Good afternoon, and good morning for those of you far enough west. I'm Geoffrey Brown, and I'm one of the NSF Program Directors managing the program Exploiting Parallelism and Scalability, or XPS. Several other Program Directors are here as well. I'm presenting on behalf of Tracy Kimbrel, the lead Program Director for XPS, who is unable to make the presentation due to illness. There are Program Directors representing all four divisions of CISE participating in the program, and their names are shown on the title slide. Thank you for taking time to join us today. In this webcast, I'll give a brief overview of the program and some of the most important things you need to know about submitting a proposal.

Here is the agenda for today's presentation. I'll start with an overview giving the origins and motivation for the XPS program. Next, I'll briefly cover some important aspects of the solicitation including the types of awards to be made, submission requirements, and of course the deadline. I'll spend a fair amount of time on the program's focus areas, describing the types of projects the program is intended to support – and this is the primary purpose of this presentation. I'll cover a few frequently asked questions, and finally I'll invite further questions from the audience and answer them with help from my colleagues.

The XPS program was developed to address a need expressed in several recent reports. A report from the National Academies of Science assessed the ability of the information technology industry to sustain the steady increase in computing performance that we've seen over the last several decades. The cover of this report, titled "The Future of Computing Performance: Game Over or Next Level?," is shown on the left. The middle image is the cover of NSF's Vision and Strategic Plan for Advanced Computing Infrastructure, released in early 2012. And finally, the Computing Community Consortium engaged the computer architecture community to develop a recommendation on future research directions, simply titled 21st Century Computer Architecture. These three reports all reach the conclusion that new foundational research into parallel and concurrent computing is essential to sustained performance growth.

With the end of frequency scaling, there is no known alternative to parallel systems for sustaining growth in computing performance. We need better ways to exploit parallelism than are currently available, including abstract models and programming languages to support parallel computation, algorithms designed both to perform well in those abstract models and to be implementable in those programming languages, compilers and higher-level tools for program generation and verification, systems at all scales from mobile devices to datacenters, computer architectures that are energy-efficient while satisfying other desirable properties, and, importantly, an integrated research effort across all these layers.

XPS is a program that CISE started last year to support groundbreaking work leading to a new era of parallel computing. XPS seeks clean-slate approaches, including ones that completely change one or more layers of the hardware and software stack, perhaps even eliminating layers or introducing new ones. XPS is

intended to support researchers working across those layers to ensure these new ideas can work in a complete system.

Here are the key pieces of information you need to know about this year's solicitation in order to submit a proposal. The solicitation's document number, NSF fourteen dash five one six, highlighted in red, will serve as a search key to find the solicitation in popular search engines. If you can't remember that, the string "NSF space XPS" might take you to last year's solicitation, but it has a link to this year's. The program has four focus areas, which will be described later. Each proposal should fit into at least one of these areas. There are two types of proposals, called full-size and exploratory. Because the aim of the program is to support cross-layer collaborations, each full-size proposal must have two or more PIs bringing different skills to the project. I'll say more about this later when I get to the FAQs. Exploratory projects are smaller and do not require multiple PIs. These are intended to support preliminary work that, if successful, could lead to a full-size project suitable for XPS. Both types of proposals are due February 24th. We expect to make around 13 to 16 full-size awards of up to one million dollars and 3 to 5 exploratory awards of up to three hundred thousand dollars.

Here are the four focus areas on a single slide. I'll get into greater detail on each of them shortly. The areas are Foundational Principles, Scalable Distributed Architectures, Cross-layer and Cross-cutting Approaches, and Domain-Specific Design. Foundational Principles includes models and algorithms, resource optimization, and language design and implementation. Scalable Distributed Architectures addresses the need to integrate applications running on devices from those you carry in your pockets to warehouse-size systems. Cross-layer and Cross-cutting Approaches is where we encourage re-thinking or even replacing one or more layers, perhaps even all layers, of the traditional hardware and software stack. Domain-specific Design refers to techniques to exploit domain-specific knowledge and the ability to generalize to new domains.
Next we'll look at each of these focus areas in detail. Note, however, that here I am presenting only a subset of the potential topics described in the solicitation, which I encourage you to read, and even the solicitation is illustrative and not exhaustive.

Foundational Principles includes high-level computational models to guide algorithm design for diverse parallel computing platforms, algorithms and paradigms for reasoning about parallel performance (including energy and communication performance in addition to parallel time and space), new programming languages and language mechanisms designed (instead of retro-fitted) for parallelism and to simplify programming to the greatest extent possible, and of course language implementation for efficient parallel performance.

Cross-layer and Cross-cutting Approaches re-evaluate the traditional computer hardware and software stack, revisiting the usual assumptions. They might define new abstractions and models exposing fundamental attributes across all layers, and determine what information and abstractions must flow between the layers to

achieve optimal performance. The relative cost of moving data, compared to computing values, is increasing, so exploiting locality is crucial and should be coordinated across layers. Verification and validation are cross-layer issues, of course, since they are relative to the abstractions exposed by one layer to another.

The Scalable Distributed Architectures focus area aims at languages, development tools, and platforms for very large distributed systems, to be accessed and supplied data by mobile devices and distributed sensors with limited computing power and severe energy constraints. Complex design issues include division of workload among devices with varying capability, while protecting privacy and providing resiliency to faults and network disruptions. These environments should be accessible to developers who aren't necessarily expert in all the nuances and complications of parallel, concurrent, and distributed computing.

Domain-specific Design focuses on parallel domain-specific languages with high-level programming models for domain experts and performance portability, hardware-software co-design for domain-specific applications providing high performance and energy efficiency, and libraries to allow the generalization and export of these features to multiple domains.

Now I'll answer some frequently asked questions about the XPS program.
The first question is: How can I tell whether my proposed research is a good fit for the XPS program?
This question has a three-part answer. Here is part one. XPS is looking for groundbreaking research on parallel computing. We're looking for transformative proposals on new and visionary approaches that re-examine the traditional stack and explore new cross-layer approaches. Achieving these breakthroughs will require a collaborative effort among researchers from different areas, so each FULL-SIZE proposal is required to have two or more PIs providing different and distinct expertise. (I'll say more about this requirement later.)

Part two of the answer is about what the program is not for. Proposals to extend existing approaches, to solve domain science problems, or to build software infrastructure are not appropriate for XPS. CISE supports these areas via different programs, some of which are listed on the slide.

Finally, we don't want to get bogged down in discussions over the semantic differences between parallelism, concurrency, and distributed computing. If there are many things going on at the same time, then it meets this aspect of the proposal requirements.

The next question is: I work in field A and my co-PI works in field B. Does this count as "different and distinct expertise?"
There is no hard-and-fast rule. It is up to the proposers to make the argument that they provide different and distinct expertise. Each FULL-SIZE proposal is required to have a collaboration plan that describes the backgrounds and different expertise

of the PIs and how they plan to collaborate to achieve the goals of the project. This plan will be evaluated by the reviewers.

The next question is: Should I discuss my proposal with NSF Program Directors?
Yes, we encourage you to discuss planned proposals with Program Directors to help determine fit to the program. We ask that you refrain from scheduling separate meetings with multiple Program Directors. Once submitted, the substance of proposals will not be discussed by NSF Program Directors, as this would constitute unfair competition, or the perception thereof.

The next question is: Who are the XPS Program Directors, and which one should I talk with?
The list of current XPS Program Directors is available on the NSF web pages (the URL is on the slide). PIs should discuss potential proposals with the Program Directors whose areas are closest to those of the proposed research. But don't worry too much about it; if you choose the wrong one, he'll refer you to the right one. And don't worry if you don't have time to copy down the URL. You can obtain the slides from today's presentation and I'll tell you how shortly.

The next question is: Do XPS proposals count against the CISE Core program limits on number of proposals allowed per year?
No, but there is an XPS program limit. No one can be PI, co-PI, or senior personnel on more than two XPS proposals.
The last question is: Will there be future XPS solicitations?
CISE has a strong commitment to support research in this area, and we anticipate continued funding in this area.

That brings us to the conclusion of the presentation. The slides and the script for this webcast, as well as an audio recording, will be available at the NSF Events web page; the URL is shown. On that page, you'll need to look for this webcast among the list of events. Also, the email addresses of the XPS program directors are shown, along with the CISE divisions they belong to. If you can't determine which one to contact based on division or the core programs they manage, just contact XPS Lead Tracy Kimbrel.

Now we will move on to questions and answers.