National Strategy for Quantum Information Science

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Office of Science and Technology Policy

Whitehouse.gov/ostp
www.quantum.gov
@WHOSTP
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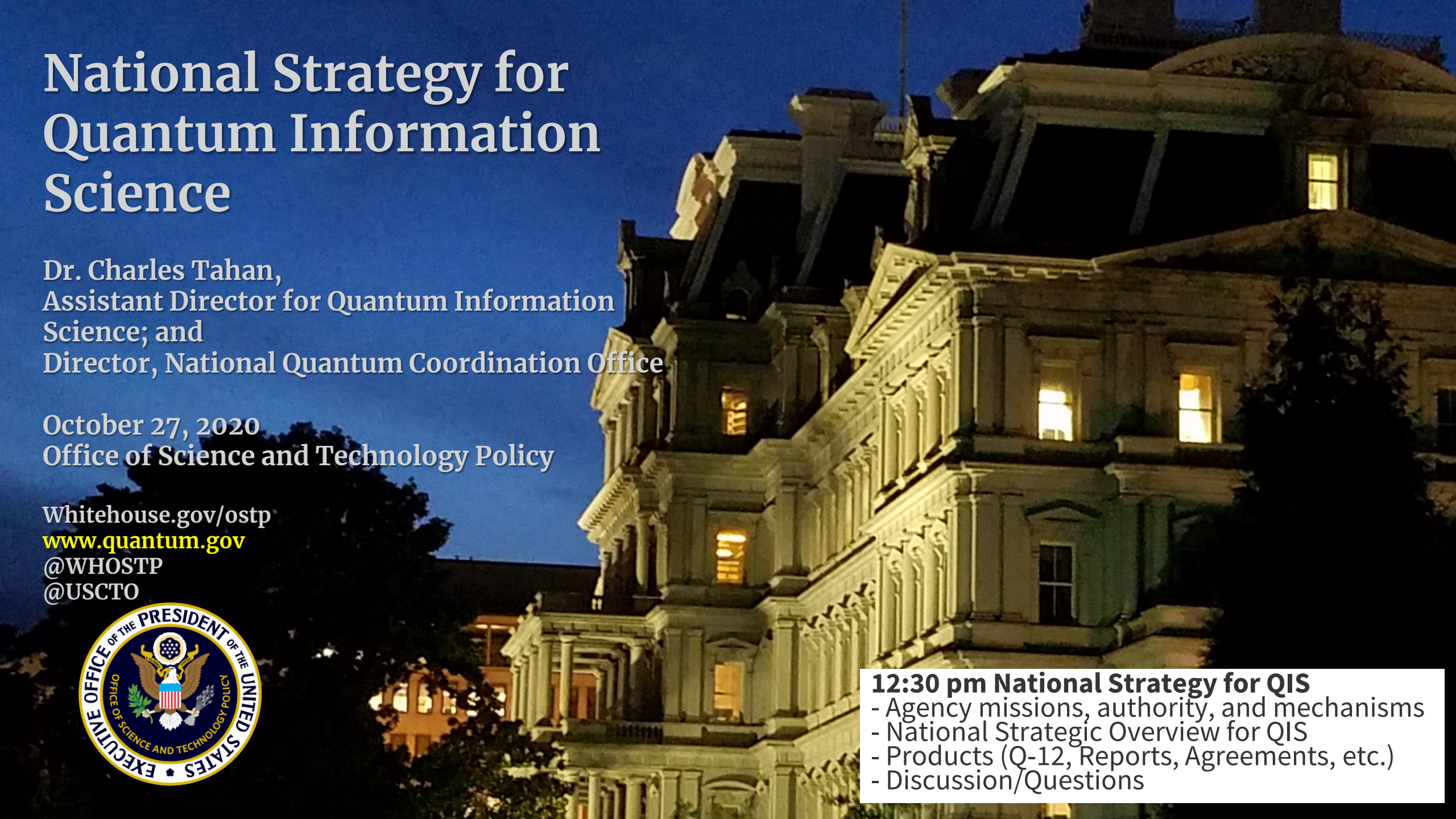
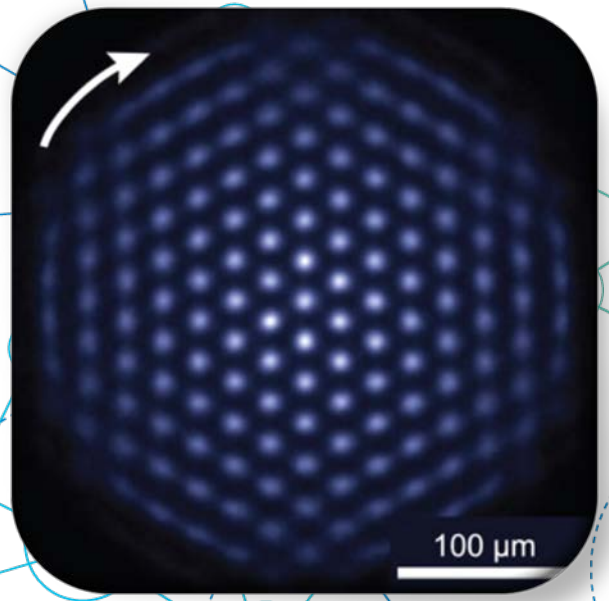


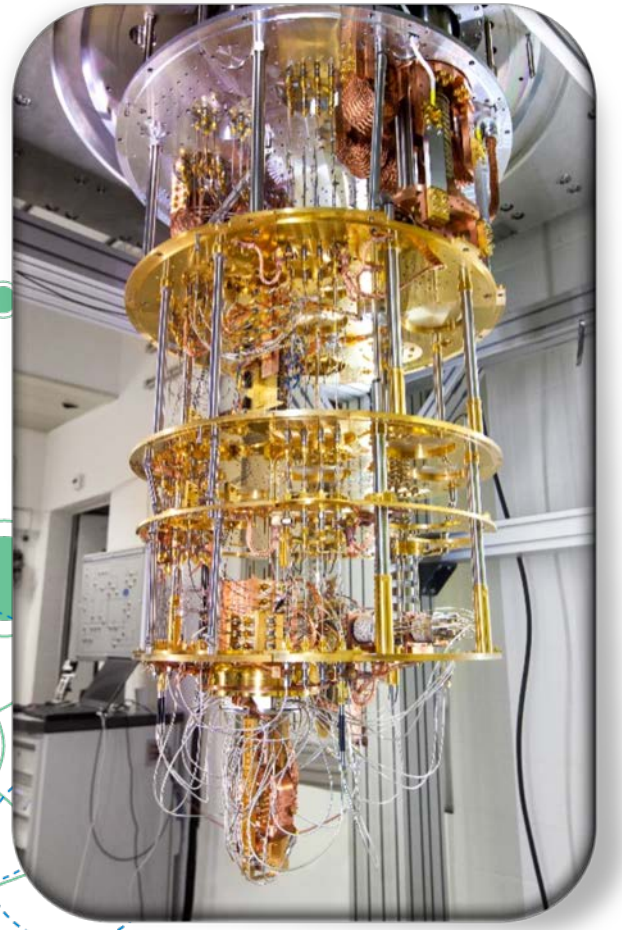
12:30 pm National Strategy for QIS
- Agency missions, authority, and mechanisms
- National Strategic Overview for QIS
- Products (Q-12, Reports, Agreements, etc.)
- Discussion/Questions

Quantum Information Science (QIS) will impact our future prosperity

Quantum Sensors



Quantum Simulators

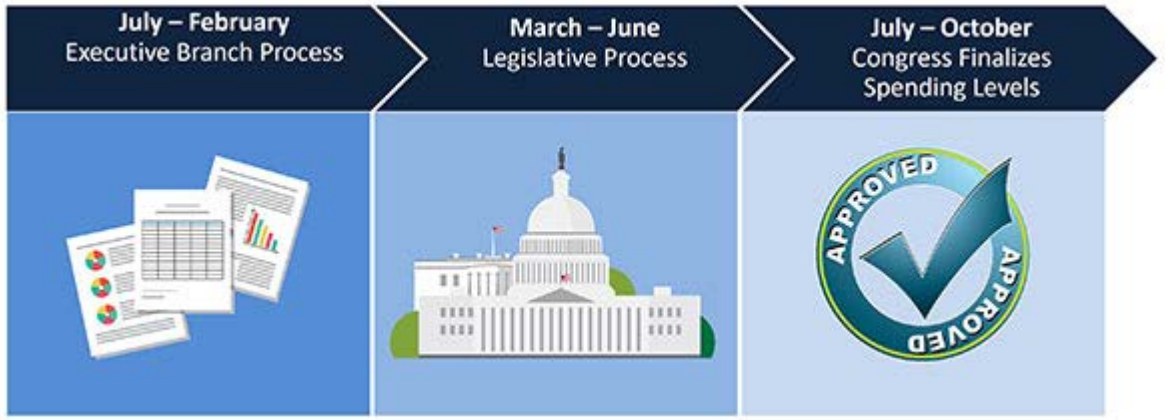


Quantum Computers

Quantum Networks

The US has a federal approach to science funding

- The science policy of the United States is the responsibility of **many** organizations throughout the federal government.
  - Legislative budget process
  - Federal agencies that spend funds allocated by Congress
  - EOP: OSTP, NSTC, PCAST advise the President
  - Congressional oversight: e.g., House Committee on Science & Tech, Senate Committee on Commerce, Science, and Transportation
- **Agency's implement** according to legislation and their mission and funding models
  - Decentralized, diverse, and robust
- Examples of **coordination**:
  - Bilateral coordination between Agencies
  - NSTC Committees and Subcommittees
    - Reports, Working Groups, Task Forces
  - National Coordination Offices (NCO)
    - Reports, Initiatives, Workshops, as legislated



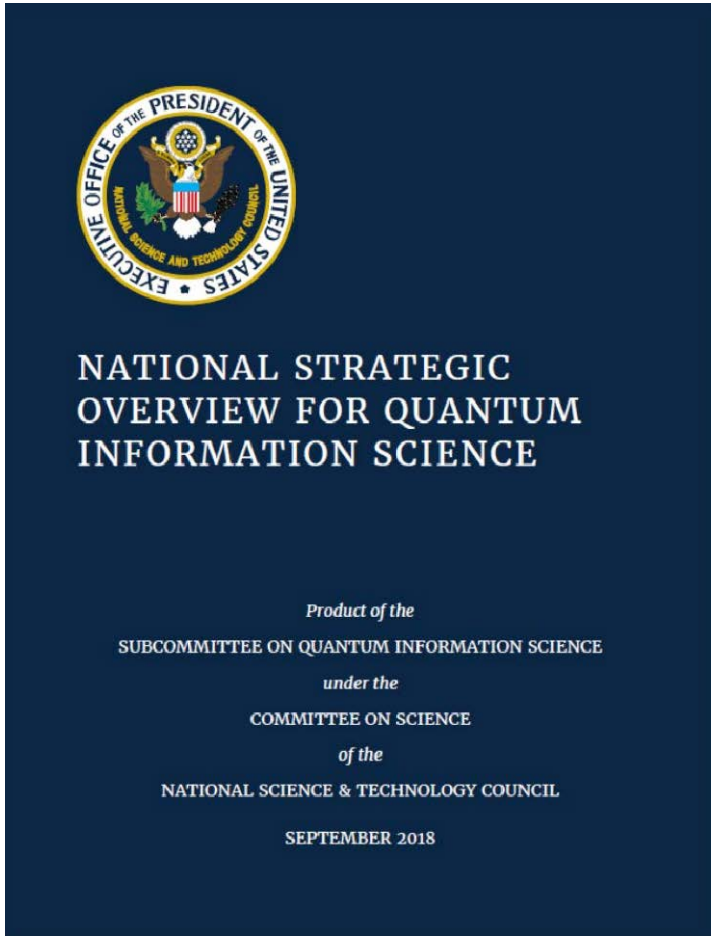
The National Quantum Coordination Office (NQCO) is the newest of only four NCO offices.

NSF, DOE, NIST, NSA, DOD, NASA, ODNI, DHS, STATE, NIH, USDA, FBI, EOP

National Strategy for QIS

First product of the Subcommittee on QIS recommended six policy thrusts:

1. Science-first approach
2. Build a quantum-capable and diverse workforce
3. Nurture nascent quantum industry
4. Balance economic and national security
5. Provide the key infrastructure
6. Continue to develop international collaboration and cooperation



Choosing a science-first approach

Strengthen Federally-funded core research ◊ Share information across community and disciplines ◊ Form National Science and Technology Council Subcommittee on Quantum Information Science (SCQIS) ◊ Identify hard technical problems to prioritize

Broad increase to US R&D QIS Programs (not just NQI Act Agencies)

- Fiscal Year (FY) 2021 Budget put the United States on a path to double Federal research and development (R&D) spending in QIS by FY2022.
- Artificial Intelligence and Quantum Information Science Research and Development Summary: Fiscal Years 2020 – 2021

SCQIS Working Groups ensure Agency cross-briefing and joint strategy dev

- Science Working Group (eg, QIS Program Day)
- Quantum Networking Working Group
  - (following DOE Quantum Internet Blueprint, NASA/NIST workshop)
- End User Working Group

NSTC Subcommittee on Quantum Information Science (SCQIS)

NQCO

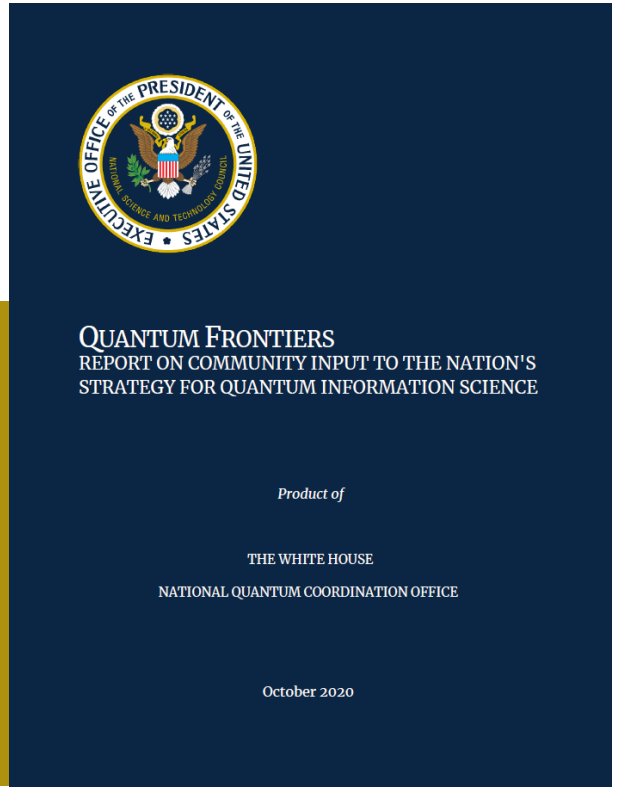
- "Senior Quantum Coordinator" position created and staffed
- *A Strategic Vision for America's Quantum Networks*
- *Quantum Frontiers Report*

REPORT ON COMMUNITY INPUT TO THE NATION'S STRATEGY FOR QUANTUM INFORMATION SCIENCE

The Quantum Frontiers

- Synthesizes feedback from NSF Request for Information (RFI) on National Strategic Overview and multiple Workshops held by Agencies in 2018/2019
- The technical challenges can be found here:

1. Expanding Opportunities for Quantum Technologies to Benefit Society
2. Building the Discipline of Quantum Engineering
3. Targeting Materials Science for Quantum Technologies
4. Exploring Quantum Mechanics through Quantum Simulations
5. Harnessing Quantum Information Technology for Preceision Measurement
6. Generating and Distributing Quantum Entanglement for New Applications
7. Characterizing and Mitigating Quantum Errors
8. Understanding the Universe through Quantum Information



The quantum frontiers capture the technical areas where the key technical challenges can be found toward the various mission and practical objectives within QIST.

Providing Critical Infrastructure

Encourage necessary investments ◊ increase access to facilities ◊ Establish end-user testbed facilities along with training and engagement ◊ Leverage existing infrastructure, including manufacturing facilities

NQI: 3 NSF Quantum Leap Challenge Institutes

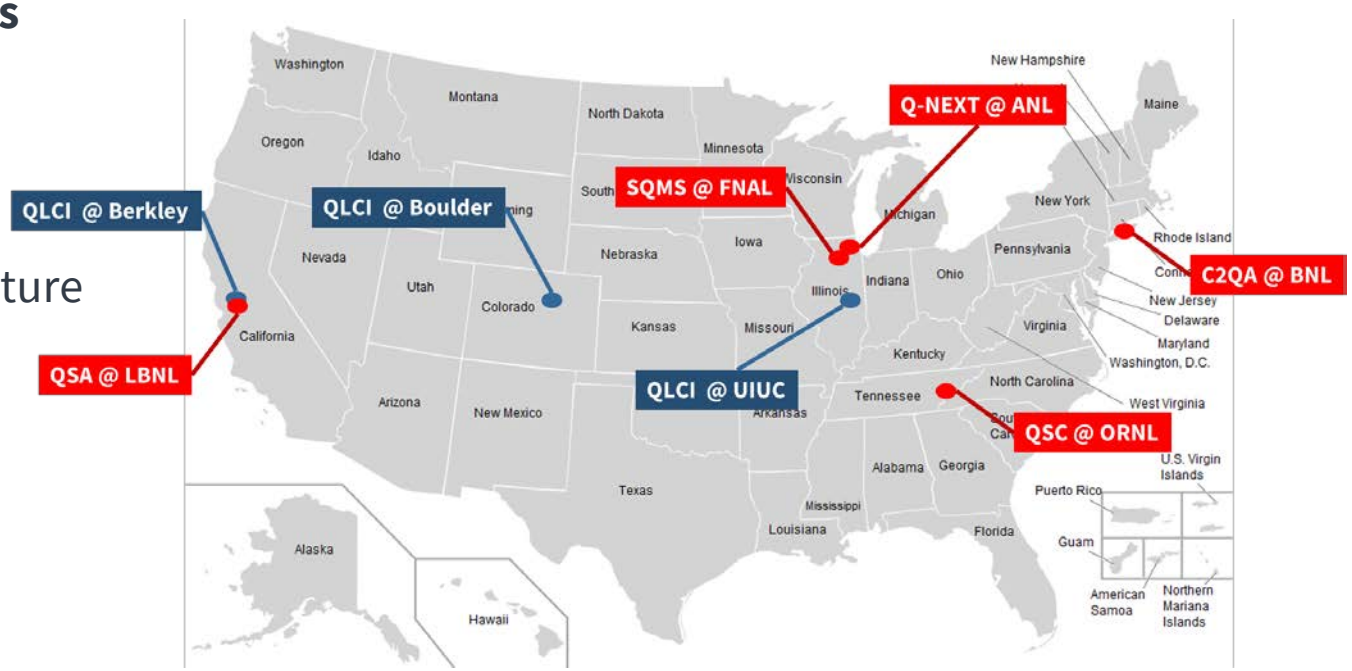
- More next year
- Plus other quantum centers

NQI: 5 DOE QIS Research Centers

- Plus existing user facilities and infrastructure

NDAA 2020: new DOD QIS Research Center(s)

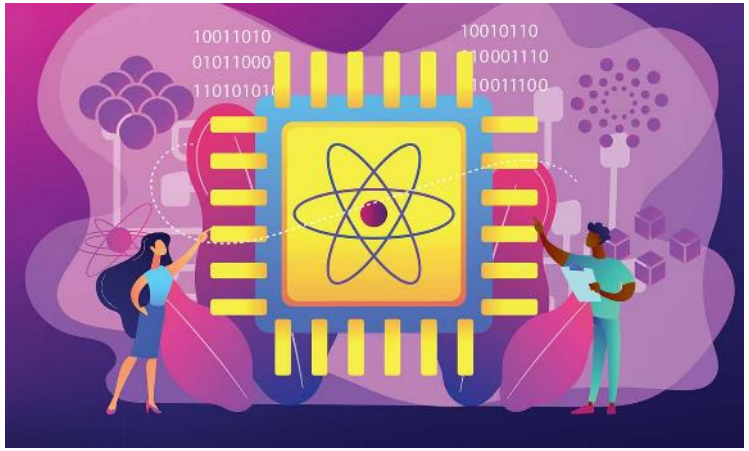
ARO/LPS Qubits for Computing Foundry RFI



Create a quantum-capable workforce

Create convergent, trans-sector approaches for diverse workforce ◊ Use and enhance existing programs ◊ Encourage academia to consider quantum science and engineering as its own discipline ◊ Address education in the area of quantum science at an early stage ◊ Reach out to broader audiences with novel or unconventional approaches ◊ Encourage the QIS community to track and estimate the future workforce needs of quantum industry

- White House Academic Roundtable on QIS (2019)
- NSTC SCQIS Workforce Working Group created
  - (Co-Chairs NSF and LPS)
- NSF internal QIS workforce team, Q2Work program awarded (2020), Convergent Accelerators, and more
- NSTC ESIX Workforce and Talent WG
  - Government Requirements Survey
- QED-C Workforce Surveys



QIS Concepts to Q-12 Education

- ~25 leaders identified key QIS concepts for future learners
- 9 concepts posted May '20

NSF Key Concepts Workshop

New NSF Programs

- Q2Work, 2 teacher conferences on quantum (Summer 2020)
- Convergence Accelerators for QIS Education
- QIS outreach embedded in centers and programs

Q-12 Education Partnership

- Oct 2020 Kickoff
- Announced August 2020
- 13 initial members: industry, professional societies, and academia
- Commits to expanding access to K-12 quantum learning tools
- Will work with the community to nurture a diverse and innovative quantum workforce

National Q-12 Education Partnership

Growing the Quantum Workforce.

Q2WORK

NQCO
SCQIS Workforce Working Group

Q12 commitment

- *"…committing over the next decade to continue working with America's educators to ensure a strong quantum-learning environment, from providing classroom tools for hands on experiences to developing educational materials, to supporting pathways to quantum careers."*

"Perform outreach to broaden access to QIS concepts."

"Help generate new materials for education and outreach."

"Develop QIS kits for middle school classrooms."

"Support and highlight career opportunities."

"Support access for high school students to quantum computing hardware and software"

"Integrate Quantum Concepts into national after-school programs."

Educate	Inspire	Experiences	Careers
Develop and deploy formal and informal approaches	Motivate young people and broaden public understanding	Grow confidence through unique opportunities	Make people aware of the great and diverse career options in quantum!

http://q12education.org/

Engage with quantum industry

Foster the formation of a U.S. Quantum Consortium ◊ Increase investment via partnerships between industry, academia, and Government to accelerate pre-competitive research ◊ Maintain awareness of how the quantum revolution may effect agency mission spaces

The Quantum Economic Development Consortium (QED-C)

- Industry consortium of stakeholders that aims to enable and grow the U.S. quantum industry.
- QED-C was established with support from the National Institute of Standards and Technology (**NIST**) as legislated by the NQI Act. (NIST and DOE sit on steering committee.)
- The mission of QED-C is to enable and grow a robust commercial quantum-based industry and associated supply chain in the United States.

NQCO

- "Industry Liaison" position created and staffed to execute NQI Act requirements

Nov 2019 QED-C Cryogenic Workshop, Montana

2020: QED-C steering committee signs Partnership Agreement and is recognized as the US Quantum Industry Consortium (per the NQI)

Maintaining national security and economic growth

Maintain an understanding of the security implications QIS ◊ Promote mechanisms for all Government agencies to stay abreast of the defense and security implications and help balance the benefits of economic growth with new risks ◊ Ensure consistent application of existing control mechanisms to provide the largest amount of information possible to American universities and industry

ESIX – Subcommittee on the Economic and Security Implications of Quantum Science

- Co-Chaired by DOD, NSA, DOE, OSTP
- Established to ensure that economic and security implications of QIS are understood across the agencies.
- Provides a national security perspective to QIS related research.
- Coordinates with NSTC subcommittees, such as the SCQIS, to ensure that the economic and national security implications of basic research and development in QIS, along with derived technologies are fully understood.

Dr. Droegemeier introduces OSTP Joint Committees on the Research Enterprise (JCORE) Subcommittees, Nov 2019

ESIX Working Group on Talent and Research Security created (July 2020)

Continue to develop international collaboration and cooperation

Increase international cooperation with like-minded industry and Government partners ◊ Ensure the US continues to attract and retain the best talent, and has access to international resources ◊ Identify and understand the evolving international QIS landscape from both technical and policy perspectives.

- International partnerships are critical to bringing together the wide range of skills, expertise, and ingenuity to accelerate the research and development around QIST
- Good-faith cooperation based on the shared values of freedom of inquiry, merit-based competition, openness and transparency, accountability, and reciprocity.
- Follow-on actions: industry and science dialogues, …

U.S.-Tokyo Statement on Quantum Cooperation

US-Australia Joint Commission Meeting highlights Quantum Information Science
US-Australia Industry Dialogue
US-UK QIS Dialogue
…

Tracking/Reporting

- Annual reports on US QIS Activities (Supplement to President's Budget)
  - Budget
  - Technical Highlights
  - Progress toward strategic thrusts
  - Coordination activities and initiatives
- Strategic Plan and Policy Thrust Strategies
  - Seek feedback from NQIAC: *What is missing in the national strategy?*
  - *Where do we want to be 5-years into the NQI?*
- Tracking progress toward policy recommendations
  - Seek feedback from NQIAC: *Suggestions for useful tracking mechanisms toward key goals (workforce, etc.).*

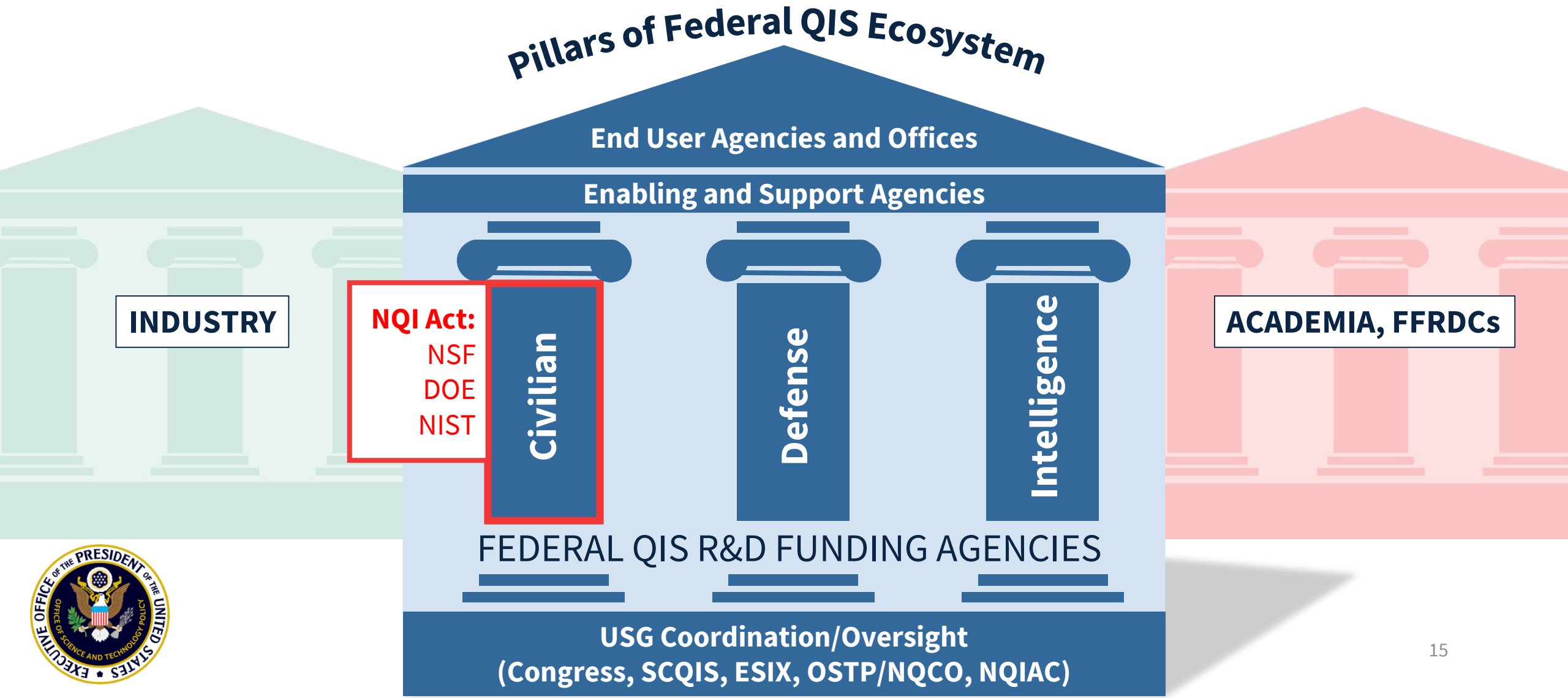
SCQIS, NQCO, ESIX have deliberately taken an all-of-government, all-of-nation approach (broader than strict NQI Act requirements)

[Track USG activities at quantum.gov]

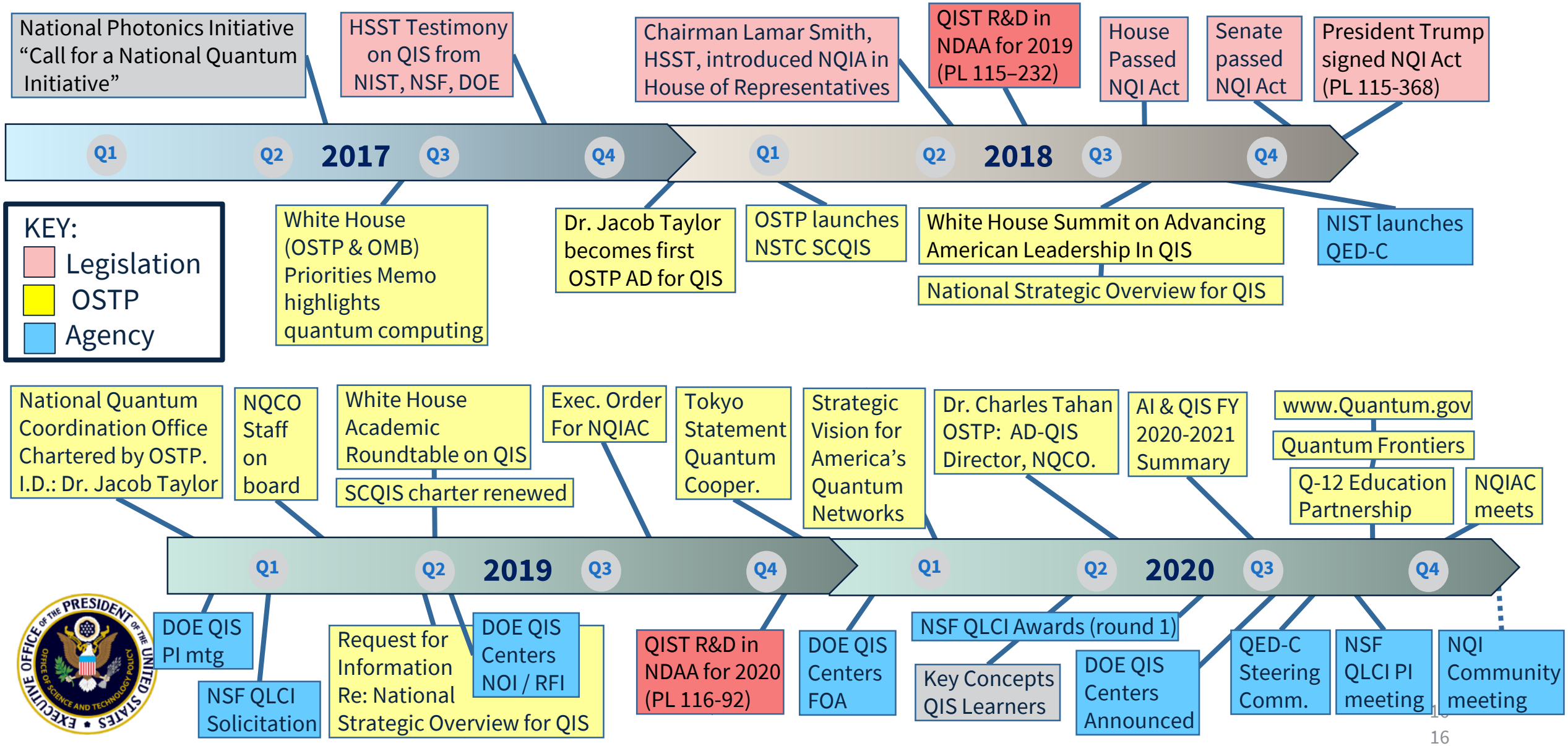
The **National Quantum Coordination Office** (NQCO)'s charge, as legislated by the National Quantum Initiative (NQI) Act of 2018, is to:

- provide technical and administrative support to the National Quantum Initiative and NQIAC;
- oversee interagency coordination;
- serve as the point of contact on Federal civilian quantum information science and technology activities;
- ensure coordination among the QIS Research Centers; to conduct public outreach;
- promote access to and early application of the output of the National Quantum Initiative; and
- promote access to quantum computing and communications systems.

Next: Implementing Agencies



Progress


National Photonics Initiative "Call for a National Quantum Initiative"
HSST Testimony on QIS from NIST, NSF, DOE
Chairman Lamar Smith, HSST, introduced NQIA in House of Representatives
QIST R&D in NDAA for 2019 (PL 115–232)
House Passed NQI Act
Senate passed NQI Act
President Trump signed NQI Act (PL 115-368)
Q1
Q2
2017
Q3
Q4
Q1
Q2
2018
Q3
Q4
KEY:
Legislation
OSTP
Agency
White House (OSTP & OMB) Priorities Memo highlights quantum computing
Dr. Jacob Taylor becomes first OSTP AD for QIS
OSTP launches NSTC SCQIS
White House Summit on Advancing American Leadership In QIS
National Strategic Overview for QIS
NIST launches QED-C
National Quantum Coordination Office Chartered by OSTP. I.D.: Dr. Jacob Taylor
NQCO Staff on board
White House Academic Roundtable on QIS
SCQIS charter renewed
Exec. Order For NQIAC
Tokyo Statement Quantum Cooper.
Strategic Vision for America's Quantum Networks
Dr. Charles Tahan OSTP: AD-QIS Director, NQCO.
AI & QIS FY 2020-2021 Summary
www.Quantum.gov
Quantum Frontiers
Q-12 Education Partnership
NQIAC meets
Q1
Q2
2019
Q3
Q4
Q1
Q2
2020
Q3
Q4
DOE QIS PI mtg
NSF QLCI Solicitation
Request for Information Re: National Strategic Overview for QIS
DOE QIS Centers NOI / RFI
QIST R&D in NDAA for 2020 (PL 116-92)
DOE QIS Centers FOA
NSF QLCI Awards (round 1)
Key Concepts QIS Learners
DOE QIS Centers Announced
QED-C Steering Comm.
NSF QLCI PI meeting
NQI Community meeting