U.S. National Science Foundation Cyber-Physical System Foundations and Connected Communities (NSF CPS) Program

U.S. National Science Foundation CISE: Future Computing Research (NSF Future CoRe)

Program Solicitation NSF 25-543

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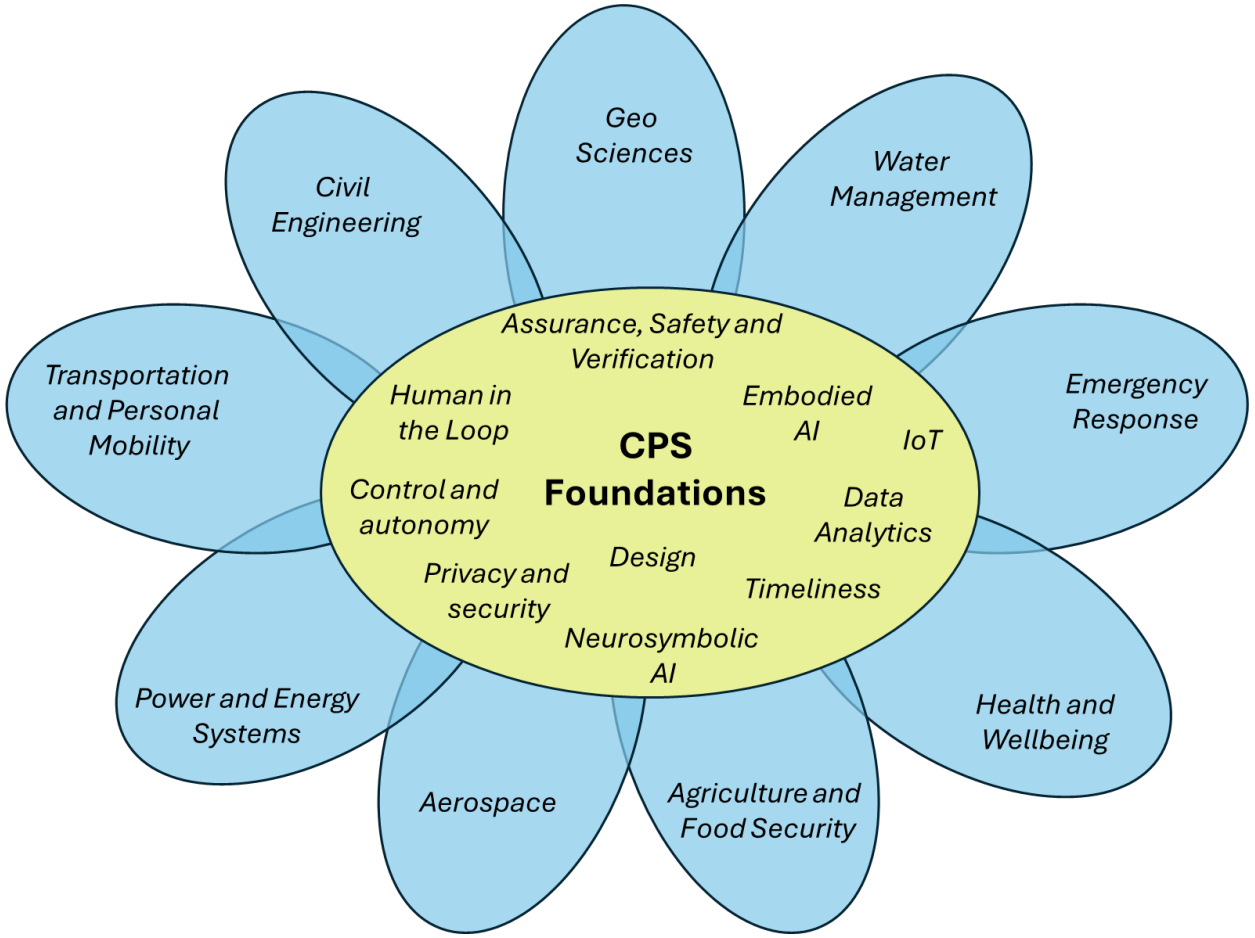
Cyber-physical systems

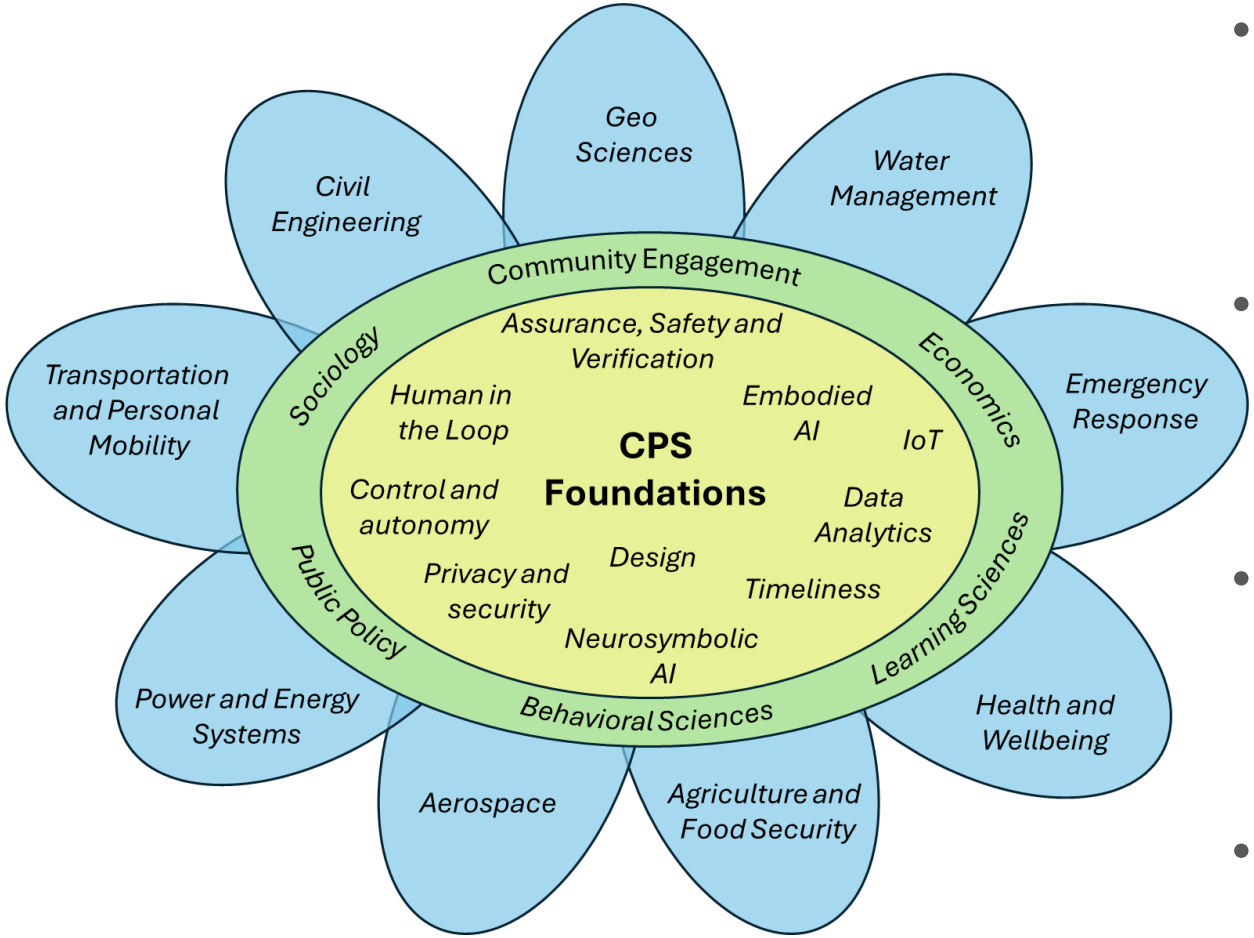


- **Seamless integration of cyber and physical**: CPS tightly couples computation with physical processes for hybrid, intelligent control that drives scientific and societal innovation.
- **Tight bidirectional interdependence**: CPS links computational processes, the physical environment and human participants in continuous interaction.
- **Validated in realistic settings**: Research is tested and demonstrated in controlled yet authentic environments to prove feasibility.
- **High societal impact**: CPS delivers benefits at both the individual and community level, shaping how people live and interact with technology.

Cyber-physical feedback loops – A key aspect of CPS

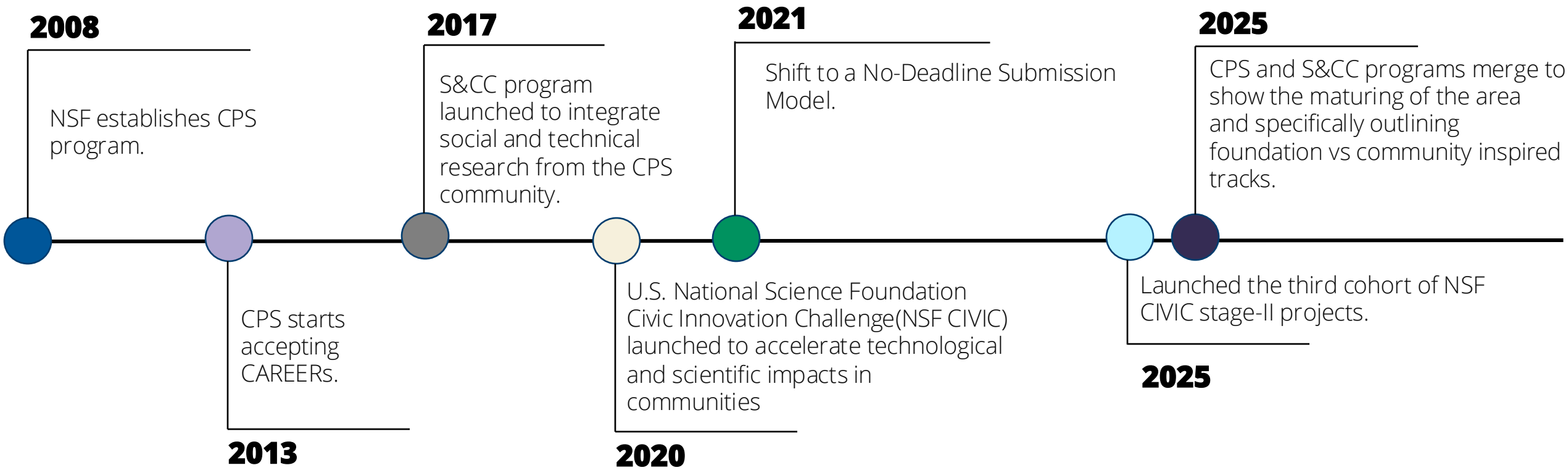
- **Real-time Feedback**
  - **Maintaining stability and control**: Feedback loops in CPS continuously monitor system behavior and adjust control actions to maintain stability.
  - **Enhancing adaptability and resilience**: Feedback loops enable CPS to dynamically respond to environmental changes and unforeseen events.
  - **Reducing latency and improving performance**: Fast feedback loops allow CPS to minimize response time and optimize operational efficiency.
  - **Ensuring safety and reliability**: Critical safety mechanisms in CPS rely on feedback loops to detect faults and implement corrective measures.
- **Design-time feedback**
  - **Co-design of cyber and physical components:** Mutual awareness leads to more efficient designs.
  - **Semantic interoperability:** Clear semantics of actions and observations allow safe updates and increased resilience.
  - **Efficiency through transparency:** Increased interpretability of complex system operations.

U.S. National Science Foundation Smart and Connected Communities (NSF S&CC) Program



- **Addressing urgent community needs:** Tackled issues like transportation inequity, disaster resilience, public safety and resource management. These efforts directly improved quality of life in U.S. communities.
- **Driving high-risk, high-reward innovation:** Advanced socio-technological breakthroughs by pushing the boundaries of computing and engineering to create transformative community technologies.
- **Integrating social and technical dimensions:** Strong alignment of social, behavioral, and community sciences ensured technology met real community needs, informed by governments, organizations and residents.
- **Scaling for nationwide impact:** Research outcomes were designed to scale across diverse communities, maximizing adoption and delivering broad societal benefits.

Program History



2010-2024 Multiple modifications to CPS and S&CC programs, expanding focus and partnerships

CPS program: ~ **$855.98 million** across **1,424** awards from 2009 to 2025
S&CC program: ~ **$301.8 million** across **560** awards from 2016 to 2025

U.S. National Science Foundation Cyber-Physical System Program within the U.S. National Science Foundation CISE Future CoRe solicitation (NSF 25-543)

Overview Of the changes

CPS In Future Computing Research (Future CoRe)

- **Part of CISE Future CoRe Programs**
  - CPS is now integrated into the broader CISE core research portfolio.
  - Two new research tracks: CPS Foundational Research (CPS-FR) and CPS Community-Inspired Research (CPS-CIR)
- **New Solicitation**
  - **NSF 25-543**: *Computer and Information Science and Engineering: Future Computing Research (Future CoRe)*
- **What It Replaces**
  - **NSF 24-581: Cyber-Physical Systems (CPS)**
  - **NSF 25-527: Smart and Connected Communities (S&CC)**

Summary Of Changes

New target dates for submission

- Target dates, not deadlines

New limits on the number of proposals for each PI

- 2 proposals across all CISE core programs per year

New budget constraints

- No mandated proposal categories, maximum of $1M

Changes to program-specific requirements

- No requirements from previous CPS and S&CC solicitations will be enforced

Target Dates

Proposals are accepted anytime

- Proposers are highly encouraged to submit by the target dates to ensure consideration during the corresponding panel review cycle.

Full Proposal Target Date(s):

- September 11, 2025 (Second Thursday in September).
- February 05, 2026 (First Thursday in February).

Eligibility: PI Proposal Limits

Limit on Number of Proposals per PI or co-PI:

- No more than 2 proposals
- In any 12 consecutive months
- Across all CISE core programs

Proposals that exceed the limits will be returned without review.

Proposals submitted to previous solicitations **do not** count towards the limit

Budget

Awards ideally will have a range of budgets and durations, including projects of smaller scope. Project durations and budgets must be commensurate with the scope of the proposed work.

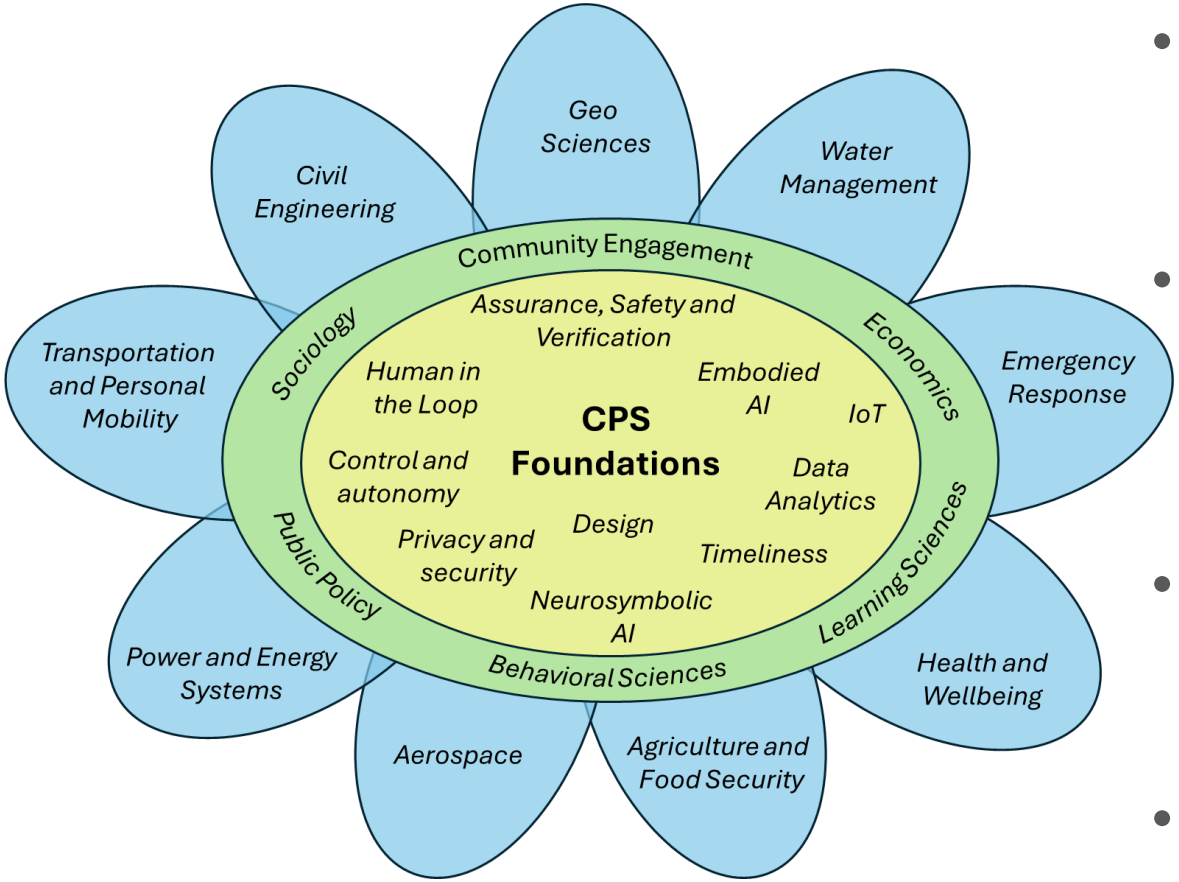
- Projects have a maximum limit of $1,000,000 with a duration up to 4 years.
- Typical projects are approximately $150,000 to $250,000 per year and are 3 to 4 years in duration. Projects are discouraged from exceeding $300,000 in any single year.
- Estimated program budget, number of awards, and average award size/duration are subject to the availability of funds.

Proposal Preparation Instructions

- Follow instructions in PAPPG (NSF 24-1)
- Include track name (CPS-FR: or CPS-CIR:) in the proposal title
  - (More on tracks in the following slides)
- No special requirements on proposal contents
- Preliminary proposals are not required
- Use letters of collaboration, not letters of support
  - E.g., “if the proposal is funded, we are committed to collaborate as specified in the project description”

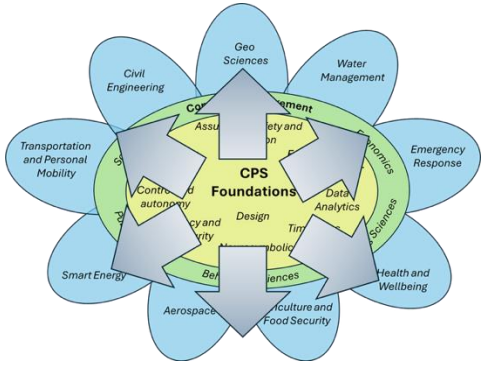
U.S. National Science Foundation CPS Foundations and Connected Communities Program

CPS Program Structure In Future CoRe



- Two complementary tracks:
  - CPS Foundational Research (CPS-FR)
  - CPS Community-Inspired Research (CPS-CIR)
- The goal of CPS-FR is to enable research in theories, methods, and tools that advance the fundamental science of CPS, evaluated within and across application domains
- The goal of CPS-CIR is to advance fundamental science in CPS and other partner disciplines inspired by the real-world needs of the community
- Community does not need to have a geographical boundary. It can be a stakeholder community.

CPS-FR Track



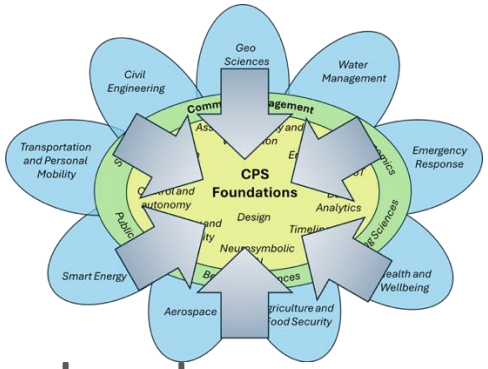
- Advances **core scientific and engineering principles** at the intersection of computation, control and physical systems.
- Research in **AI/ML-enabled autonomy, safe learning and decision procedures** for CPS.
- **Formal methods** for verification, assurance and trust in CPS (including AI-integrated systems).
- **Control and dynamics** of complex CPS in uncertain, real-time environments.
- **Co-design of hardware/software**, real-time scheduling, and resource management.
- **Security, privacy, and resilience** under adversarial and failure conditions.
- Exploration of **quantum algorithms** to expand CPS capabilities.

CPS-FR proposals should **not** be framed as domain applications alone but as contributions that **advance fundamental CPS science** and are **broadly reusable across applications in one or more than one domain.**

Helpful Suggestions For A Strong CPS-FR Proposal

- **Alignment with foundational CPS science:** Frame research around core CPS principles (bi-directional interdependence between physical, computational and human). Contributions must be generalizable and reusable beyond a single application domain. **Explicitly state why the work belongs in CPS-FR track.**
- **Define success and metrics:** Clearly articulate what success looks like. Identify the scientific questions being answered and the metrics that demonstrate progress.
- **Robust experimentation:** Move beyond simplified examples by clearly describing the experiments to be conducted, the CPS systems or testbeds to be used, and the methods for validating hypotheses under realistic conditions.
- **Integration of tasks and teams:** Demonstrate how different technical tasks fit together, define responsibilities for each team member and explain how collaboration and cross disciplinary integration are achieved.

CPS-CIR Track



- Fundamental Research in CPS and related disciplines shaped by clearly defined community needs.
- Focus on research that provides high-risk and high-impact within communities.
- Explicit definition of community (who, where, and why).
- Stakeholder partnerships must help shape the research questions.
- Includes a robust evaluation plan with metrics of success tied to community outcomes.

CPS-CIR proposals must deliver ***use-inspired, translational innovations*** rooted in clearly defined community needs, validated through engagement and **designed for measurable impact**

Helpful Suggestions For A Strong CPS-CIR Proposal

- **Alignment with CPS Science:** Frame research around real community challenges. Emphasize how research can advance foundational CPS Science and related disciplines while being inspired by community needs and lead to impactful solutions.
- **Define the intended community (beneficiaries):** Identify who the community is, what their needs are and how they are represented in the project (local governments, organizations, residents, or segment stakeholders).
- **Engage the community:** Engagement is not just outreach—it's integral to the research process. Demonstrate active collaboration with community partners in shaping research questions, guiding design, and validating solutions.
- **Evaluation:** In addition to technical evaluations, specify measurable societal outcomes (e.g., safety, resilience, sustainability) and how success will be tracked through community feedback and data.

CPS Partners

- CPS is administered by the NSF CISE Directorate
- Interdisciplinary collaborators in
  - NSF Directorate for Engineering (NSF ENG)
  - NSF Directorate for Social, Behavioral and Economic Sciences (NSF SBE)
  - NSF Directorate for Geosciences (NSF GEO)
  - NSF Directorate for STEM Education (NSF EDU)
- Existing cross-agency collaborations with the National Institute of Food and Agriculture and the Federal Highway Administration.
- All proposals should be submitted through CISE.

Proposal evaluation considerations

Commonly Encountered Concerns

- Persuade reviewers that CPS is the right program for your project.
  - Identify the relevant CPS application domain(s).
  - Identify core CPS technologies to advance.
  - Explain “tight, bidirectional interdependence” between cyber and physical parts.
- Demonstrate the need of the project to the reviewers.
  - Explain to the reviewers that the research is not just a design of a new AI model and development of a ‘framework’. Explain the innovation and why it is needed
  - Explain that the research is not incremental and is state of the art.
  - Explain how the different parts of the proposal fit together.
- Evaluation of outcomes.
  - Make sure success criteria are clear.
  - Comprehensive and convincing evaluation is important.
- Collaboration and management of interdisciplinary projects.
  - Are all necessary areas of expertise covered?
  - Explain the risk--if any.
  - How will team members with complementary expertise interact?

Community-Inspired Research

- Tell reviewers about your community.
  - Define the community: no one size fits all
  - Identify stakeholders.
  - Identify community representatives: you will be speaking with the community through them.
- Explain how you will engage the community (and have engaged in the past).
  - Understanding community needs.
  - Helping you plan the research.
  - Evaluating the outcomes.
  - Identify the required expertise for the project and have a strong integration and management plan for the project.

- For program-related inquiries: cise-cps@nsf.gov

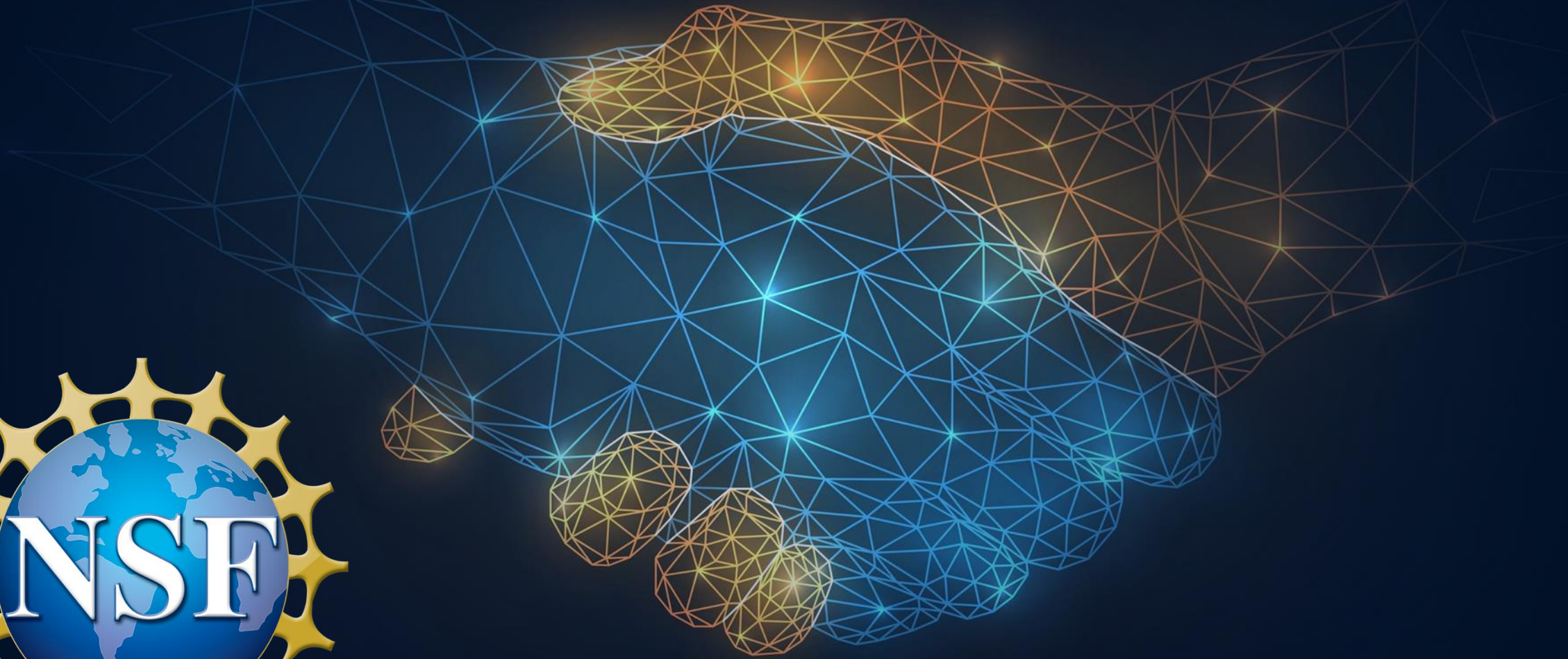
Office Hours

When:

Every Tuesday & Thursday, 3 PM – 4 PM Eastern. Until September 11, 2025.

Register at:
https://nsf.zoomgov.com/meeting/register/jXawp57mQdiYu22zd8Bpgg#/registration

Questions?

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