March, 2022

Program Officer Presentation
on
Spectrum Innovation Initiative: National Radio Dynamic Zones (SII-NRDZ) Solicitation

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Logistics

A recording of this briefing is available on the SII home page

SII home page

- https://nsf.gov/mps/oma/spectrum_innovation_initiative.jsp

Live Q&A webinar

- Registration required
- Date, registration link, and link to recording – posted to SII home page

Written questions

- Email to SII@nsf.gov
- Responses posted to the solicitation page – possible 30 day delay

Caveats

- NSF publications take precedence over this briefing
- Forward-looking information may be changed without notice

Spectrum Innovation Initiative: National Radio Dynamic Zones (SII-NRDZ)

Goal	Advance the use of dynamic spectrum sharing
Method	Extended field trials of radio dynamic zones
Vision	Radio dynamic zones enhancing spectrum access for multiple facilities and applications
	A National Radio Dynamic Zone supporting a facility for at-scale research and experimentation on systems that use or manage spectrum in innovative ways

Interdisciplinary collaboration sought in SII-NRDZ

Research on Spectrum Sharing

- Spectrum sharing, monitoring, and enforcement
- Spectrum management
- Systems engineering, control, analysis, and prototyping
- Reliability and cybersecurity analysis and engineering

Research on Applications and Sites

- Spectrum-dependent applications
- Scientific activities, or instruments
- Operations / constraints of specific facilities / systems
- Interference issues, mitigations
- Spectrum access opportunities

Engineering and Field Trials

- Systems engineering, software engineering
- Hardware / software integration, validation
- Field testing of complex systems
- Operation and construction of complex facilities
- Spectrum regulations and processes

Research on Adoption (Anticipated FY23)

- Interactions between technical / regulatory changes and social, behavioral, economic issues
- Spectrum user business models
- Auctions and federal agency incentives

Important Proposal Information

Solicitation text and deadline

- Link at: https://nsf.gov/mps/oma/spectrum_innovation_initiative.jsp

Anticipate 8-12 awards

- Approximately 6-10 grants for SII-NRDZ Studies, up to $2,000,000
- Approximately 2 cooperative agreements for Engineering and Execution Lead Phase 1, up to $500,000

Proposals may be submitted by

- Institutions of Higher Education
- Non-profit, non-academic organizations

Memorandum of Agreement with NTIA and FCC

- NSF may share information from proposals; may discuss the shared information; may request feedback

Total anticipated funding: $10,000,000

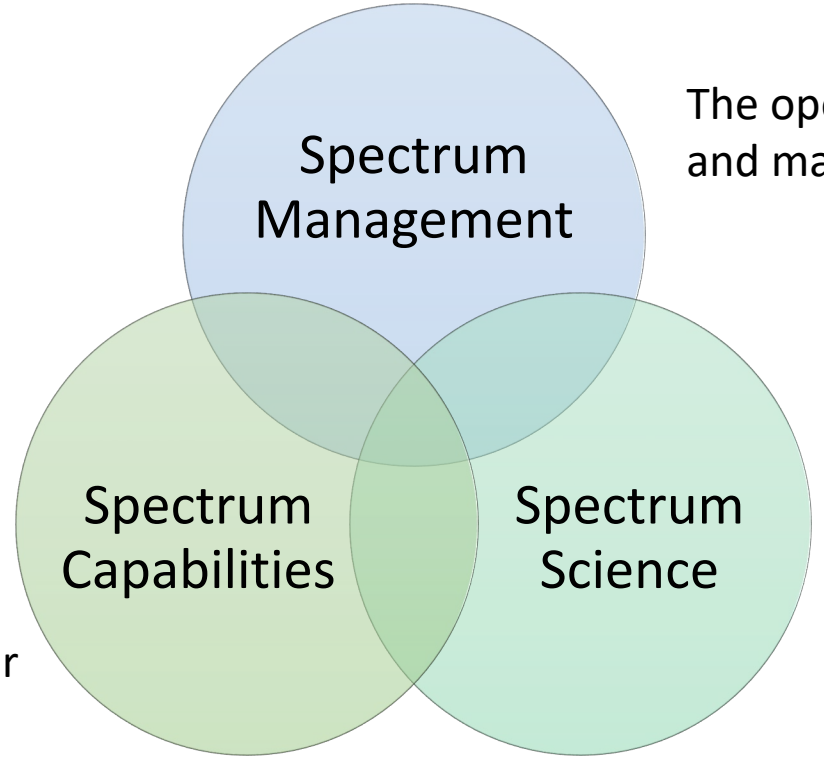
Context

Categories of NSF work in the radio spectrum

Activities and investments that use the radio spectrum

- Astronomy
- Advanced Wireless
- Geosciences
- Climate Change
- Biosphere Monitoring
- Wireless Devices/Circuits
- Economic Theory
- …

Activities and investments that ensure spectrum is available for use



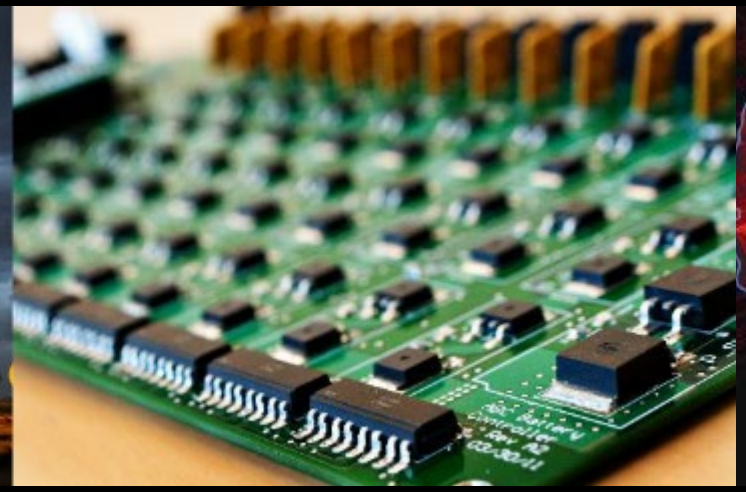
The operational activity of planning and managing spectrum use

Devices and techniques enabling a system to operate in multiple bands or in constrained or shared spectrum

The basic and applied understanding of resource management of the electromagnetic spectrum

NSF's Spectrum Innovation Initiative

https://nsf.gov/mps/oma/spectrum_innovation_initiative.jsp

I. Spectrum Innovation Centers
II. National Radio Dynamic Zones
III. Spectrum Research Integrative Activities
IV. Education and Workforce Development

Terminology

Spectrum Sharing

Traditional spectrum management

- Static separation of systems in frequency, space, or time
- Fixed limits on transmission power and out of band emissions

Spectrum sharing

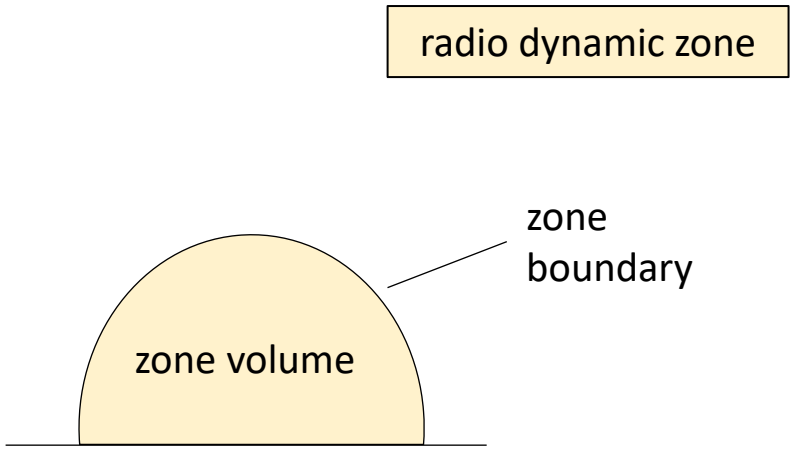
- Operation of independent systems close enough together
  that dynamic mechanisms are required to prevent harmful interference

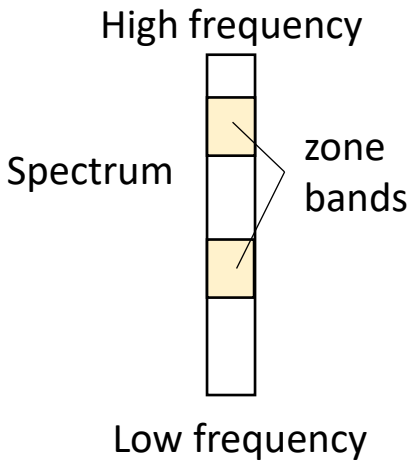
Radio dynamic zone

An area or volume

with automatic spectrum management mechanisms

that control electromagnetic energy entering, escaping, or occupying the zone





SII-NRDZ Program

SII-NRDZ priorities – sites and applications

	Application	Desired benefits
Sites for field trials starting in 5 years or less	1. Research and experimentation facility	Enhance spectrum access and reduce delays
	2. Radio telescope observatory	Mitigate interference, enhance broadband access
	3. Satellite-based sensors	Mitigate interference from terrestrial communications
	4. Radar	Improve efficiency when co- or adjacent-channel communications
Future national facility site	Research and experimentation facility	Same as #1

SII-NRDZ priorities – solicitation-specific broader impacts

Near term	Enhance spectrum access for facilities or applications • Achieve one or more of the benefits listed in the previous slide
Mid term	Enable wider use of spectrum sharing • Overcome technical and nontechnical barriers to approval and acceptance • Address workforce needs • Inform spectrum regulation • Create reusable components and tools
Long term	Establish a research facility that accelerates innovation
Overall	Build trust in spectrum sharing

Solicitation-specific merit review criteria

1. How effectively does the proposed project support one or more of the broader impact goals identified for the SII-NRDZ program?

A challenge

Professional engineering and management is required

E.g., to enhance spectrum access for active facilities or applications

- integrate new mechanisms into complex facility operations
- operate successfully for 6–12 month field trial

Engineering and Execution Lead (SII-NRDZ-EEL)

Near term

- System/software engineering of a robust solution based on SII-NRDZ research prototypes
- Scientific, operational, and spectrum regulatory lead for field trials

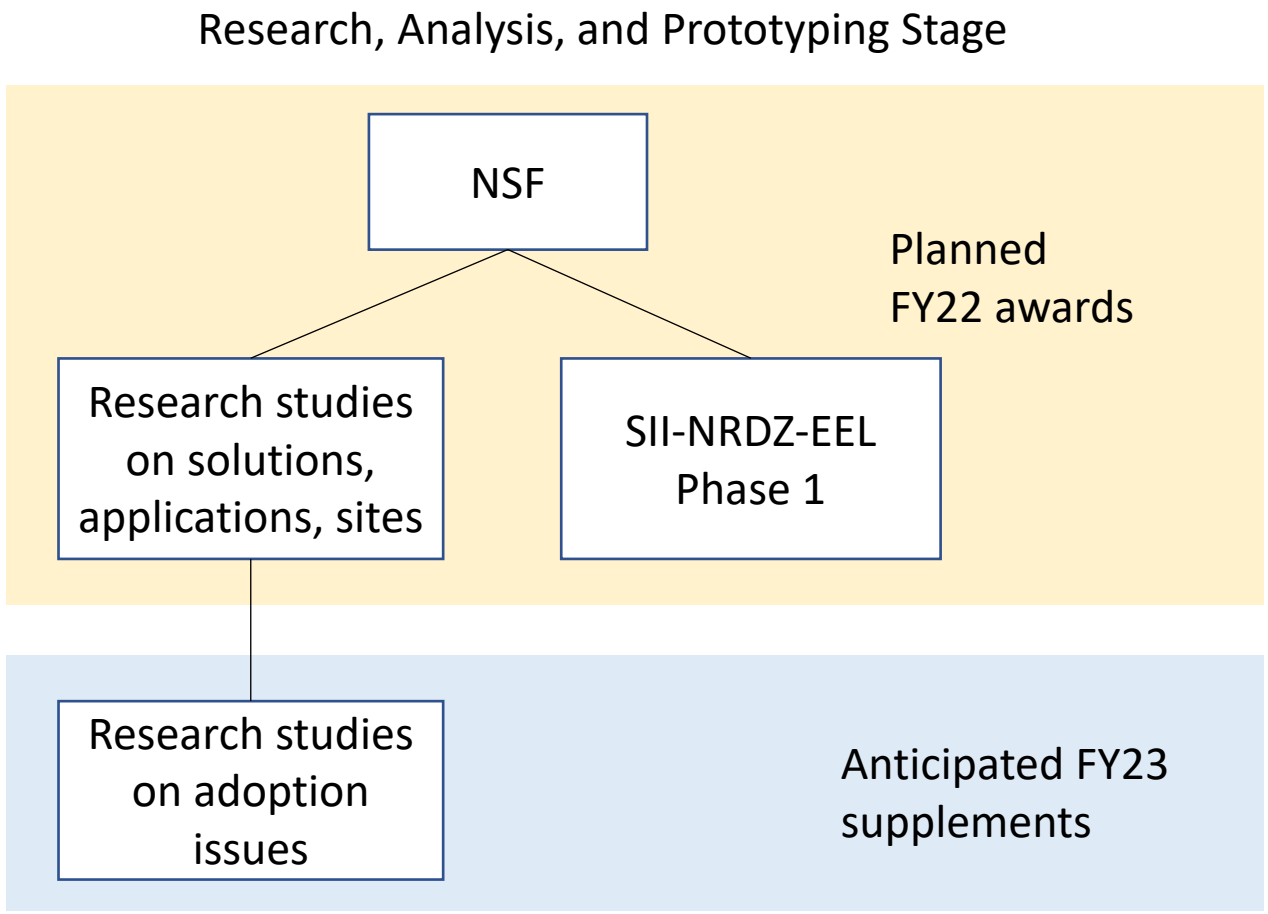
Mid term

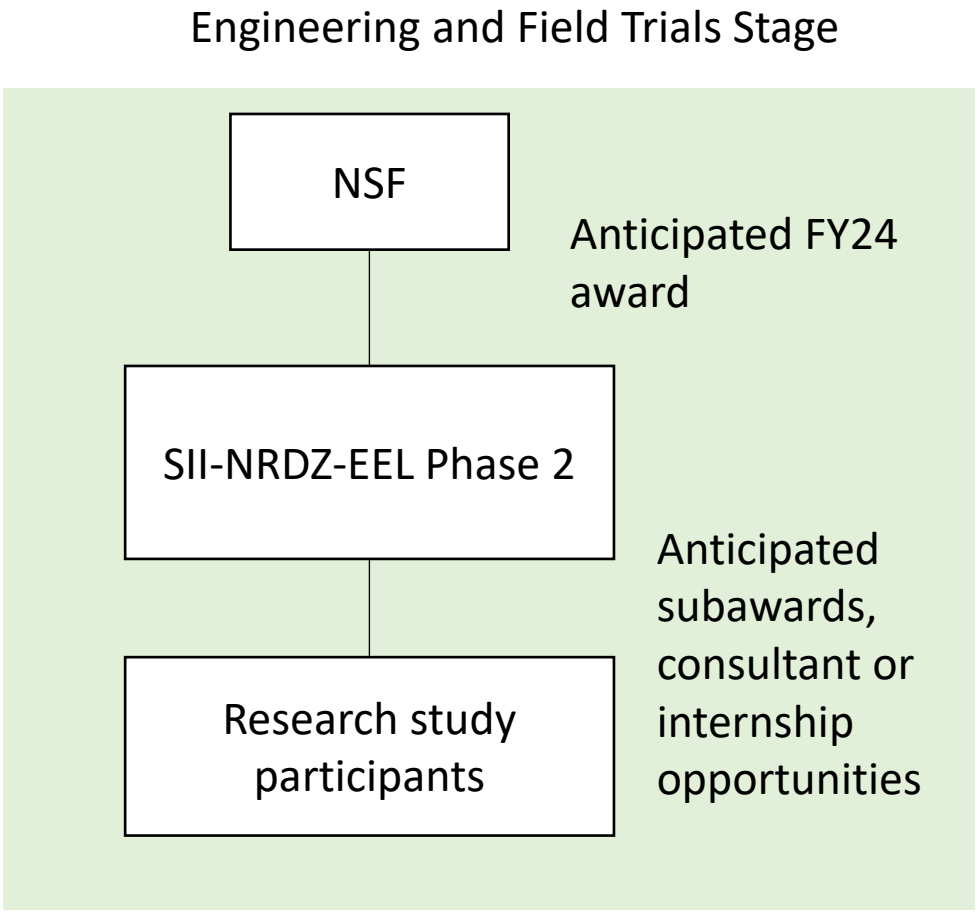
- Engages with skeptical spectrum stakeholders
- Fosters a community of researchers, practitioners, and industrial partners
- Engineers and supports a reusable toolkit of components for spectrum sharing solutions

Long term

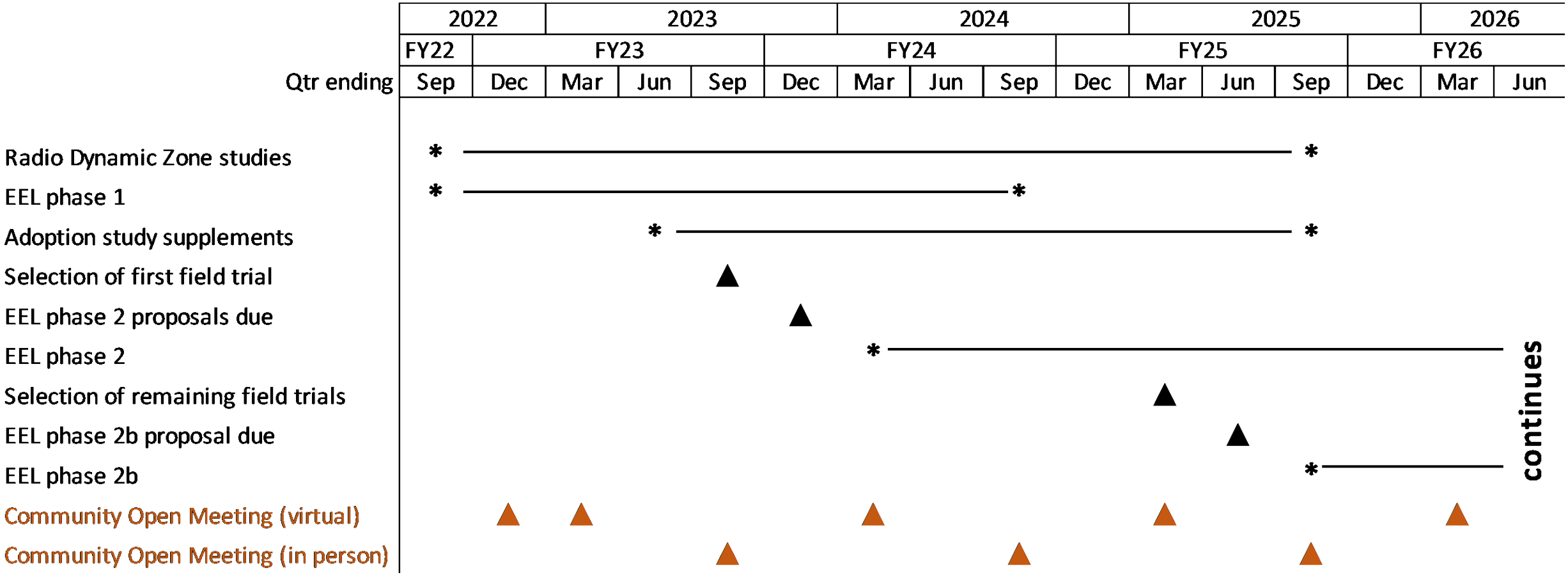
- Evolves into builder and operator of the envisioned national facility

Evolution of SII-NRDZ program structure

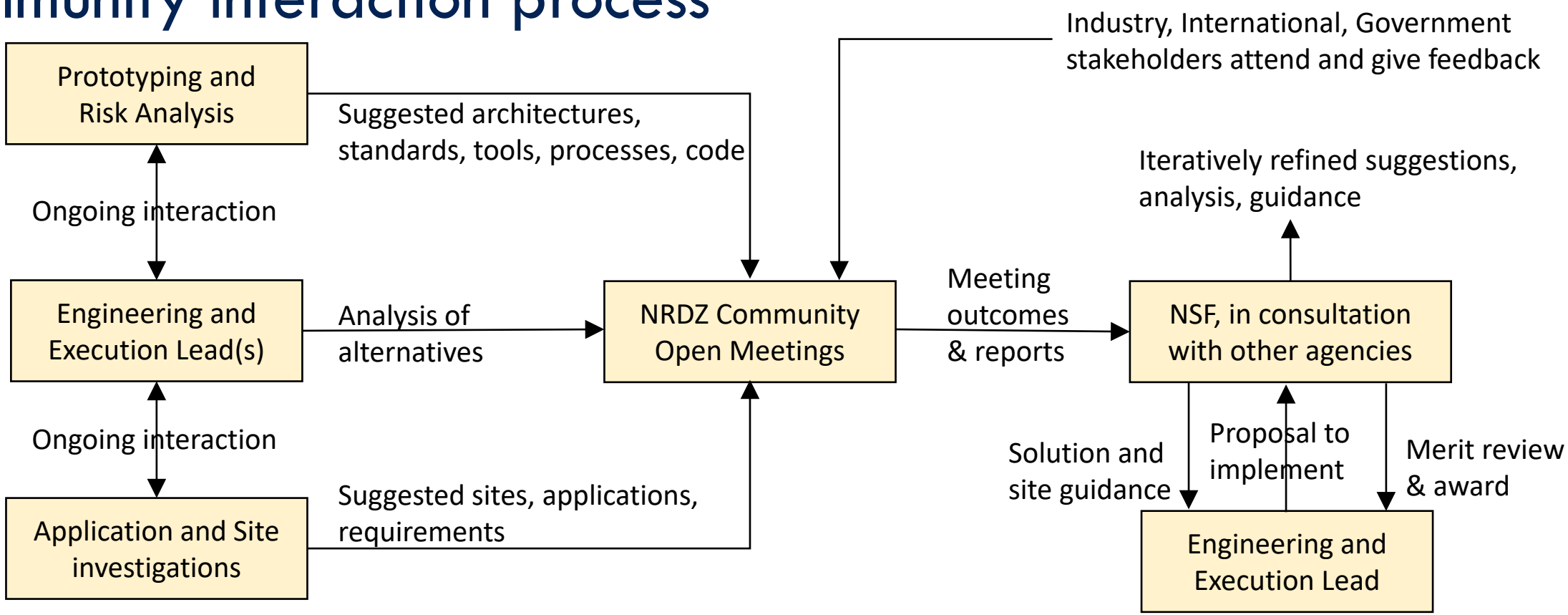




Anticipated program timeline for SII-NRDZ



Community interaction process



Solicitation-specific merit review criteria

2. How effective is the proposed plan for interaction with and responding to information provided by other SII-NRDZ program participants and stakeholders?

Solicitation Overview

Area 1
Area 2
Area 3
EEL

Proposal opportunities in SII-NRDZ solicitation

SII-NRDZ Studies

- 3 areas
  - Area 1 – Prototyping and Risk Analysis
  - Area 2 – Application and Site Analysis
  - Area 3 – Field Tests
- A proposal may cover multiple areas
- Multiple proposals are permitted from a PI or Co-PI *

  * only one proposal may cover Area 1

SII-NRDZ Engineering and Execution Lead Phase 1

SII-NRDZ Studies Area 1

Prototyping and Risk Analysis

- Prototype needed for field trials
- Risk analysis needed to build trust and facilitate regulatory approval

Research on a range of spectrum sharing topics is in scope, for example:

- Prediction of potential interference
- On-line computation of constraints that dynamically prevent interference
- Rapid detection and identification of interference sources
- Methods to limit the likelihood, severity, duration, or impact of interference
- Hardware components for retrofit to enhance spectrum sharing
- Collection or obfuscation of spectrum monitoring data
- Bounding the performance of AI/ML subsystems
- Approaches to simplify the regulatory complexities of spectrum sharing

Area 1
Area 2
Area 3
EEL

Prototyping of end-to-end solutions

Integrate all components required for a radio dynamic zone

- Technical components including
  - Architecture, standards, software applications, hardware devices, tools, system designs, and control algorithms
  - Monitoring and characterizing radio frequency interference, and for detecting and identifying rogue emitters

- Non technical components including
  - Human and organizational processes for radio dynamic zone operations and for spectrum management activities
  - Applications of approved regulatory structures or proposals for regulatory changes
  - Model contracts and business processes for interactions among spectrum users
  - Integration into external spectrum management and other control systems

Prototypes may use simplified implementations or models of some components

Area 1
Area 2
Area 3
EEL

General applicability and assessment

Generally applicable solution

- Applies to multiple spectrum sharing scenarios
- May require specializing components

Assess in 2 of the field trial priority scenarios

- Analysis
- Modeling and simulation — Challenge: aggregate interference
- Emulation — Radios exchanging RF via a wired channel emulator

Solicitation-specific merit review criteria

4. How generally applicable is the proposed solution?
5. What is the potential for the proposed solution or components to be used in SII-NRDZ field trials?

Risk Analysis of Prototype

Required: likelihood of excursion beyond interference limits

Additional creative/innovative techniques are encouraged

- Severity, duration, or impact of interference
- Likelihood of interference due to causes that are not just statistical variation
  - Security vulnerabilities
  - Software bugs, hardware faults, and malfunctions
  - Spurious emissions, out-of-band emissions, and intermodulation effects
- Simplification of risk analysis through synergies with hardware/software design

Medium-term broader impact goal

Enable spectrum sharing mechanisms to be more easily approved by regulatory authorities, through developing innovative analysis techniques for interference and security risks

Area 1
Area 2
Area 3
EEL

Active NSF solicitations for research on spectrum sharing

Spectrum and Wireless Innovation enabled by Future Technologies (SWIFT)

- Individual components, tools, algorithms, subsystems, or analysis techniques
- Can be fundamental research
- Max research award $750,000
- Due 5/11/2022

SII-NRDZ Area 1

- End-to-end solutions and analysis
- Apply to identified facilities or applications
- Max research award $2,000,000

SWIFT: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf22571

SII-NRDZ Studies Area 2

Application and site analysis

To study distinct sites or applications, submit multiple independent Area 2 proposals

Area 1
Area 2
Area 3
EEL

SII-NRDZ Studies Area 2

Comprehensive investigation of all topics relevant for selection as a field trial or national facility site

- Ways to use dynamic zone spectrum sharing that are beneficial and deployable
- Roadmap of bands and dynamic zone features or capabilities
- Tradeoffs between dynamic zone performance and application benefits
- Design of experiments
- Interference monitoring and characterization
- Social/economic impacts and mitigations

Create the requirements for Area 1 prototypes

Educational innovation is encouraged

Solicitation-specific merit review criteria

6. What is the potential for the selected application and site to be used for a SII-NRDZ field trial or for the future national facility?

SII-NRDZ Studies Area 3

Early field testing relevant to a potential future SII-NRDZ field trial

- Gather data to inform field trial design
- Assist in regulatory approval
- Reduce risk through characterizing prototype solution's behavior

Envisioned use of funds (other uses are permissible)

- Add-on to an Area 1 or Area 2 project
- Area 1 + 3: gain early field experience with prototype
- Area 2 + 3: deploy existing spectrum sharing solution to gain experience with application & site

Solicitation-specific merit review criteria

7. How much benefit will the proposed field tests provide for the design, approval, or risk reduction of a potential SII-NRDZ field trial?

Area 1
Area 2
Area 3
EEL

Some NSF-sponsored experimental resources

Large-scale emulator

- https://www.northeastern.edu/colosseum/
- colosseum@northeastern.edu

City-scale outdoor experimentation platforms

- https://advancedwireless.org/platforms/
- Salt Lake City powder-contact@powderwireless.net
- New York City: cosmos-contact@cosmos-lab.org
- Research Triangle aerpaw-contact@ncsu.edu
- Central Iowa contact@arawireless.org

SII-NRDZ Engineering and Execution Lead Phase 1

Program participation and planning by teams interested to serve as the SII-NRDZ-EEL in Phase 2

An organization can submit SII-NRDZ-STUDY and SII-NRDZ-EEL proposals

- PIs and co-PIs must be different

Area 1
Area 2
Area 3
EEL

SII-NRDZ-EEL Phase 1 activities

Support collaborations as invited by SII-NRDZ study teams

NRDZ Community Open Meeting inputs, participation and reports

Long-lead technical and spectrum regulatory work for potential Phase 2 activities

Prepare a SII-NRDZ-EEL Phase 2 proposal

Phase 1 proposal must describe qualifications to do Phase 2 work

Solicitation-specific merit review criteria

9. How qualified is the proposed team to successfully perform a SII-NRDZ Engineering and Execution Lead Phase 2 project?

Area 1
Area 2
Area 3
EEL

Spectrum Access risks & mitigations

Program risk #1: spectrum access for field trials

Proposers are encouraged to include project activities to help mitigate this risk

The solicitation includes a list of potentially useful activities

- Creative proposals for activities not on the list are also encouraged

Solicitation-specific merit review criteria

3. How effective is the plan for mitigating spectrum access risk?

Area 1
Area 2
Area 3
EEL

Miscellaneous solicitation items

Proposal titles must have the format “SII-NRDZ: Your Project Name”

Proposals are encouraged to use the terms and definitions from the solicitation

Proposals that include spectrum monitoring should describe privacy protections

Letters of Collaboration from centers funded under NSF solicitation 21-558 (SII-Center) must be non-exclusive

SII-NRDZ Study projects should not initiate interactions with federal regulators

- Initially, NSF will be primary contact for regulators and will establish interaction opportunities
- Thereafter, the EEL will take the lead role

Proposals should include an IP management plan that supports the broader impact goals of SII-NRDZ

- Field trials, and the subsequent reusable toolkit published by the EEL, may incorporate IP from multiple SII-NRDZ awardees

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Thank you