NSF/VMware Partnership on Edge Computing Data Infrastructure (ECDI)

March 14, 2018 Webinar

Agenda

- **Welcome and CISE Context** — *James Kurose*, *Assistant Director, CISE*
- **ECDI Program--VMware Perspective** — *David Tennenhouse*, *Chief Research Officer, VMWare*
- **EDCI Research Overview** — *Ken Calvert*, *Division Director, CNS/CISE*; *Samee Khan*, *Program Director, CSR*
- **ECDI Proposals, Review, & Project Management** — *Darleen Fisher*, *Program Director, NeTS*
- **Questions** — *NSF-VMWare Team*

ECDI: Background

- Exponential growth in devices and users resulting in explosion of data at the edge.
- Hardware & software heterogeneity at the edge which makes management challenging.
- Sensitive edge data, causing data security and privacy to be paramount.
- New latency sensitive applications
- Existing infrastructure and application silos, which are wasteful and create a big barrier in new application development.

ECDI: Today's Inflection Point

Where:

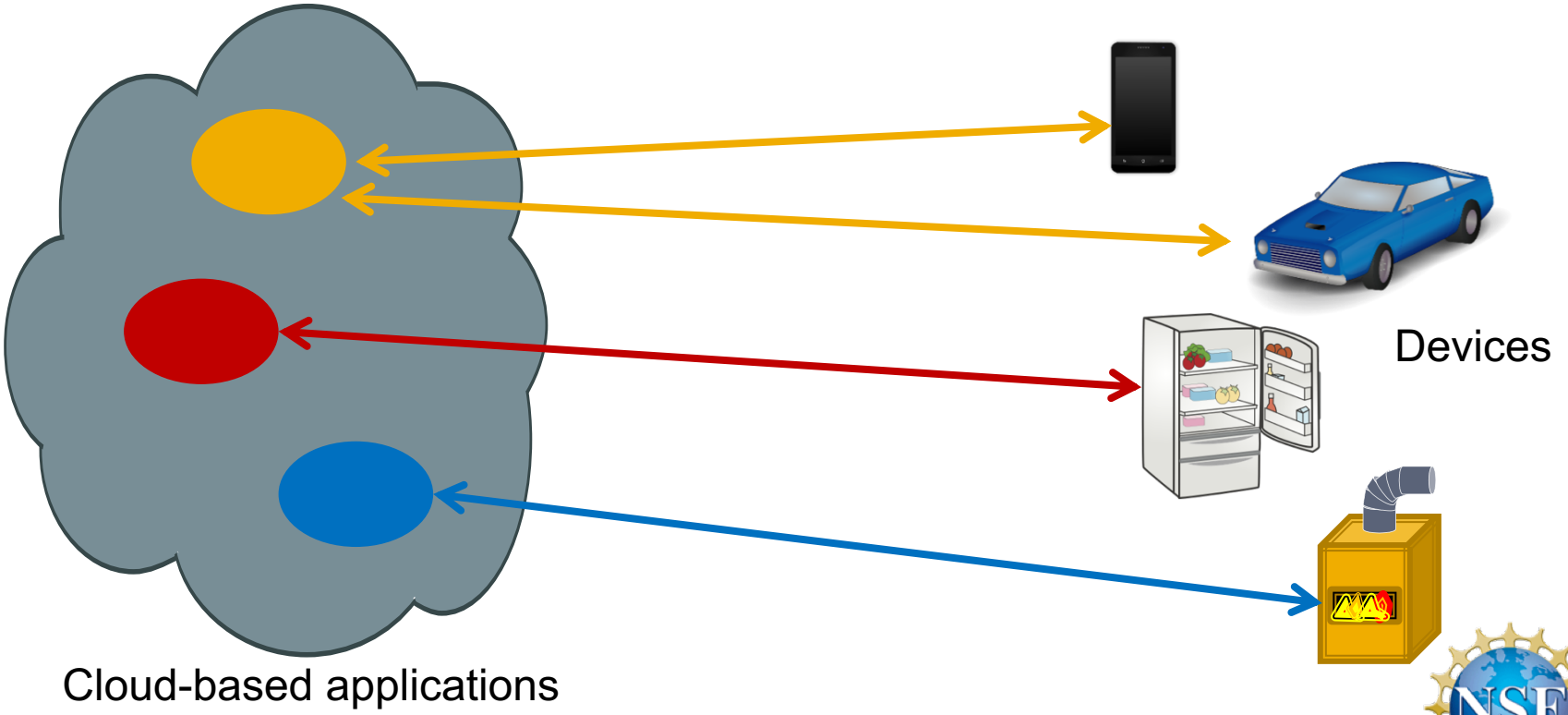
- Data is abundant & unlocking its value through:
  - Resource and data sharing
  - Across the edge computing ecosystem
  - While maintaining security & privacy
- → novel applications & services

ECDI: Background

- With proliferation of mobile and Internet-of-Things (IoT) there is shift from edge devices consuming data from a cloud to "edge computing" where devices produce voluminous data and compute and storage are positioned at the network edge resulting in:
  - Requirement for more cohesive and time-responsive communication, computation, and storage systems;
  - A need for a privacy-preserving, secure systems and architectural perspective, along with supporting algorithms and data analytics;
  - Challenges to data placement, movement, processing, and sharing closer to the endpoints.

ECDI: Architectural Context

Edge computing sandwiches an "edge cloud" between devices and data centers.



Images: public domain

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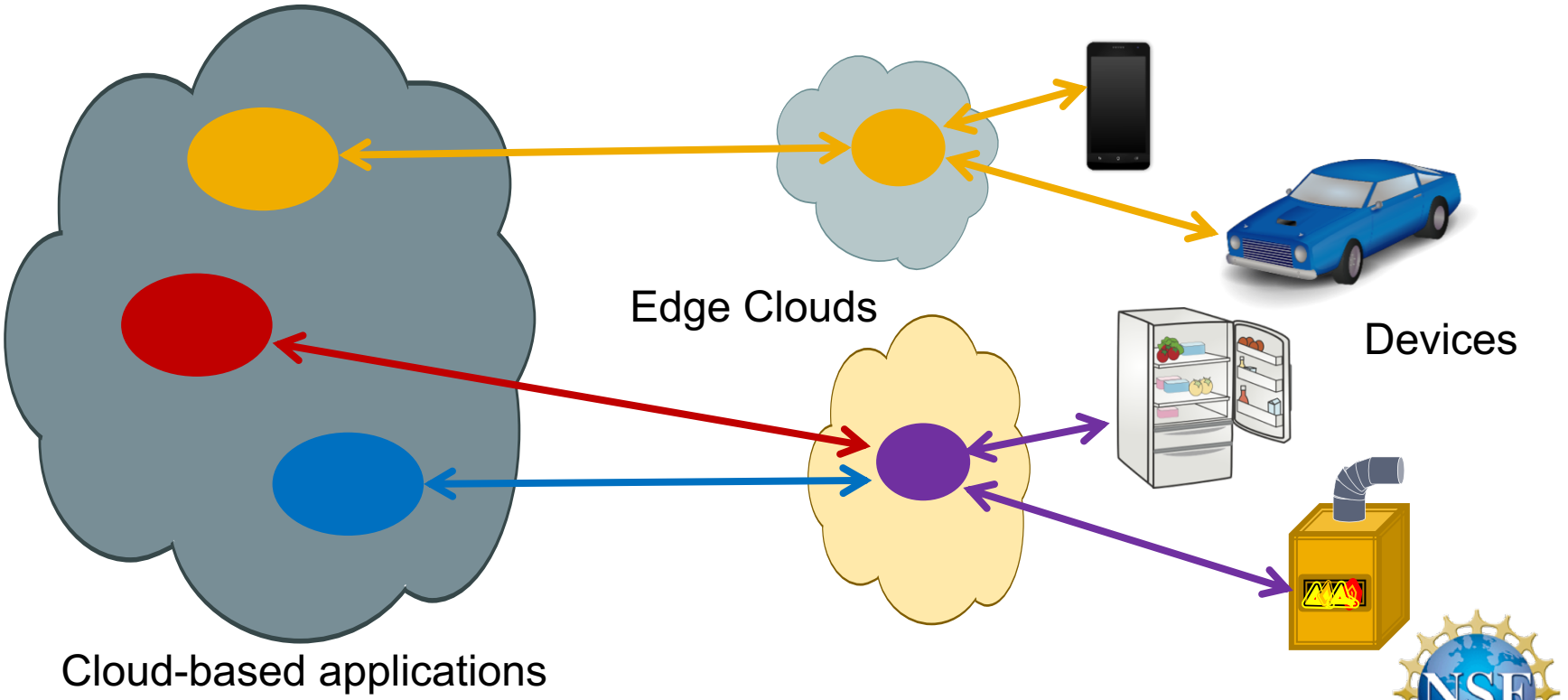

ECDI Challenge: Research in Multi-tenancy/Multi-stakeholder Environments

Desirable outcomes of this program:

- Rich "silo-free" multi-stakeholder service ecosystem on top of multi-tenant distributed edge infrastructure where
  - Multi-tenancy refers to the situation where the infrastructure is multiplexed among multiple applications, regardless of stakeholders
  - Multi-stakeholder refers to the fact that applications/services operate for the benefit of multiple parties
- New data-centric architectural approach with both data security and data privacy across different players
- Data as the "narrow waist" to deal with heterogeneous hardware and software at the edge
- Novel edge applications that leverage multiple data types

ECDI Challenges:

To realize fully the potential for multi-tenant edge computing, include developing appropriate:

- Data-centric edge architectures and abstractions
  - For example, to dynamically control complex domains such as a smart building or industrial facility
- Programming paradigms
- Runtime environments and
- Data manipulation and Data-sharing frameworks

ECDI: Overarching Question

Solicitation asks:

> What data-centric, multi-tenant, multi-stakeholder edge architectures, programming paradigms, runtime environments, and data sharing approaches will enable compelling new applications and fully realize the opportunity of big data in tomorrow's mobile and IoT device environments?

ECDI: Example Research Vectors

- System Architecture
  - E.g. Movement of computation & data, network and storage; virtualization, edge operating systems, system, abstractions
- Programming Paradigms
  - E.g. Programming abstractions, data curation, division of computation
- Security, Privacy, Data Sharing
  - E.g. controlled location-independent data sharing, isolation, security in architecture and programming models

ECDI: Application Domains

Research should be grounded in one or more applications of societal import. Examples are:

- Intelligent transportation
- Smart cities and communities
- 5G and beyond telecommunication
- Industrial IoT

ECDI: Develop Prototypes

Purpose of prototypes

- Explore implementation aspects of designs
- Empirical demonstration of effectiveness of approaches

Prototypes should leverage existing software, tools, frameworks, testbeds if possible

ECDI: Research and Broader Impact Results

Potential program results should include solutions in the context of one or more specific application domains, have an evaluation component, and include one or more of the following outcomes:

- Theories
- Algorithms
- Data-centric edge architectures
- Programming paradigms
- Runtime environments
- Prototypes of system components
- Prototypes of applications
- Testbeds

ECDI: Solicitation and Review

- Solicitation Requirements
- Review Process
  - Solicitation-Specific Review Criteria
- Award Selection Process
- Management of the Projects
- Q & A

ECDI: Key Numbers

NSF 18-540

- Proposals due: May 22, 2018
- Approximately 2 project awards
  - Up to $3,000,000 per project
  - Over 3 years
- NSF funds from FY2018
- Awards late summer 2018

ECDI: Who Can Submit

- Institutes of Higher Education (IHEs) Universities and two- and four-year Colleges (including community colleges)
  - See special instructions for International Branch Campuses of IHEs
  - Sub-awardee requirements: same as submitting institutions

ECDI: Proposal Requirements

- Personnel:
  - 1 proposal submission per person as PI, co-PI, or senior personnel in response to this solicitation.
    - Inclusion of each member needs to be justified with respect to the goals of the project
  - Some number of graduate students expected
  - Some number software engineers or programmers may be submitted as needed
- Proposal Sections
- 20-pages for the Project Description
  - 1 Gantt chart: tasks, milestones, interdependencies

ECDI: Proposal Requirements

- 1-page Postdoc Mentoring Plan (if applicable)
- 2-page (max) Collaboration Plan
  - Appropriateness of team participants and expertise
  - Role of each team member
  - Management and Coordination mechanisms
  - Interdependencies among tasks
  - Reference of budget lines to support collaboration
- 2-page (max) Data Management Plan
  - See http://www.nsf.gov/cise/cise_dmp.jsp for guidance.
- 0 general letters of support

ECDI: Intellectual Property

- NSF/VMware Partnership awardees will agree to dedicate to the public all intellectual property resulting from the research funded as part of this program, and further:

- The awardees will offer its software through an open source license under an Apache 2.0 license found at:
  - http://www.opensource.org/licenses/apache2.0.php or other similar open source license; in the event the software already contains code licensed under GNU's General Public License (GPL), then the open source shall be through GPL version 3 found at http://www.gnu.org/licenses/gpl.html;

- The awardees will submit for publication in openly available literature any results of this research; and

- The awardees will deposit all published manuscripts and juried conference papers in a public access-compliant repository in accordance with the guidelines set forth in NSF's Public Access Policy (see NSF Public Access Frequently Asked Questions at:
  - https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf18041) no later than 12 months after initial publication.

ECDI: Review Process

NSF: Panel with ad hoc reviews as appropriate:

- Intellectual Merit & Broader Impacts
- See NSF 18-1; Proposal and Award Policies and Procedures Guide (PAPPG) for more information
- Additional Review Criteria—see next slide
- VMware team members participate as observers

Joint NSF-VMware reverse site visits as needed

Joint NSF-VMware decisions on awards based on NSF Merit Review process

ECDI: Solicitation-specific Review Criteria

In addition to Intellectual Merit and Broader Impact, the proposal will be evaluated on the degree to which:

- Project pursues a systems perspective and the creation, deployment, and evaluation of demonstrations or prototypes at the component and eventually the system levels;
- Project features a lean, well-integrated team of researchers with expertise area(s) necessary to conduct the proposed work;
- Projects demonstrate concrete plans to impact the broader industry;
- Researchers leverage existing components and infrastructure including multi-tenant edge computing software frameworks (e.g. EdgeX, Open Edge Computing, Cloudlets , CloudLab, Chameleon, GENI, etc.) and provide justification for their choices including the need to develop something new.

ECDI: Funding Model

Projects will be jointly funded by NSF and VMware through separate NSF and VMware funding instruments.

- NSF awards will be made as grants.
- VMware awards will be made as VMware agreements (Contracts or Grants) through VMware or its Vanguard-managed University Research Fund.
- NSF and VMware will manage their respective awards/agreements in accordance with their own guidelines and regulations.
- Either organization may supplement a project without requiring the other party to provide any additional funds.

ECDI: Program Management

- NSF and VMware will each designate a Program Director for each NSF/VMware Partnership award who will jointly oversee the execution of the project

- The VMware Program Director may become a member of the NSF/VMware Partnership Project Management Team.
- Annual on-site reviews may be conducted jointly by NSF and VMware.

- Institutions may request site visits to VMware or invite site visits from VMware.

- VMware may invite academic faculty and students to visit VMware and may visit research institutions upon request.

ECDI: Proposal Summary

- Title: ECDI: <title>
  - For Collabs: ECDI: Collaborative Research: <title>
- Project Description: 20 pages
- Supplementary Documents
  - A list of Project Personnel and Partner Institutions
  - Collaboration Plan
  - Data Management Plan
  - Post-Doctoral Mentoring Plan (if applicable)
- Single Copy Documents
  - list of collaborators

ECDI: Full Proposals

Deadline

5:00 pm submitter's time on May 22, 2018

"Save the date" -- July 13, 2018 for possible Reverse Site Visit (virtual)

Questions?