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Welcome to this Webinar about the CNS Core Program for Fiscal Year 2019.

My name is Ken Calvert, and I am the Division Director for the Division of Computer and Network Systems in the Directorate for Computer and Information Science and Engineering.

With me are Program Directors Samee Khan and Darleen Fisher, and the Deputy Division Director of CNS, Jeremy Epstein.

This year, we have done a major revision of the CNS core solicitation.

This revision is motivated by a couple of observations.

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i) The first is that our field, Computer Systems and Networking, moves very quickly. One of our biggest challenges is determining where we should be leading, and where others (that is, industry and academia) are or can be leading. It is hard to predict where things are going.

ii) The second is that the distinction between “Computer Systems” and “Networking” has become somewhat arbitrary – the vast majority of implemented computing and networking systems today – from mobile phones to data centers to the networks that interconnect everything – include components that perform computation, components that store information, and components that enable communication among the other components. Moreover, increasingly these components are dynamically customizable/programmable.

These observations have motivated two major changes in the solicitation.

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First, you will be submitting your proposals to a single program, the “CNS Core” program. We have done this to highlight the fact that the boundaries are blurred, and to encourage cross-fertilization among CNS areas. Obviously, researchers' expertise will typically be focused on one component or aspect of the system, whether it be operating systems, file systems, networks, or what have you. And internally we still have “Nets” and “Computer Systems” clusters in CNS. But we want to encourage researchers to “cross the aisle”, so to speak, to work with others in different parts of the system “stack”.

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The second big change is that rather than provide a list of research topics, we have focused on the characteristics of systems – what we want out of them. We want to encourage the community to think about as many of these aspects as possible.

You'll hear more about this later, but general requirements are those that always, or almost always, apply. Security, reliability, correctness, manageability, cost-effectiveness are among the characteristics that make systems useful.

On the other hand, the importance of some requirements depends on the context in which the system operates. In some cases, performance is paramount; in other cases, we may be willing to trade performance to get something else, for example mobility, or lower cost, or increased privacy.

Of course, researchers are always looking for ways to improve along all of these dimensions. And they have generally done very well at that over the last few decades.

But increasingly – especially as Moore's Law runs out of gas – there will be tradeoffs – and that's a lot of what systems research is about: understanding those tradeoffs and how to navigate them. That is where we believe cross-fertilization can pay dividends.

Also: it tends to be “easier” to obtain results in dimensions that are easy to measure – performance being the prime example. So our community naturally tends to focus its efforts there.

Although performance has always been of some importance, in many areas these other characteristics are arguably at least as important. So we want to encourage people to consider those other aspects, even if they are harder to measure.

Before I turn things over to Samee and Darleen, **I want to stress that we are not narrowing the scope of the program**; we are not excluding topics that previously were in scope, although we do encourage everyone to take a step back and consider the impact of their work.

Now Samee and Darleen and Jeremy will take you through the details of the solicitation.

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Given this vision for the solicitation.

Research of interest for this solicitation will explore fundamental principles and create innovative technologies, protocols, and systems that define the future or—more realistically—harness current and emerging technologies, trends, and applications;

Research of interest for this solicitation will produce practical abstractions, techniques, tools, artifacts, or datasets that address/enhance both general and functional requirements;

Research of interest for this solicitation will reflect a clear understanding of what each component does and how it interfaces with the rest of the system and the environment;

Research of interest for this solicitation will disseminate artifacts in such a way that others can repeat, reproduce, validate, or otherwise verify the results.

Although purely intellectual investigations are within scope, research that takes into account current and future societal needs is encouraged.

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The solicitation notes that a hallmark of computer and networking systems research is understanding the tradeoffs that must be navigated when designing and implementing those systems. However too often in making tradeoff choices, security loses out to performance or functionality, for example. Yet we all realize that security is critically important. This solicitation specifically emphasizes security by design; thus, making security a first-class citizen. It challenges researchers to ask, for example, what it will take to ensure integrity and confidentiality of networked systems and data; can we delineate permissible actions, enforce compliance and establish security defaults in design processes? Can we by design anticipate vulnerabilities and provide defenses against unforeseen attacks?

Please note that exclusive focus on cybersecurity threats and countermeasures would be considered a better fit for the SaTC program

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Another key element being called out to consider when developing systems for the future is robustness. For example, how can systems—existing and future—be made more adaptable and resilient to natural and anthropogenic hazards (e.g., weather events, malware, sabotage), as well as other normal or expected events, such as component failures, misconfigurations, and overloads?

For example, consider what innovative approaches would enable one to ensure system robustness and to identify, communicate, and mitigate system anomalies in real-time for outages at both small and large scale? The examples provided in the solicitation are only meant to spark interest in the community to think about robustness when improving current systems and designing the next generation of systems.

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Systems are becoming more and more complex and need to support a growing number of diverse applications. We might ask what new architectures, protocols, measurement and monitoring capabilities can aid in overall systems management and provide support for application developers. How can we meet the challenges of comprehensive, pervasive, and accurate measurement capabilities, near real-time analytics, and systems management when the systems are massive and at the scale of the Internet? Can we design and implement truly autonomous systems which are self managing by design?

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In general, any topic having to do with augmenting, understanding, enhancing, or transforming computing and communication systems undertaken from a systems point of view is within scope.

Issues that reside primarily at the device or application level and that are highly context-specific **will not be considered a good fit** for this program. Projects that focus exclusively or primarily on cybersecurity threats and countermeasures may be a better fit for the Secure and Trustworthy Cyberspace (SaTC) program. Projects focused primarily on design or enhancement of sensing and control systems that interact with the physical world may be a better fit with the Cyber-Physical Systems (CPS) program.

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Science by definition requires that research results be validated. We highly recommend including a project validation plan in the proposal. Important components include describing the underlying setup, processes, mechanisms, and metrics to assess success as well as clearly describing the level of abstraction at which the underlying research is validated. Validation may be undertaken through hypothesis testing using simulation, emulation, testbeds or a combination of these. We recommend using existing testbeds instead of creating your own.

We also recognize that architecture research validation may have a longer time scale than the duration of the project, in which case you must include in your proposal a long-term validation approach for architecture validation.

Please note that the Project Validation Plan is to be included within the Project Description.

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We are requesting investigators to include a detailed results dissemination plan when submitting proposals. Please note that this is different from the Data Management Plan, which has the goal of highlighting plans for data curation.

The results dissemination plan must provide details on the scaffolding provided by the PIs to ensure that the research results (e.g., data, programs, logs, test case, emulators, simulators, etc) produced will be made available to the extent necessary to validate the findings independently, as indicated in the *NSF Proposal & Award Policies & Procedures Guide (PAPPG)*.

This criterion is to facilitate reproducibility of results, which in turn will facilitate collaborations among the system researchers.

Please note that the Results Dissemination Plan is to be included as a supplementary document.

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The CNS core programs require Data Management Plans. There are standard CISE reporting requirements, including for example, description of types of data, software, curriculum materials and other materials generated in the project. In addition, we ask you to describe steps to ensure that artifacts are available for use by the community for a stated reasonable time beyond the end of the project.

Please note that the Data Management Plan is to be included as a supplementary document.

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Because the success of collaborative research efforts is known to depend on thoughtful coordination mechanisms that regularly bring together the various participants of the project, a separate Collaboration Plan is required for all Large proposals and all Medium projects with more than one investigator.

Collaboration Plans are optional for Small proposals but encouraged.

Please note that the Collaboration Plan is to be included as a supplementary document.

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For all proposals, reviewers will be asked to consider:

How well does the proposed work address and advance the following?

- Secure-by-design systems;
- Systems robustness;
- Manageability of the system under consideration; and/or
- Fundamental understanding of the system or system component.

Please notice that **at least one** of the aforementioned aspects must be present. It is not necessary that all four elements should be present.

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The reviewers will be asked to specifically comment on the following aspects as well.

How well does the proposal describe an evaluation plan that assesses and where appropriate quantifies the expected research outcomes?

How well does the proposal describe research dissemination plans to ensure that the research results can be validated independently?

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For Large and relevant Medium proposals, reviewers will be asked to:

Comment on the extent to which the project scope justifies the level of investment requested, and the degree to which the Collaboration Plan (if required) adequately demonstrates that the participating investigators will work synergistically to accomplish the project objectives.

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For Large and relevant Medium proposals, reviewers will be asked to:

Comment on whether key personnel, and especially lead PIs, have allocated adequate time for both their individual technical contributions and the leadership of collaborative activities necessary to realize the synergistic effects of larger-scale research.

At this moment, let me call upon Jeremy Epstein, the Deputy Division Director of CNS to detail other important changes in the solicitation.

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CISE is committed to broadening the participation of underrepresented populations in computing and closely-related disciplines.

CISE strongly encourages meaningful actions that address the longstanding underrepresentation of various populations, including women, persons with disabilities, and minorities – African Americans, Hispanics, American Indians, Alaska Natives, Native Hawaiians, Native Pacific Islanders, and persons from economically disadvantaged backgrounds — in computing.

Consequently, for this solicitation, CISE is expanding its pilot effort started last year. Each Medium and Large project is strongly encouraged to include a 1-3 page Broadening Participation in Computing, or BPC, plan as a supplementary document. Plans included with submissions will be reviewed by BPC experts before the regular panel review. If your award is recommended for funding, the Program Officer will work with the PIs on the plan, which must be approved by the time of the award.

Although a BPC plan is not mandatory for the Smalls project, we are encouraging the community to consider including them. CISE intends to conduct an evaluation of the effectiveness of the current pilot and determine appropriate next steps, including potential further expansion of this effort in future years.

I encourage the community to please look at the URL shown in the screen for more details on BPC. This URL is also included in the solicitation.

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Proposals may only be submitted by the following:

Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of

performance at the international branch campus and justify why the project activities cannot be performed at the US campus.

Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

As of the submission deadline, PIs, co-PIs, or other senior project personnel must hold primary, full-time, paid appointments in research or teaching positions at US-based campuses/offices of organizations eligible to submit to this solicitation (see above), with exceptions granted for family or medical leave, as determined by the submitting institution.

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Individuals with primary appointments at for-profit, non-academic organizations, or overseas branch campuses of US IHEs are not eligible, even if they also have an appointment at a US campus.

Please note that it is the submitter's home institution's responsibility to determine the fulltime status before submission.

If further clarifications must be sought, please contact one of the cognizant PDs listed for this solicitation.

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In any contiguous September through November period, an individual may participate as PI, co-PI or Senior Personnel in **no more than two** proposals across all size classes submitted in response to the *coordinated solicitations* (where *coordinated solicitations* are defined to include the *Computer and Network Systems (CNS): Core Programs*, *Computing and Communication Foundations (CCF): Core Programs*, *Information and Intelligent Systems (IIS): Core Programs*, and the *Office of Advanced Cyberinfrastructure (OAC): Core Programs* solicitations). For example, between September 2018 and November 2018, an individual may participate as PI, co-PI or Senior Personnel in one proposal submitted to a core program in CCF and in a second proposal submitted to a core program in CNS, or an individual may participate as PI, co-PI or Senior Personnel in two proposals submitted to an IIS core program, etc.

These eligibility constraints will be strictly enforced to treat everyone fairly and consistently. If an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e., the first two proposals received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

Note that the limit on the number of proposals per PI, co-PI or Senior Personnel applies only to the *coordinated solicitations*.

Subawards are not permitted to overseas branch campuses/offices of US-based proposing organizations eligible to submit to this solicitation.

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The CNS Core program expects to fund 100-150 grants and anticipates the total funding for the CNS Core will be \$60M.

There are three classes of project sizes: Small, Medium, and Large. The exact sizes in terms of allowable project durations and budget ranges are specified on this slide and in the solicitation.

The submission window for both Medium and Large projects is September 24 through October 2, 2018.
The submission window for Small projects is November 2 through November 15, 2018.

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To avoid overdue reports blocking award actions during the end of a fiscal year, institutions are discouraged from seeking project start dates between July 2 and September 30 of a given year. Awardee institutions may incur allowable pre-award costs within the 90-day period immediately preceding the start date of the grant subject to the conditions specified in the PAPPG; this will allow support for students or other relevant activities to begin over this period.

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Titles begin with CNS-Core, followed by the project size designation such as Small or Medium followed by the title. Exceptions include a secondary program for possible co-review such as CHS (cyberhuman systems). NOTE use the acronym of the program, not the division. Use Collaborative Research, if submitted by two or more institutions. GOALI or RUI are special program designations you need to include if appropriate. Items are always separated by a colon and a single space.

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Let me detail some important changes in the proposal submission.

The foremost is the inclusion of the keywords.

These keywords are included to provide guidance to the program directors to best match reviewers and proposals.

Proposers are **required** to select keywords in each of the following 4 dimensions. The first dimension describes the most relevant systems topic area; the second dimension identifies the context or class of systems; the third dimension corresponds to the primary goal or objective of the proposed work, and the fourth dimension indicates any specialized knowledge or techniques to be applied. Because such sets cannot be constructed exhaustively, proposers can specify up to 6 additional proposal specific keywords that would in their opinion adequately capture the proposed system research. Details on each of these dimensions and the usage of additional keywords will be provided shortly.

On the screen we can see the keywords for the first dimension – the topic area, which consists and composes the depth and breadth of CNS topic areas. These keywords are also listed in the solicitation.

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On the screen we can see the keywords for the second dimension – the target context or platform class.

These keywords are also listed in the solicitation.

Again, please note that proposed research may have multiple target contexts or platform classes.

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On the screen we can see the keywords for the third dimension – the target requirement. Please note that proposed research may have multiple target requirements. For example, power and performance.

These keywords are also listed in the solicitation.

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Some proposals include techniques, that are often mathematical, such as graph, control, or game theory. Other examples include machine learning or network coding. In such cases we would like you to include the name of such technique in order to have your work reviewed by appropriate experts from the CNS community who are also knowledgeable about such techniques. You may select NONE as an option.

You may also add up to 6 additional proposal-specific keywords that best describe your work. The solicitation instructs you on the format for listing the keywords.

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To assist the community in understand - how one can include appropriate keywords in their submission. Consider the following examples.

For example, a proposal to use machine learning to develop low-cost file system abstractions for content delivery in low-latency edge environments might have the following string in the Keywords field:
[File Systems] [Access Networks] [Cost, Performance] [machine learning]

A project focused on compilers to enhance manageability in enterprise networks could have the following as Keywords:
[Compilers and Programming Languages] [Enterprise Networks] [Manageability] [none]

A proposal on mmWave beamforming using machine learning could have the Keywords as shown on the screen
[Wireless Networks] [Access Networks] [Performance] [Machine Learning] mmWave, Beamforming

These examples are listed in the solicitation as well.

The list of keywords should be the last paragraph of the Overview section of the Project Summary.

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Project Description, must describe the research and education activities to be undertaken in up to 15 pages for Small and Medium proposals and in up to 20 pages for Large proposals. Proposals that exceed these limits will be returned without review.

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In the Supplementary Documents section, upload the following information where relevant:

A list of Project Personnel and Partner Institutions.

In collaborative proposals, the lead institution should provide this information for all participants.

Provide current, accurate information for all personnel and institutions involved in the project. NSF staff will use this information in the merit review process to manage reviewer selection. The list must include

all PIs, Co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, Postdocs, and project-level advisory committee members.

The length of and degree of detail provided in the Collaboration Plan should be commensurate with the complexity of the proposed project. In collaborative proposals, the lead institution should provide this information for all participants.

If a Large proposal, or a Medium proposal with more than one investigator, does not include a Collaboration Plan of up to 2 pages, that proposal will be returned without review.

A data management plan, results dissemination plan, and a BPC plan (if applicable) are to be uploaded, as detailed previously.

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On the screen, you can see the names and contact emails of all of the PDs involved in this solicitation. Please feel free to contact them, should you have any questions or concerns.

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We thank all of you for your attention.

Operator, we are now ready to take questions from the audience. As you queue those up, here are some questions listed here to start.