ADVANCED WIRELESS RESEARCH

Advanced Wireless Research Funding[1]

(Dollars in Millions)

	FY 2021 Actual	FY 2022 (TBD)	FY 2023 Request
CISE	$87.45	-	$93.26
ENG	25.83	-	27.75
MPS	17.00	-	17.00
TIP[2]	0.75	-	30.55
Total	**$131.03**	**-**	**$168.56**

[1] Funding displayed may have overlap with other topics and programs.

[2] FY 2021 funding for TIP is shown for comparability across fiscal years.

Overview

Advanced wireless networks and systems will provide the backbone that connects users, devices, applications, and services that will continue to enrich America's economy. NSF has a proven track record of investing in fundamental research on wireless technologies. For example, today's fifth-generation ("5G") wireless networks and systems have been enabled by ground-breaking NSF-funded research on millimeter-wave capabilities, advanced antenna systems, and other novel algorithms and protocols dating back to 2004. NSF partners with other federal agencies and industry on such research. Looking forward, NSF-supported research will innovate in areas critical to future generations of wireless networks and systems, such as new wireless devices, circuits, protocols, and systems; security and resilience; mobile edge computing; distributed machine learning, and inferences across mobile devices; and fine-grained and real-time dynamic spectrum allocation and sharing. This research will offer new insights capable of making wireless communication faster, smarter, more affordable, and more robust and secure.

In addition, by deepening public and private partnerships through programs like the Resilient & Intelligent Next-Generation Systems (RINGS) and Platforms for Advanced Wireless Research (PAWR), NSF will accelerate the lab-to-market translation of innovative research outcomes in academic and government labs to successful products and services for the benefit of society.

Goals

NSF's leadership in wireless research has three intertwined components:

1. *Fundamental Research on Advanced Wireless:* Support fundamental research enabling the conception, exploration, and development of advanced wireless technologies.
2. *Advanced Wireless Research Testing Platforms:* Establish advanced wireless research testing platforms, in collaboration with industry, to experiment with new technologies at scale and to generate data sets that can be used by the research community to validate proposed methods and techniques at earlier stages of development.
3. *Education and Workforce Development:* Catalyze academic, industry, and community leaders to work together to nurture the next generation of the wireless and spectrum workforce, including researchers, engineers, technicians, and practitioners, as well as to increase public awareness of advanced wireless.

FY 2023 Investments

Fundamental Advanced Wireless Research

- Through foundational research programs in CISE and ENG, outcomes from NSF investments in advanced wireless over the last decade have enabled 5G deployments capable of delivering multi-gigabit-per-second (Gbps) bandwidth to individual wireless users. Continued investments in advancing these frontiers are focused on developing advanced technologies to support ultra-low latencies of the order of sub-milliseconds while simultaneously connecting hundreds of millions of devices. NSF foundational research programs are also investing in technologies beyond 5G systems, developing more efficient uses of spectrum bands, higher-order spectrum, spectrum sharing, sensing using wireless communications, and novel codes for highly-efficient device-to-device communications as well as improving resilience and security of wireless networks. These investments will continue to support the foundations of U.S. leadership in advanced wireless R&D.
- In FY 2023, in partnership with the Department of Defense (DOD) Undersecretary of Defense for Research and Engineering (OUSD (R&E)), the National Institute of Standards and Technology (NIST), and nine industry partners, NSF will continue to support the RINGS program; laying the groundwork for next-generation wireless connections that will enable faster service; resiliency to natural disasters, malicious attacks, and service interruptions; and broader access to wireless connectivity for people across the U.S.
- In FY 2023, NSF will continue to support the Spectrum and Wireless Innovation enabled by Future Technologies (SWIFT) program with emphasis on miniaturized efficient low-cost hardware, innovations on radio-frequency (RF)/analog and hardware security, distributed machine learning, spectrum sharing, wireless-enabled smart manufacturing, and beyond-5G wireless components and systems.
- In FY 2023, NSF will support, in collaboration with DOD OUSD (R&E), use-inspired research on 5G security through a track of the Convergence Accelerator, Securely Operating Through 5G Infrastructure. The goal of this track is to enhance end devices and/or augment 5G infrastructure to enable military, government, and critical infrastructure operators to have the capability to operate through public 5G networks, while meeting security and resilience requirements.
- In FY 2023, NSF will support research on advanced sensing and communication technologies under water. Research will focus on new technologies addressing the challenges of communications and sensing to support underwater and under-ice science missions, which see increasing needs of advanced technologies given the importance of the ocean and polar regions and their roles in climate change and economic development.
- In FY 2023 NSF will continue its support for the NSF AI Institute for Edge Computing Leveraging Next-generation Networks (Athena) and the NSF AI Institute for Future Edge Networks and Distributed Intelligence (AI-Edge). Athena will focus on developing edge computing with groundbreaking AI functionality while keeping complexity and costs under control. AI-Edge will leverage the synergies between networking and AI to design future generations of wireless edge networks that are highly efficient, reliable, robust, and secure.
- NSF investments in fundamental advanced wireless research will be in synergy with the National Center for Wireless Spectrum Research (SII-Center) program under the Spectrum Innovation Initiative (SII) which also invests in the National Radio Dynamic Zones (SII-NRDZ) program. SII-NRDZ is an interdisciplinary program that seeks to foster collaborations among stakeholders to advance the use of dynamic spectrum sharing.

Advanced Wireless Research Testing Platforms

- NSF is pursuing a convergent approach to validate advanced wireless research through its PAWR program, a $100.0 million public-private partnership comprising $50.0 million of NSF investment paired with $50.0 million in cash and in-kind contributions from a wireless consortium of 35 companies. With oversight from the NSF-funded PAWR Project Office hosted at US Ignite, Inc., and Northeastern University, PAWR platforms in Salt Lake City, UT; West Harlem, NY; Research Triangle, NC, and Ames, IA, are helping to build core wireless capabilities through creative university partnerships, attracting government and corporate research funding as well as local wireless jobs, and using advanced wireless capabilities to enhance community services and economic development. FY 2023 will be the second year when all four PAWR testbeds are expected to be operational and generally available simultaneously to the research community, unleashing the full potential of translational opportunities for advanced wireless R&D.
- The PAWR testbeds will continue to benefit from NSF investments in the NSF National Radio Dynamic Zone program under the SII. In FY 2023, the PAWR testbeds will support proofs of concept for dynamic spectrum sharing across diverse geographic and spectrum use cases.

Education and Workforce Development

In FY 2023, NSF will continue emphasizing the need to develop a workforce trained in advanced wireless technologies, which is critical to maintaining U.S. leadership in advanced wireless. Through ongoing investments in programs such as Research Experiences for Undergraduates, Research Experiences for Teachers in Engineering and Computer Science, Computer Science for All: Researcher Practitioner Partnerships, Improving Undergraduate STEM Education: Computing in Undergraduate Education, NRT, and GRFP as well as the SII-Center, NSF will continue to train future generations of scientists, engineers, and practitioners to pursue careers in this domain.