AGI), which is the development of machines that possess general intelligence comparable to human cognitive abilities across a wide range of tasks. However, PCAST notes that this is not yet demonstrated.

Until quite recently, progress in all of these areas (except perhaps AGI) has been steady and incremental. Significantly, over the last decade, a class of ML techniques known as "deep learning," typified by so-called deep neural networks (DNNs) and large language models (LLMs), have gradually come to dominate almost all of the above subfields.

DNNs and LLMs can be scaled up almost without bound, limited only by hardware, power availability, and human developer availabilities. Following on indications already in academic work, a few companies demonstrated in LLMs a phenomenon sometimes termed emergence, in which, above a certain scale, performance unexpectedly and radically increases. A result was OpenAI's product ChatGPT, soon joined by similarly effective offerings from other companies.

Independent of its very real technical merit and likely ability to transform society in multiple ways, AI has also become a meme for embracing rapid technological progress, even if (in Silicon Valley parlance) it "breaks things." Annual capital investment in AI-related companies is, by some estimates, expected to soon exceed $200 billion.

In toto, AI is rapidly emerging as one of the most transformative technologies of our time, with a societal impact that many suggest will be as profound as, if not greater than, the invention of the internet. The explosive growth in AI capabilities, particularly in areas like machine learning, natural language processing, and computer vision, is poised to reshape industries, economies, and even the very fabric of society. AI's significance appears likely to surpass that of high-performance computing, which was the original focus of the NITRD Program when it was founded.

Finding 8: AI's long-term societal significance could be comparable to the invention of the internet, and greater than high-performance computing was in its time—the original impetus for founding NITRD.

Despite AI's clear importance, the NITRD Program does not yet appear positioned to address this "special moment" in AI. We think it is an oversight that in the 20,000-word Executive Order on the federal response to AI,[26] OSTP is mentioned twenty-one times, NSF fifteen times, NIST twelve times, but NITRD was not mentioned at all, although coordination among sets of NITRD member agencies was noted. The government's response to AI includes, to date, bodies such as NSTC's Select Committee on AI, the National AI Advisory Committee, the NAIRR pilot, a proposed permanent Chief AI Officers (CAIO) Council, the NSTC Subcommittee on ML and AI, and the National Artificial Intelligence Initiative Office. AI does not appear to be just another PCA, but will also impact many other NITRD component areas.

[26] Executive Order 14110. (October 2023). Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence.

Given the NITRD Program's history of fostering leadership and collaboration in NIT across federal agencies, it should play a more visible and proactive role in the federal government's response to AI, moving rapidly to align its activities with the rapidly expanding AI ecosystem.

Finding 9: We believe an opportunity exists for NITRD to contribute to, and in some cases lead, activities being undertaken government-wide in response to the Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence.[27]

Recommendation 7. The activities of NITRD entities should more specifically address the "special moment of AI." The NITRD NCO should reach out to increase its involvement with, and usefulness to, the plethora of new federal activities in AI, augmenting or leading as appropriate.

We recommend that NITRD specifically reorient some of its activities to better address the unique challenges and opportunities presented by AI. This should include reaching out to the many new federal initiatives focused on AI, such as the National AI Advisory Committee (NAIAC),[28] the National Artificial Intelligence Research Resource (NAIRR) pilot,[29] and the Chief AI Officers Council.[30] By increasing its involvement in these activities, NITRD entities can enhance the Program's relevance and usefulness in the federal AI landscape, providing the long-term institutional memory and research coordination that these rapidly evolving initiatives will require. Among AI challenges, we note that NITRD entities appear valuably positioned to address cybersecurity and privacy concerns related to AI; for instance, issues related to the privacy of training data, the potential for bias or other misinformation to arise from AI use, and the risk of AI model tampering or misuse. NITRD entities should seize this moment to become a central player in the federal AI strategy, leveraging their participants' expertise to help shape the future of AI research and development across the government.

Conclusion

The NITRD Program has historically been a useful driver of innovation, maintaining U.S. leadership in networking and information technology for decades. Its unique ability to foster cross-agency collaboration has made it an enduring asset to the federal government. However, as technology continues to evolve at an unprecedented pace, the program must adapt to ensure its continued

[27] Executive Order 14110. (October 2023). Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence.

[28] Establishment of the NAIAC: 116th Congress. (Jan. 1, 2021). Public Law 116-283. Section 5104 of the National Artificial Intelligence Initiative Act of 2020.

[29] Establishment of the NAIRR Task Force: 116th Congress. (Jan. 1, 2021). Public Law 116-283. Section 5106 of the National Artificial Intelligence Initiative Act of 2020. Establishment of the NAIRR proposed in legislation: 118th Congress. (July 31, 2024) S.2714. CREATE AI Act of 2023.

[30] An "interagency council to coordinate the development and use of AI" was proposed in Section 10.1 (a) of Executive Order 14110 and reinforced in section 3.b.ii.H of OMB Memo M-24-10. (March 28, 2024). Advancing Governance, Innovation, and Risk Management for Agency Use of Artificial Intelligence.

relevance and effectiveness. This report has identified several key areas for improvement, including broadening the NITRD NCO's outreach, refreshing the PCAs to be more forward-looking, enhancing budget reporting, and increasing the NITRD Program's involvement in policy and governance of emerging fields like AI.

The overarching message is that, while the NITRD Program remains invaluable, it is at risk of missing critical opportunities due to procedural inertia and a narrowing of focus. By taking steps to expand its customer base, modernize its strategic direction, and engage more proactively with the rapidly advancing AI landscape, the NITRD Program will continue to play a useful role in shaping the future of federal IT research and development.

Appendix A: External Experts Consulted

PCAST sought input from a diverse group of additional experts and stakeholders. PCAST expresses its gratitude to those listed here who shared their expertise. They did not review drafts of the report, and their willingness to engage with PCAST on specific points does not imply endorsement of the views expressed herein. Responsibility for the opinions, findings, and recommendations in this report and for any errors of fact or interpretation rests solely with PCAST.

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Appendix B: Acronyms and Definitions

ACNS	Advanced Communication Networks and Systems
AI	Artificial Intelligence
AWRD	Advanced Wireless R&D
CHuman	Computing-Enabled Human Interaction, Communication, and Augmentation
CNPS	Computing-Enabled Networked Physical Systems
COP	Community of Practice
CSIA	Cybersecurity and Information Assurance
CPSR	Cyber-Physical Systems Resilience
CSP	Cyber Security and Privacy
Customer	In this report, customer refers to federal agencies that do or might in the future engage with NITRD but also encompasses stakeholders such as private companies, academic researchers in many fields relevant to NITRD (the social sciences are particularly noted), non-profit organizations, and the public
DARPA	U.S. Defense Advanced Research Projects Agency
DHRD	Digital Health Research and Development
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DT	Digital Twins
EdW	Education and Workforce
EHCS	Enabling R&D for High-Capability Computing Systems
ENIT	Electronics for Networking and Information Technology
FTAC	Fast Track Action Committee
FFRDC	Federally Funded Research and Development Corporation
FY	Fiscal Year
HCIA	High-Capability Computing Infrastructure and Applications
HEC	High End Computing
IIRD	Information Integrity Research and Development
IRAS	Intelligent Robotics and Autonomous Systems (
IWG	Interagency Working Group
LSDMA	Large-Scale Data Management and Analysis
LSN	Large Scale Networking
NCO	National Coordination Office
NIH	U.S. National Institutes of Health
NITRD	Networking and Information Technology Research and Development
NSF	U.S. National Science Foundation
NSTC	National Science and Technology Council
PCA	Program Component Area (within the NITRD program)
R&D	Research and Development
SC	Sub-Committee
SPSQ	Software Productivity, Sustainability, and Quality
WSRD	Wireless Spectrum R&D

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