The Computing & Information Science & Engineering Landscape: A look forward

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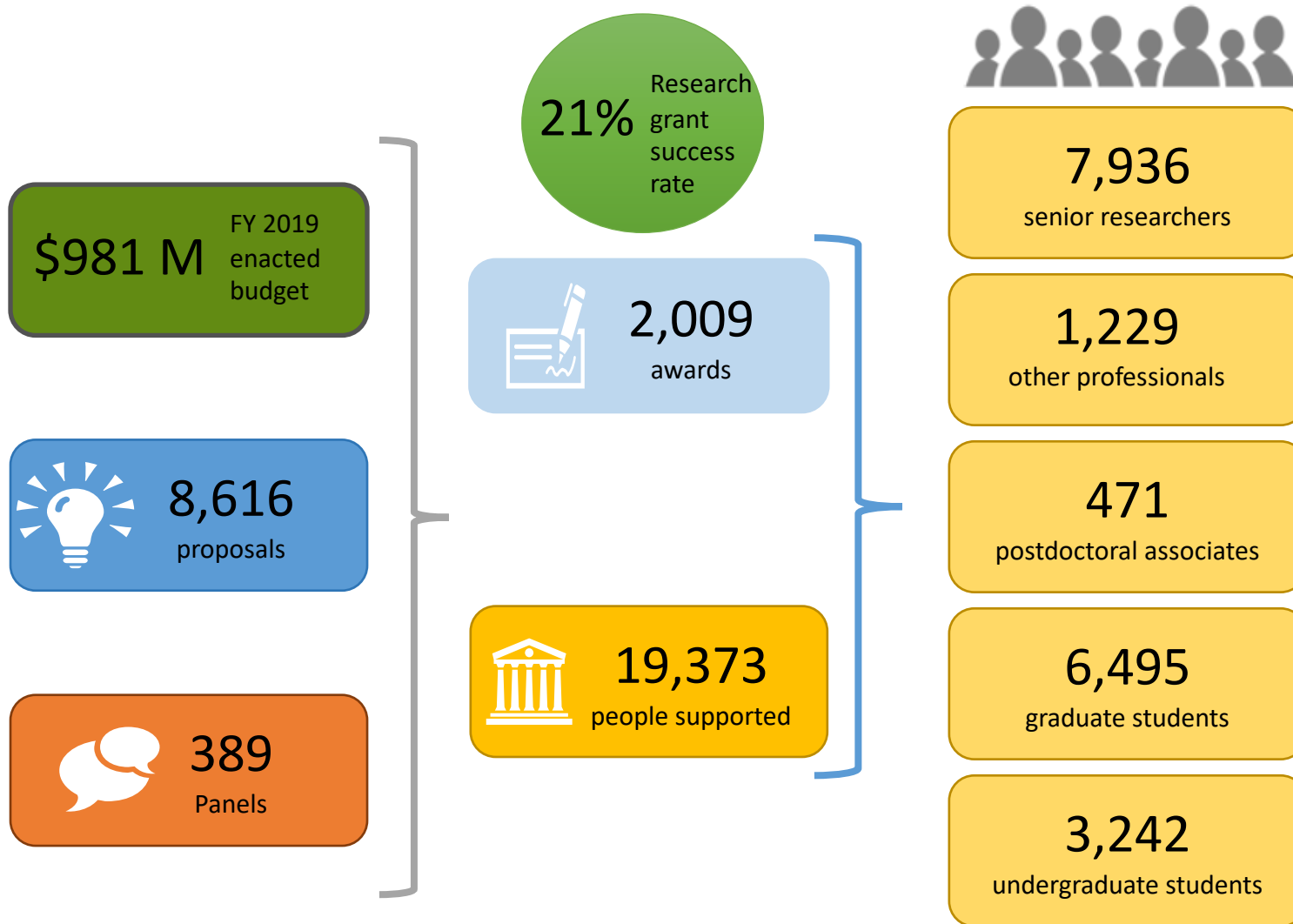
November, 2020

Research:
Planting trees now,
in order to
have shade in
the future

NSF CISE by the numbers, FY 2019

21% Research grant success rate

$981 M FY 2019 enacted budget

8,616 proposals

389 Panels

2,009 awards

19,373 people supported

7,936 senior researchers

1,229 other professionals

471 postdoctoral associates

6,495 graduate students

3,242 undergraduate students

NSF funds > 85% of federally-funded academic CS research in the US.

(Source: NCSES)

FY 2020: CISE: $1.01B

FY21 Pres Budget Request:
NSF: $7.74B (-6.5%)
CISE: $1.06B (+5%)

Today…

- Technical Themes
- "How to get there": Programs, Infrastructure, People…
- Recent Events: Impacts and Responses
- Q&A

Technical Themes

- CISE in a Post-Moore World: The Seismic Shift
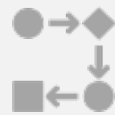- Transcendence of Artificial Intelligence
- CISE's Sociotechnical Frontier

Technical Themes

CISE in a Post-Moore World: The Seismic Shift

Transcendence of Artificial Intelligence

CISE's Sociotechnical Frontier
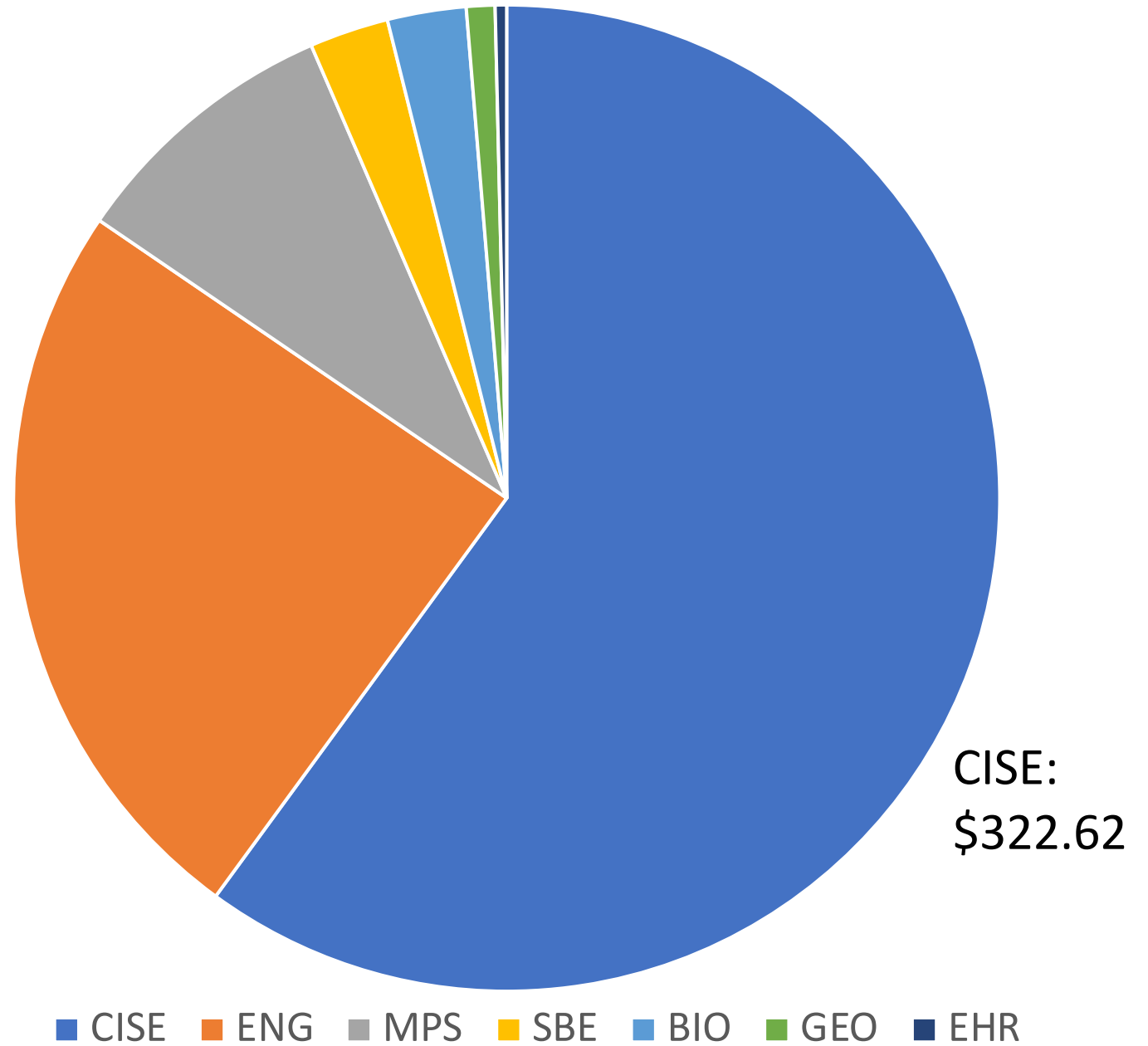
NSF-led National AI Research Institutes
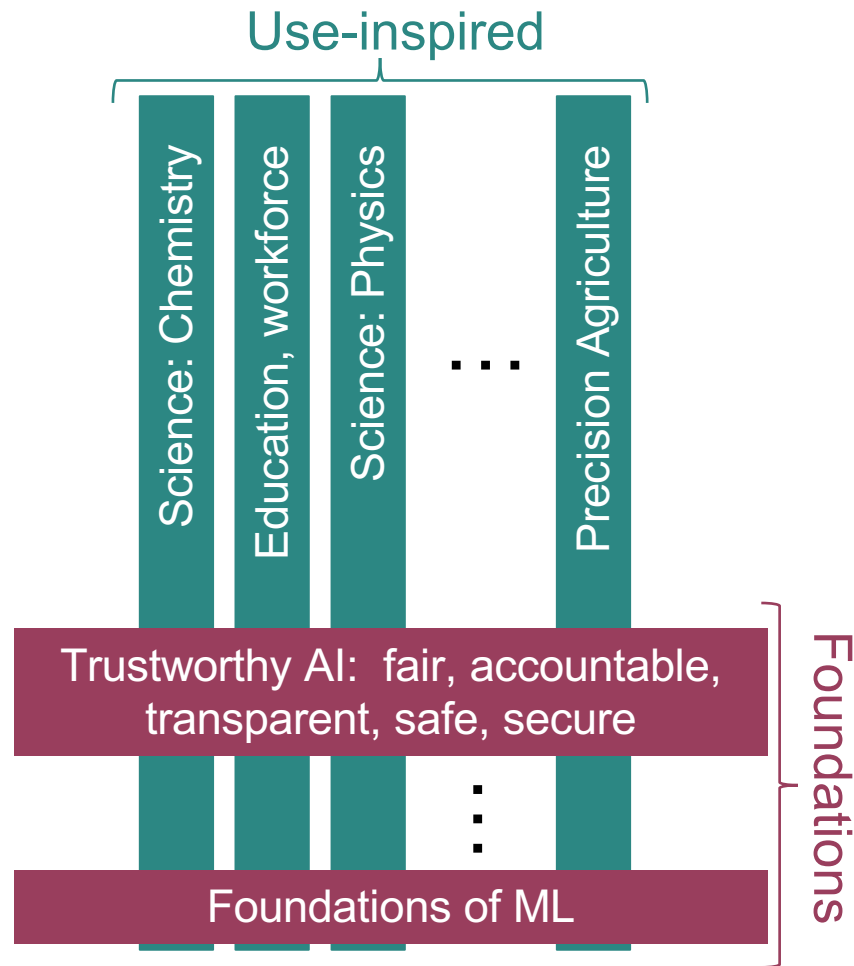
Use-inspired

Science: Chemistry
Education, workforce
Science: Physics
. . .
Precision Agriculture

Trustworthy AI: fair, accountable, transparent, safe, secure

Foundations of ML

Foundations

National hubs for universities, government, industry and nonprofits to advance AI research and education

- $20M over five years per Institute

- First round of awards announced Aug. 26, 2020
  - Launched seven new Institutes nationwide ($140 million)

2020 AI Research Institutes

Artificial Intelligence (AI) Research Institutes

The NSF-led AI Research Institutes — two USDA-NIFA AI hubs plus five NSF — comprise the nation's most significant single federal investment in AI to date and will advance national competitiveness in AI by accelerating research, transforming society, and growing the American workforce.

NSF AI Institute for Research on Trustworthy AI in Weather, Climate, and Coastal Oceanography

★ **Primary:** University of Oklahoma, Norman Campus
■ **Principal Organizations:**
 – University of Oklahoma
 – Colorado State University
 – North Carolina State University
 – University at Albany, SUNY
 – Texas A&M University-Corpus Christi
 – University of Washington
 – Del Mar College
 – National Center for Atmospheric Research/ University Corporation for Atmospheric Research
● **Partners/Collaborators**

USDA-NIFA AI Institute for Next Generation Food Systems

★ **Primary:** University of California, Davis
■ **Principal Organizations:**
 – University of California-Davis
 – Cornell University
 – University of California, Berkeley
 – University of Illinois at Urbana-Champaign
 – University of California Agriculture and Natural Resources
● **Partners/Collaborators**

NSF AI Institute for Foundations of Machine Learning

★ **Primary:** University of Texas at Austin
■ **Principal Organizations:**
 – University of Texas at Austin
 – University of Washington
 – Wichita State University
 – Microsoft Research
● **Partners/Collaborators**

NSF AI Institute for Student-AI Teaming

★ **Primary:** University of Colorado Boulder
■ **Principal Organizations:**
 – University of Colorado Boulder
 – Colorado State University
 – University of California, Santa Cruz
 – University of California, Berkeley
 – Brandeis University
 – Worcester Polytechnic Institute
 – Georgia Tech
 – University of Illinois at Urbana-Champaign
 – University of Wisconsin-Madison
● **Partners/Collaborators**

NSF AI Institute for Artificial Intelligence and Fundamental Interactions

★ **Primary:** Massachusetts Institute of Technology
■ **Principal Organizations:**
 – Massachusetts Institute of Technology
 – Northeastern University
 – Harvard University
 – Tufts University
● **Partners/Collaborators**

Molecule Maker Lab Institute (MMLI): NSF AI Institute for Molecular Discovery, Synthetic Strategy, and Manufacturing

★ **Primary:** University of Illinois at Urbana-Champaign
■ **Principal Organizations:**
 – University of Illinois at Urbana-Champaign
 – Pennsylvania State University
 – Rochester Institute of Technology
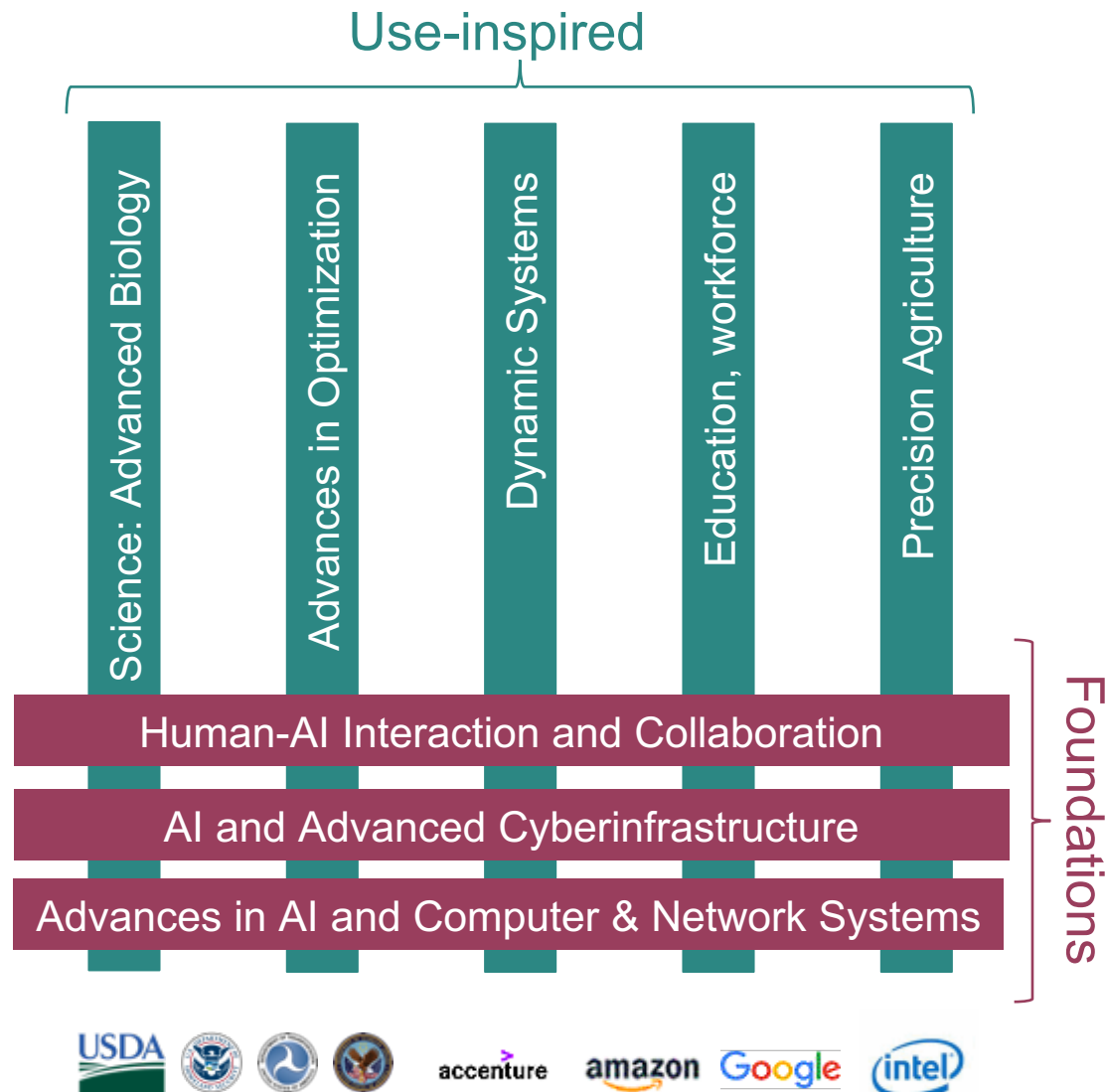● **Partners/Collaborators**

USDA-NIFA AI Institute for Future Agricultural Resilience, Management, and Sustainability (AIFARMS)

★ **Primary:** University of Illinois at Urbana-Champaign
■ **Principal Organizations:**
 – University of Illinois at Urbana-Champaign
 – University of Chicago
 – Michigan State University
 – Tuskegee University
 – Danforth Plant Science Center
● **Partners/Collaborators**

National Science Foundation

2021 AI Research Institutes

Use-inspired

- Science: Advanced Biology
- Advances in Optimization
- Dynamic Systems
- Education, workforce
- Precision Agriculture

Human-AI Interaction and Collaboration

AI and Advanced Cyberinfrastructure

Advances in AI and Computer & Network Systems

Foundations

National hubs for universities, government, industry and nonprofits to advance AI research and education

- $20M over five years per Institute

- First round of awards announced Aug. 26, 2020
  - Launched seven new Institutes nationwide ($140 million)

- FY 2021 solicitation (NSF 20-604)

- NSF Program Webinar: Sept 21, 2020. 3:30-5pm ET

Technical Themes

CISE in a Post-Moore World: The Seismic Shift

Transcendence of Artificial Intelligence

CISE's Sociotechnical Frontier

CISE's Sociotechnical Frontier

- Cyber-Physical and Cyber-Human interactions increasingly shape our society and economy

- Responsibility Meets Opportunity
  - Reshape computation to "bake in" notions of security, trust, verifiability, privacy and fairness

- At all levels and in many forms:
  - Health, connectivity, community, fair access to trustworthy information...

**PuebloConnect. NSF #1831698
Lead PI: Elizabeth Belding
UC-Santa Barbara**

HIghlights

- **CIVIC Innovation Challenge**
- **Project Overcome**
- **CISE/SBE workshops look ahead toward future investments**
- **NASEM CSTB Study Launched this month on Responsible Computing Research: Ethics and Governance in our Research and its Applications**

Civic Innovation Challenge: Building Upon Smart & Connected Communities

- Challenge Format
- Two themes (mobility and resilience)
  - Strong COVID-19 alignment
- Flip the dynamic: Communities apply and bring researchers with them.
- Accelerate impact of Smart & Connected Communities research
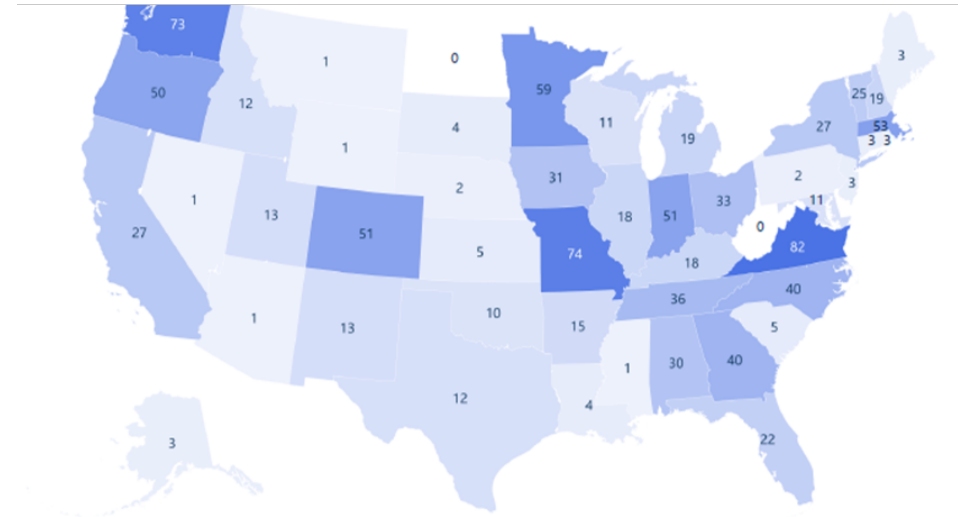- August deadline: 400 entries! Roughly half on COVID topics

https://nsfcivicinnovation.org
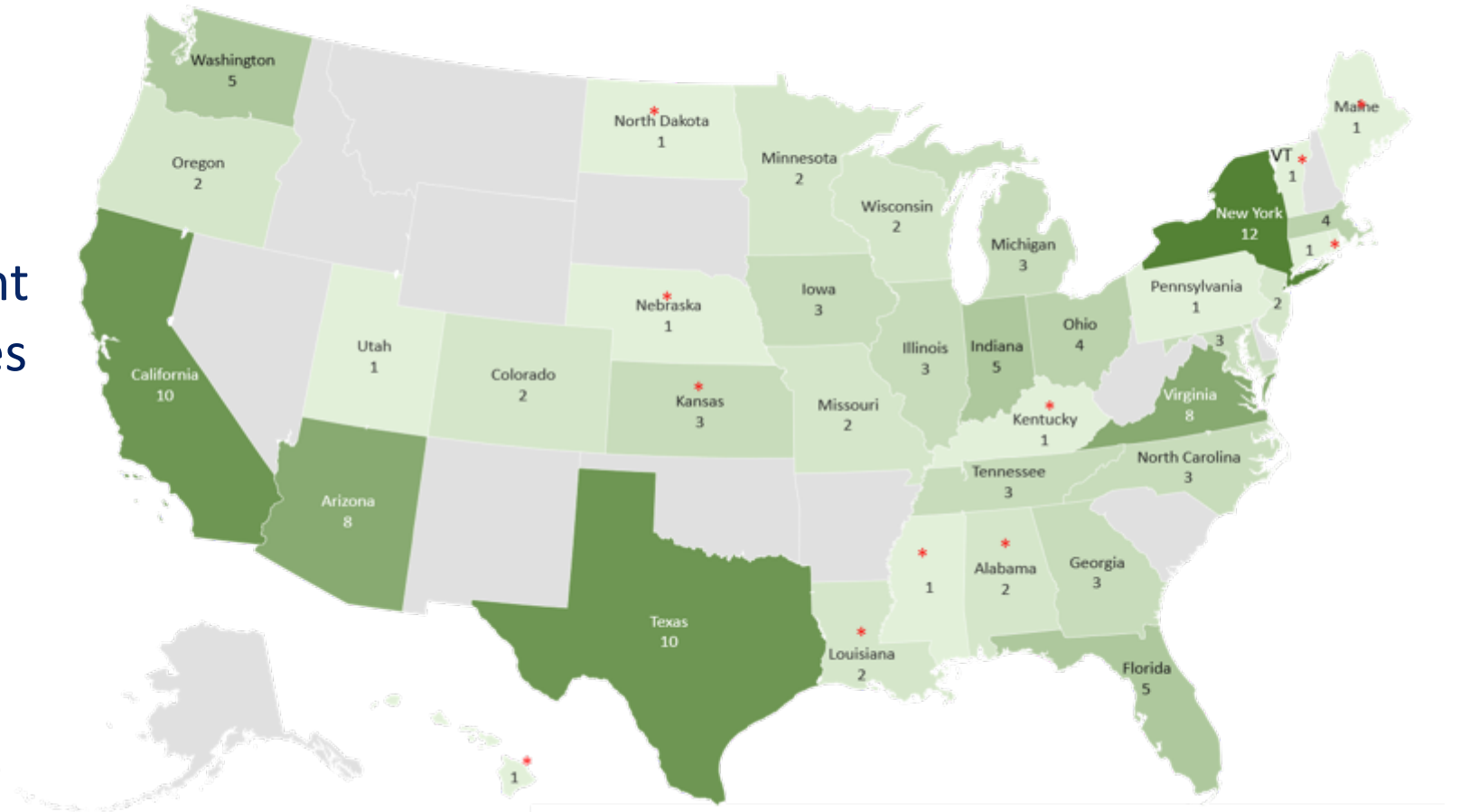
S&CC community includes 42 States plus DC and PR
(with subawards, all states represented except South Dakota)

Project Overcome

- Facilitated by funding -> US Ignite

- Goal: 5 proof-of-concept network deployments supporting virtual learning in underserved communities

- <u>Community proposals draw from</u> mix of academic, nonprofit, industry, government, student, and volunteer partners.

- <u>Selected proposals to reflect</u> a mix of population densities, demographics, geography, housing types, local and industry collaborations, and technical approaches.
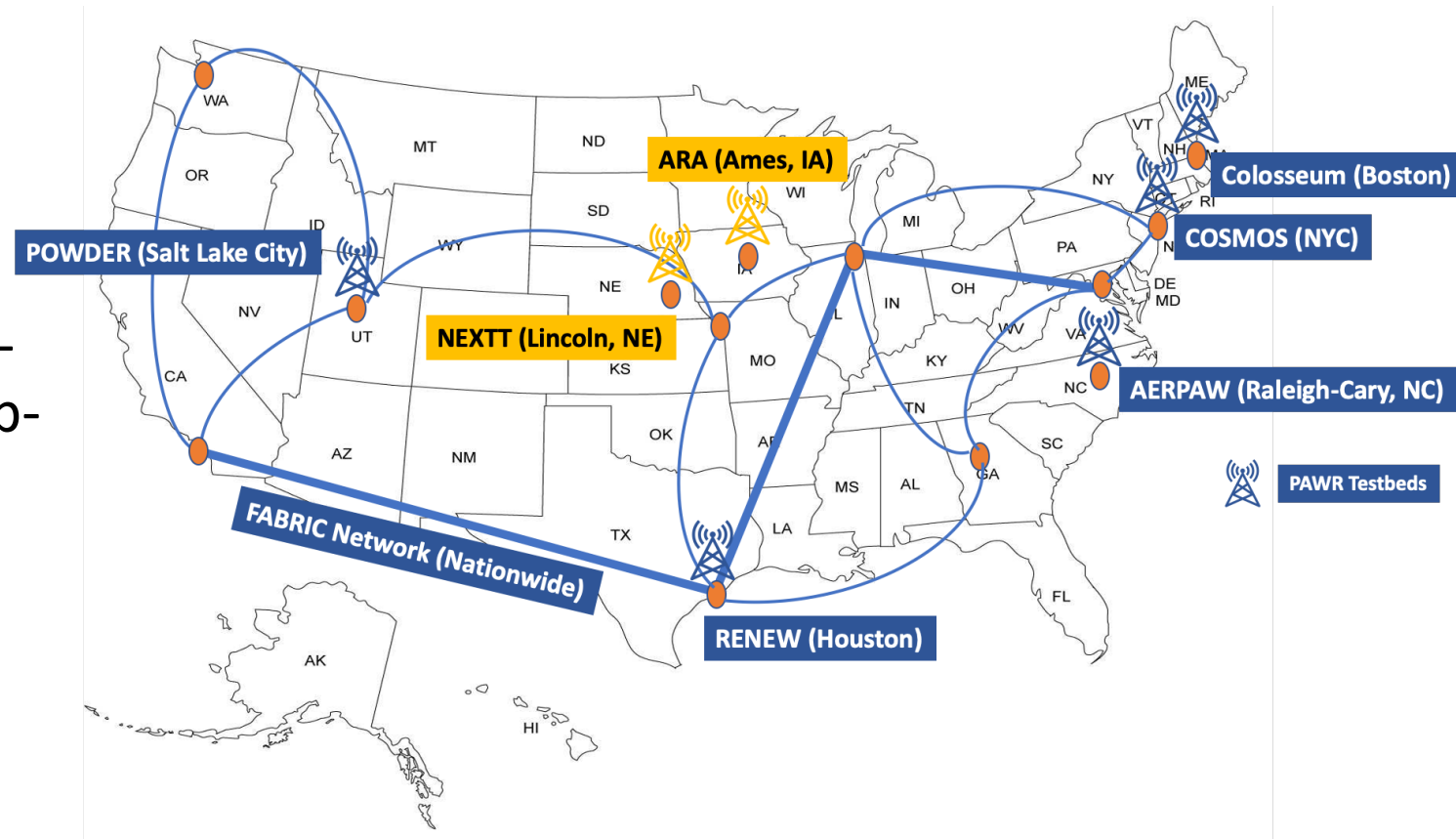
Estimated Cities with Municipal Broadband Programs by State

https://www.us-ignite.org/news/us-ignite-launches-project-overcome-funded-by-the-national-science-foundation/

PAWR Rural Broadband "Bakeoff"

- **Platforms for Advanced Wireless Research (PAWR):** Public-private partnership with 32 companies/associations, totaling $100M over 5 years, to build 4 city-scale experimental platforms in sub-6 GHz and mmWave frequencies, featuring UASs, IoT, SDN, transport and backhaul solutions

- 2020-1: Rural Broadband Bakeoff

ARA (Ames, IA)

POWDER (Salt Lake City)

NEXTT (Lincoln, NE)

Colosseum (Boston)

COSMOS (NYC)

AERPAW (Raleigh-Cary, NC)

PAWR Testbeds

FABRIC Network (Nationwide)

RENEW (Houston)

(intel)

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Vision: A National Research Cloud

"Partnerships can help researchers overcome technical and financial barriers, as NSF is doing through its CloudBank initiative to connect NSF-sponsored researchers to cloud computing resources. This could expand into a nation-wide National Research Cloud."
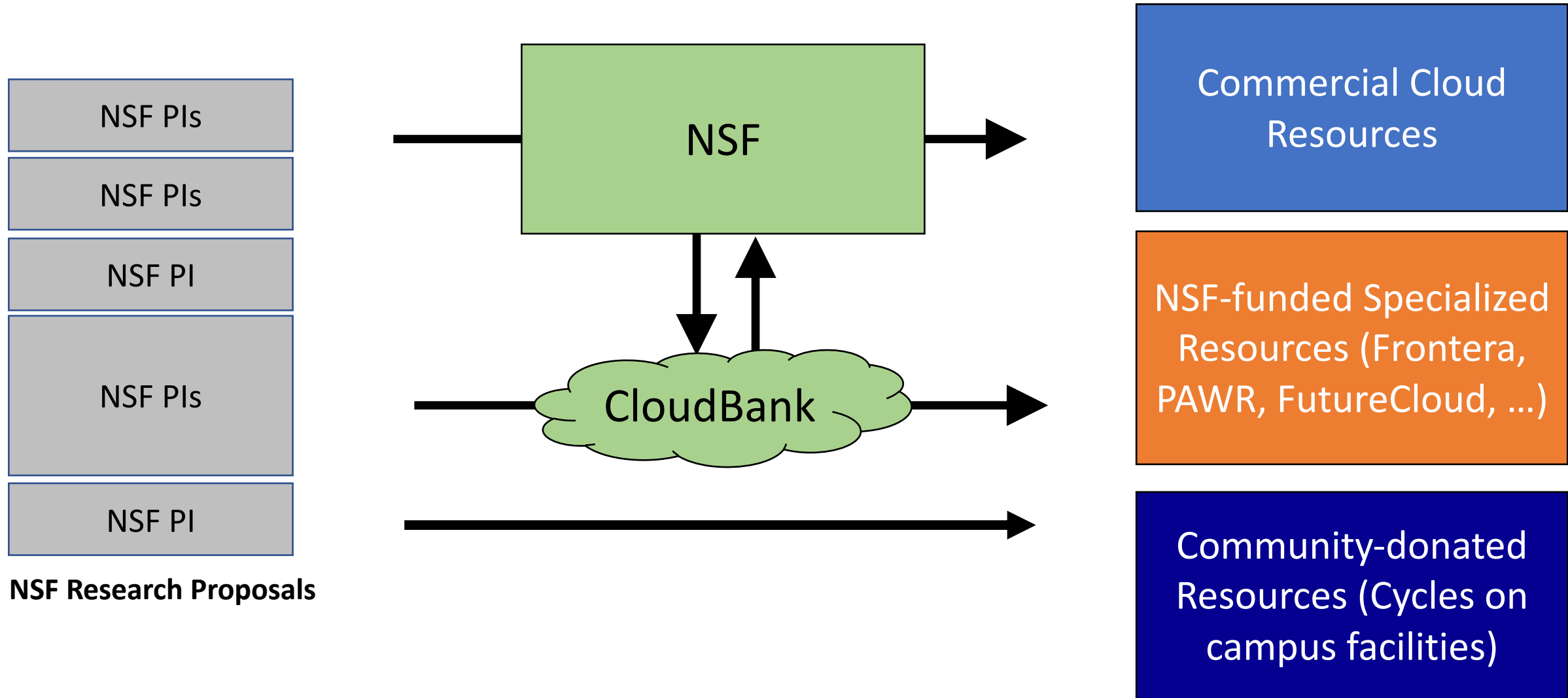
Eric Schmidt, January 2020 Testimony to HSST
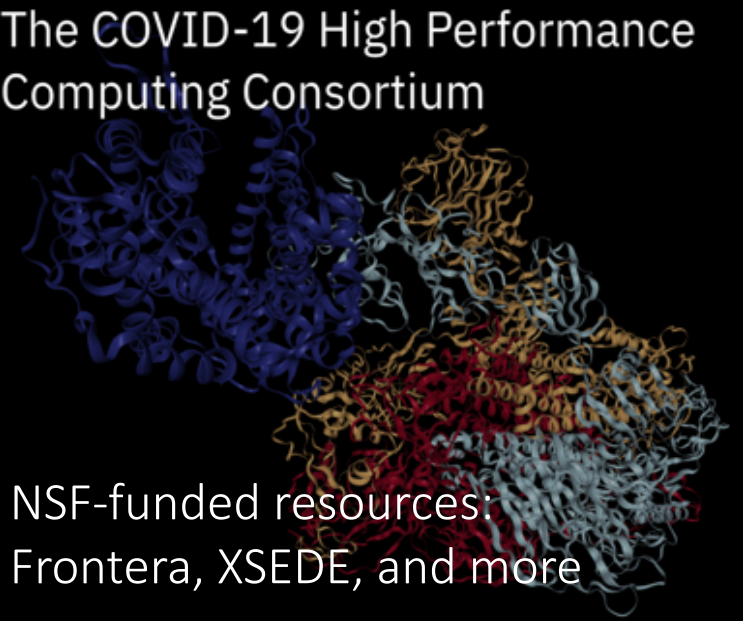
https://www.cloudbank.org

Goals:

1. Scale from CloudBank ($5M pilot) to national capacity.

2. Democratize access to rich and diverse set of NSF-funded and commercial research resources
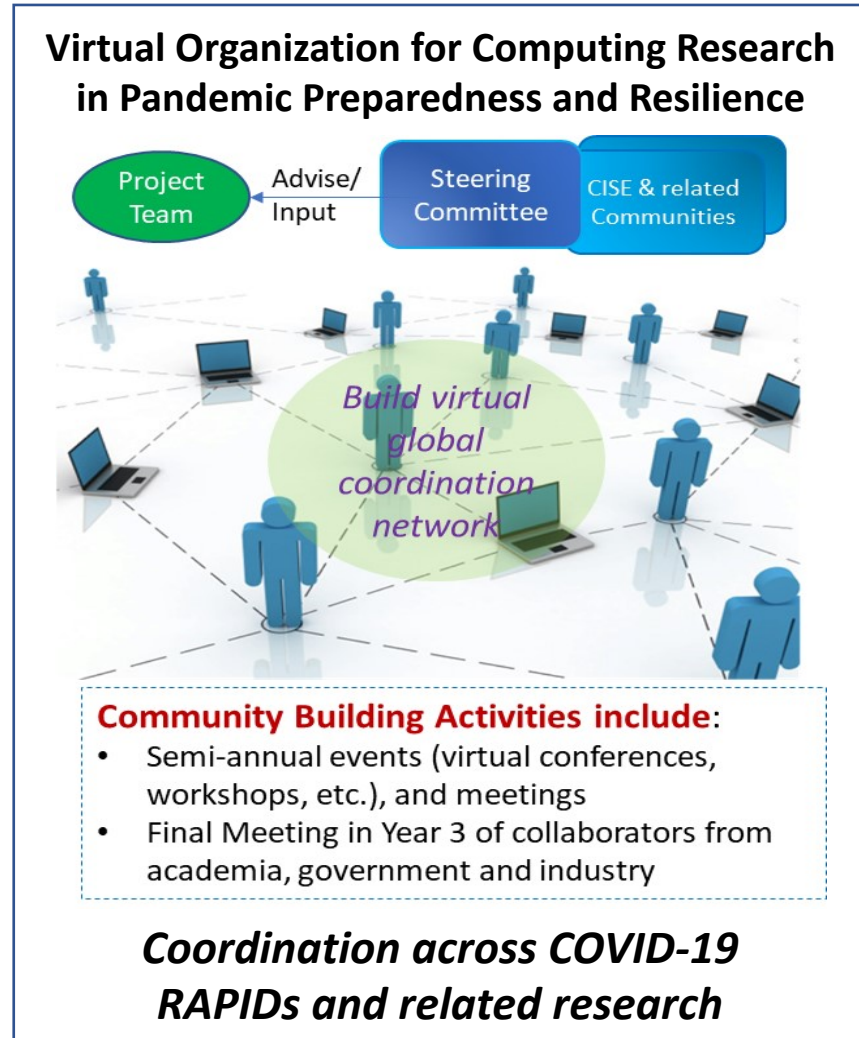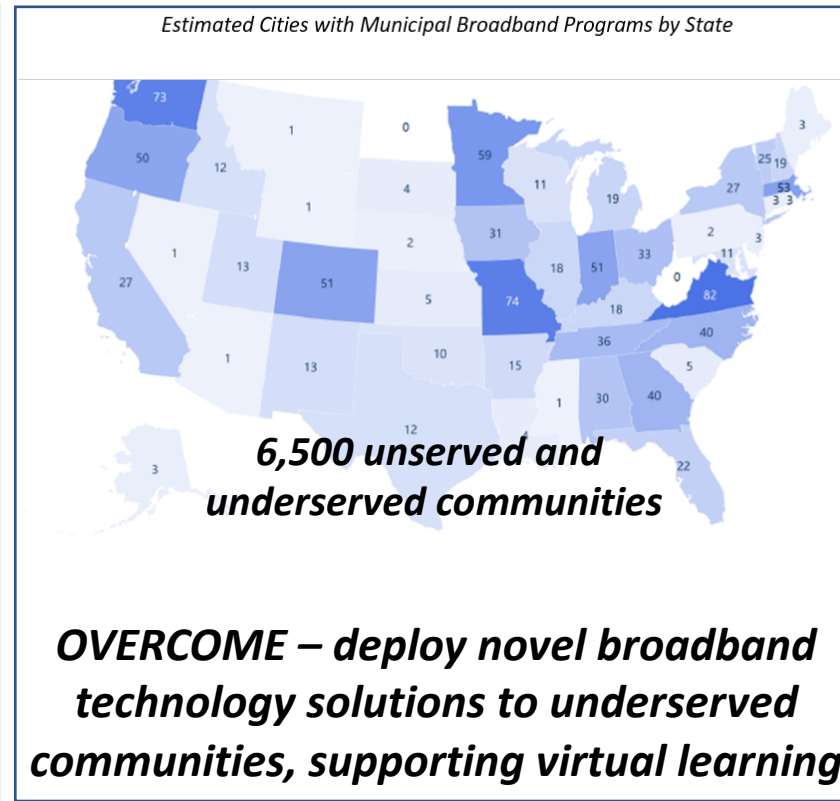
Towards a National Research Cloud

CISE COVID-19 Impact & Response

The COVID-19 High Performance Computing Consortium

NSF-funded resources: Frontera, XSEDE, and more

Addressing the need for advanced computing for COVID-19 research

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Estimated Cities with Municipal Broadband Programs by State

6,500 unserved and underserved communities

OVERCOME – deploy novel broadband technology solutions to underserved communities, supporting virtual learning

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CIFellows 2020
Computing Innovation Fellows

CRA — Computing Research Association
CCC — Computing Community Consortium

Fellowships for graduating doctorate students impacted by hiring reductions at IHEs

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Virtual Organization for Computing Research in Pandemic Preparedness and Resilience

Project Team — Advise/Input — Steering Committee — CISE & related Communities

Build virtual global coordination network

Community Building Activities include:
- Semi-annual events (virtual conferences, workshops, etc.), and meetings
- Final Meeting in Year 3 of collaborators from academia, government and industry

Coordination across COVID-19 RAPIDs and related research

Join Us!

Students

- Research Experiences for Undergraduates (REU)
- NSF Graduate Fellowships

Faculty

- Send us your great proposals
- Proposal Writing Workshops
- Tell us your research triumphs
- Be an NSF Panel Reviewer
- Be an NSF Rotator!