NATIONAL SCIENCE FOUNDATION
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ARLINGTON, VIRGINIA 22230

NSF 15-081

Dear Colleague Letter: Conducting "Future Cloud" Research - Leveraging NSFFutureCloud Experimental Infrastructure in Research Proposals

May 21, 2015

Dear Colleagues:

The Directorate for Computer and Information Science and Engineering (CISE) announced the CISE Research Infrastructure: Mid-Scale Infrastructure (NSFFutureCloud) program in September 2013 to support research infrastructure that enables the CISE academic research community to develop and experiment with novel cloud architectures addressing emerging challenges, and pursue new, architecturally-enabled applications of cloud computing. The goal of NSFFutureCloud is to enable community exploration of resource sharing in clustered computing; virtualization with software-defined networking technologies; quality of service guarantees; and the interplay among applications, cloud computing architectures, and the physical environment; etc. This research infrastructure will enable the CISE community to go beyond the use of existing commercial cloud offerings, allowing researchers to influence such offerings in the future.

In August 2014, CISE issued two $10 million NSFFutureCloud awards. The first of these projects supports the design, deployment and initial operation of Chameleon, a large-scale, reconfigurable experimental environment for cloud research, co-located at the University of Chicago and The University of Texas at Austin. The second project supports the development of CloudLab, a large-scale, distributed infrastructure based at the University of Utah, Clemson University and the University of Wisconsin, on top of which researchers will be able to construct many different types of clouds. Both projects provide "bare-metal access," allowing for experimentation with existing cloud computing technologies, as well as research on new technologies that could improve reliability, security and performance. Detailed descriptions of the hardware and capabilities of each system are available on their respective websites, http://www.chameleoncloud.org and http://www.cloudlab.us. Both systems are currently open for use, with application instructions available on their websites, and are expected to reach full capacity around December 2015.

With this Dear Colleague letter (DCL), the CISE directorate announces the availability of the NSFFutureCloud prototypes, and encourages researchers to consider utilizing these resources when submitting proposals to relevant NSF research programs. Such programs include, but are not limited to:

- Algorithms in the Field (AiTF);
- Computer Systems Research (CSR);
- Critical Techniques and Technologies for Advancing Foundations and Applications of Big Data Science & Engineering (BIGDATA);
- Cyber-Physical Systems (CPS);
- Exploiting Parallelism and Scalability (XPS);

- Information Integration and Informatics (III);
- Networking Technology and Systems (NeTS);
- Secure and Trustworthy Cyberspace (SaTC); and
- Software and Hardware Foundations (SHF).

The NSFFutureCloud prototypes may be used to stimulate and promote a range of foundational, applied, and experimental research across many areas of cloud computing. Research topics include, but are not limited to:

- Cloud architectures and systems, including cloud self-monitoring, prediction, and autonomic control, fault-masking and reliability, and data portability, interoperability, and standardization;
- Scalable, distributed architectures and domain-specific design in the context of exploiting scalability and parallelism;
- Design of networks and operating systems that offer low latency and scheduling noise for tightly coupled, distributed computations;
- Domain-specific languages, programming models, software or system analysis and verification, balancing and optimizing performance goals, and run-time and IO/storage that interact with the application level in the cloud;
- Measurement experiments to understand functionality, efficiency (including, for example, energy usage), network traffic patterns, etc., of/within the cloud;
- Energy efficiency of the cloud and the effects of variable power sources;
- Geo-distributed data storage and data movement, coupling data and computational resources that are distributed over a wide area;
- Improved networked services and applications that require in-network computation and storage;
- Cloud Radio Access Network (Cloud-RAN) infrastructure for enhanced radio signal processing and capacity gain;
- Security, privacy, authentication, and auditing issues in a cloud-based environment;
- Security enforcement and monitoring of end-systems using cooperative cloud systems;
- Real-time, safety, stability, and reliability requirements in cyber-physical systems (CPS) interacting with the cloud, and the design and operation of CPS that include new factors induced by cloud computing;
- Mobile cloud systems, such as architectures for running core network components in the cloud and workload offloading;
- Foundational issues and innovative applications of Big Data, at the algorithmic as well as systems level (e.g., novel approaches for dealing with scalability, elasticity, fault-tolerance, availability, privacy, quality, and heterogeneity);
- Developing algorithms, components, and tools leading to improved or more capable cloud computing services, and leveraging of cloud capabilities to solve large-scale and distributed computing challenges;
- New techniques and software architectures that support high-performance or high-throughput computing in the context of cloud infrastructure; and
- Developing new advanced cloud applications that depend on the innovations in cloud architecture listed above.

For additional research topics, prospective Principal Investigators (PIs) are encouraged to review videos and proceedings from a December 2014 NSFFutureCloud workshop focused on experimental support for cloud computing: http://www.chameleoncloud.org/nsf-cloud-workshop/.

Prospective PIs who expect to require large allocations of facility resources are also encouraged to contact Chameleon and/or CloudLab prior to submitting a proposal to ensure that their projects will feasibly fit into the facility(ies):

- Chameleon: contact@chameleoncloud.org; and
- CloudLab: contact@cloudlab.us.

If you have questions (e.g., about the appropriateness of a research topic), please contact the cognizant Program Director for the program to which you are interested in submitting research proposals:

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Sincerely,

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