Webinar on Advanced Wireless Initiative & Platforms for Advanced Wireless Research (PAWR)

July 28, 2016

Agenda

- Welcome and CISE Context
- Advanced Wireless Research Initiative
- Platforms for Advanced Wireless Research (PAWR)
- PAWR Project Office (PPO) Solicitation, NSF 16-585
- PPO scope, requirements, & review
- Questions

Advanced Wireless Research Initiative

- Announced on July 15, 2016 by the White House and NSF
- $400M investment over the next 7 years in advanced wireless platforms and research
  - $50M for creating 4 new city-scale wireless research platforms – the PAWR program
  - Industry contributions totaling at least $35M towards PAWR
  - Up to $350M in NSF funding for supporting research on these new platforms
- Two NSF Prize Challenges each with $1M in prize money
- $6M NSF-Intel joint solicitation on Info-Centric Networking for Wireless Edge Nets
- $4.5M US-Finland solicitation on wireless network research
- Research Coordination Network in millimeter-wave research
- Collaboration with DARPA Spectrum Collaboration Competition Challenge (SC2) by supporting NSF researchers.
- Two workshops aligned with the PAWR effort.

NSF Prize Challenges

- CNS-1649768 awarded to Mozilla Foundation
- Will run two prize challenges – open to all
  - Challenge Prize A: Off-the-Grid Internet
  - Challenge Prize B: Smart Community Internet
- Solutions using wireless technologies to provide anytime, anywhere connectivity that can support content and services
  - Build first and demonstrate to win the prizes
  - Two stage process
  - First stage: up to 10 prizes; Second stage: three prizes
- Starting in January 2017
  - Look for announcements from Mozilla Foundation in October 2016.

NSF-Intel solicitation, NSF 16-586

- NSF/Intel Partnership on Information-Centric Networking in Wireless Edge Networks
  - http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf16586
  - $6M investment with equal parts from NSF and Intel
  - 2 – 3 large awards of up to $3M each
- Deadlines
  - Letter of Intent (required) due on: September 19, 2016
- More information on program page:
  - https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505310
- Webinar today afternoon at 3pm ET
  - Sign up on program page noted above.

US-Finland WiFiUS solicitation, NSF 16-587

- Wireless Innovation between Finland and US (WiFiUS)
  - http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf16587
  - Fourth year of solicitation
  - Focus this year on IoT
- Full proposal deadline of
  - More details on WiFiUS program page
  - Finnish partner information at: http://209.140.21.224/~jwifiusa/

Research Collaboration Network on mm-wave communication networks

- CNS-1648917 led by Profs. Akbar Sayeed and Xinyu Zhang (U Wisc)
- Three year effort with kickoff workshop in Dec 2016 in Washington DC
  - Series of six workshops with thematic focal areas
  - Focusing on spectrum above 26 GHz.
  - Bring together industry, federal and academic researchers
  - Share latest outcomes, prepare research roadmap, publish to community
  - Policy outreach with regulators with unbiased view as a scientific entity
  - Create synergy and pathways to tech transfer and standards formation

Collaboration with DARPA SC2 Challenge

- DARPA Spectrum Collaboration Competition (SC2) Grand Challenge
  - http://spectrumcollaborationchallenge.com/
  - Starts in 2017 and runs until early 2020 <confirm deadlines>
  - Open to all – including academics, students
  - Proposer's Day on August 10, 2016
- Limited funds available from DARPA to seed solution development by select teams
  - To teams that clear technical hurdles at the various stages
- NSF will provide support for academic researchers if they clear the SC2 Stage Qualification Hurdles
  - Support students for up to one year, up to 5 – 6 awards, starting in March 2017.
  - Details in DCL-16-114 http://www.nsf.gov/news/news_summ.jsp?cntn_id=127138

Two Workshops

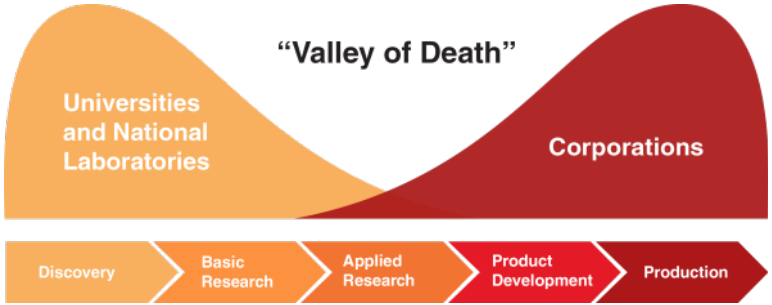
- NSF Workshop on “Communities of Practice” for networking testbeds
  - Focus on lessons learned from running large-scale testbeds
  - To be held in late October 2016
  - PIs: Morley Mao (Univ of Michigan) and Ivan Seskar (Rutgers Univ)

- Second NSF Workshop on Ultra-low latency networks
  - Challenges in delivering ultra-low latency services via the wireless edge
  - To be held in early November 2016
  - PI: Eytan Modiano (MIT)

Platforms for Advanced Wireless Research (PAWR)

Key Attribute	Summary of Approach
Definition	Enhance efforts of ~400 university researchers who need mid-scale testing capabilities to ensure successful validation of research (facilities to be funded by NSF at ~$50M annually, shaped by PAWR Industry Consortium with 20+ companies, contributions of more than $35M)
Early Industry Involvement	Multi-use research platforms with “pre-competitive” research topic areas (3-8 years out) selected *bottom-up* by university PIs, with industry input
Platform Scope	City-scale (but not entire city), experimental (not production) open platforms, 10-20 antenna sites, backhaul, SDRs, 100 SDR-based clients
Flexibility and Speed	1 - 2 platforms per year in years 1 and 2, followed by a 4th in year 3
Streamlined governance, deployment, and operation	One governance board focusing on upfront research and policy issues, not tactics; city/university groups propose how to streamline deployment and operation

Why PAWR?



NSF funding $50M annually in fundamental, pre-competitive wireless research (3-6 years out) with over 400 university researchers.

This research will be strengthened by:

- Access to mid-scale, end-to-end research platforms
- Industry collaborating earlier in helping to define and focus research areas (today, industry focuses primarily in the 1-3 year commercialization window)

NSF wants to avoid the well-established "valley of death," and industry wants to capitalize on potential breakthroughs.

Through this effort, pre-competitive research stands to become more focused and viable over the long-term to industry participants.

PAWR Current Charter Members

http://www.advancedwireless.org/

PAWR Value Propositions

Industry

Take advantage of 4 simpler, flexible, multi-use research platforms staged over 3-5 years, to shape fundamental wireless research by:

Helping to select best, most flexible research platforms needed to meet researcher and industry needs

Helping to shape research topics covered by 50% of research time funded by NSF and other agencies, plus gaining preferential access to those research results, 6 months ahead of time

Gaining preferential access to research time for proprietary company research on these large platforms covering the ~50% of remaining research time (with Founding Members getting more access times than others)

Focusing research to increase number of potentially disruptive research efforts and speed time-to-market

Expanding pool of wireless experts through education, training, and nurturing of today's students

Research Community

Enhance ability to guide researchers' efforts with industry as equal partner in line with industry trends and expressed topic areas of interest

Speed up transfer rate from university research to industry end users

Cities

Building core wireless capabilities through creative university partnerships

Attracting government and company research funding and local wireless jobs

Utilizing advanced wireless capabilities to enhance city services

PAWR Overview

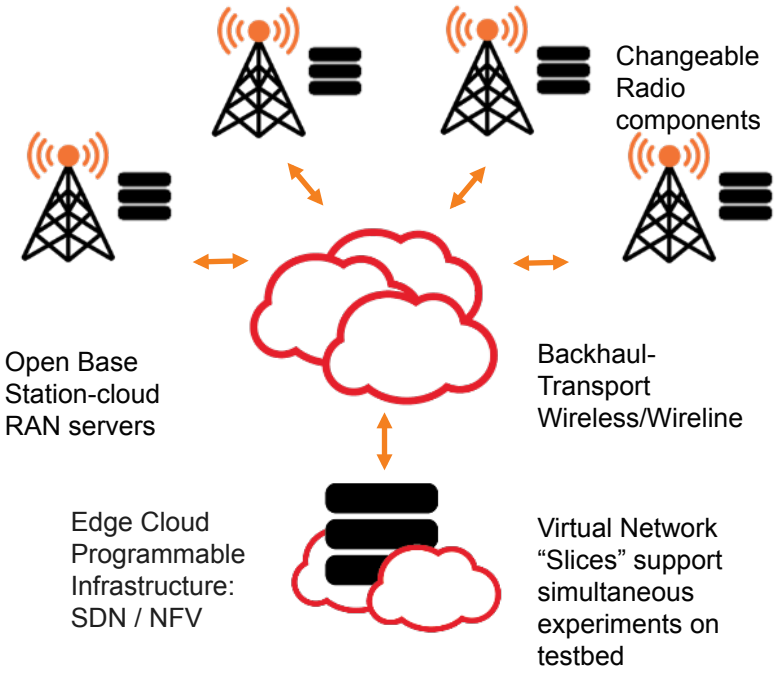
- Locations focusing on small cities, campuses plus small cities, or select portions of a large city covering a campus within the city
- Research platforms will be built on software-defined radios – devices capable of operating across multiple radio frequencies and connected via a programmable back-end network infrastructure with access to high-speed network connectivity such as Internet2 or other backhaul (i.e., not production networks)
- Researchers will be able to take advantage of the multi-use capability of the platform infrastructure by “plugging in” additional experimental technologies
- RFPs will seek proposed Platforms Enabling Advanced Wireless Research (PAWRs) that have the capability to support a minimum number of research topic areas (e.g., mmWave, Dynamic Spectrum, Architecture) plus others as proposed by responders
- Proposed experimental research platforms will allow researchers to validate cutting-edge technologies (e.g., radio layer, protocol, sensors, core architecture), spectrum usage paradigms, application performance, and/or service behavior

PAWR Scale and Technologies

- 10-20 Sites (radio/antenna locations) per PAWR
- Software Defined Radios, capable of operating across multiple frequencies and technologies:
  - Operating sub-6 GHz or between 37 -100 GHz for millimeter wave research
  - Optional support for commercial equipment in other bands (such as 28 GHz) when available for interoperability testing
- Connected via a programmable backhaul network infrastructure supporting SDN and NFV, with access to high-speed network connectivity such as Internet2 or other backhaul
- Approximately 100 SDR-based clients, across a variety of stationary and mobile (human/ vehicle) platforms, at a minimum

PAWR Sample Architecture

Sites support SDR radio technology: 10-20 sites per PAWR



ARCHITECTURE

Infrastructure Provides:

- SDR radio layer
- Wireless-Fiber backhaul
- Software configurable infrastructure (SDN, NFV)
- Ability to add or swap components for projects
- Time or geographical sharing of environment

Flexible enough to support multiple research areas:

- Small cells and mm mesh access-backhaul
- Flexible spectrum usage
- SDN, NFV, MEC architectures to support infrastructure
- Cellular and WiFi wireless technology
- Network performance and analytics

SAMPLE TOPIC AREAS TO BE ENABLED BY RESEARCH PLATFORMS

mmWave to enable R&D and systems testing at the millimeter-wave bands that are about 26GHz, with a target of 100 Gbps in data rates for small-cell networks that cover a few city blocks.

Dynamic Spectrum to focus on the spectral bands that are sub-6GHz, and aim to identify spectral opportunities in existing networks and establish usage models for novel spectrum driven applications, while also studying co-existence and protection issues.

Architecture to test data network architectures for next-generation networks that operate with a wireless edge.

Mobility-at-Scale to address larger issues with network-mobility from the transport to MAC layers, including evaluation of large-scale, dense, heterogeneous wireless networks, including issues such as connection management, load balancing, and mobility management.

Wide-area Whitespace to utilize novel whitespace-based wireless networks to design, build and demonstrate 16Gbps connectivity to remove locations via long-range wireless mess connections.

Network Metrology to advance capabilities to measure and monitor wireless network performance and support research on methods to improve the security, reliability and performance of wireless networks.

Applications/Services in later years – Platforms will serve as examples of Smart and Connected Community networks that demonstrate potential applications/services including Cyber-Physical Systems, Cyber-Security, Internet of Things, Robotics, Smart and Connected Health, and Big Data.

How does it work?

Industry Consortium

Cash, equipment & material, engineering, marketing, & R&D support

Federal Agencies

(NSF and Others)

Grants, experimental spectrum licenses, other support

Governance Process

1
- **Selection of non-profit Consortium manager, the PPO.**
  - Ideally a 501(c)(3) organization with no policy agenda, selected through competitive solicitation process
  - PAWR Steering Council to advise the PPO

2
- **Integration of contributions from government and corporate partners**
  - Non-profit will gather committed resources and execute definitive agreements
  - Contributions will be catalogued and allocations of other resources determined

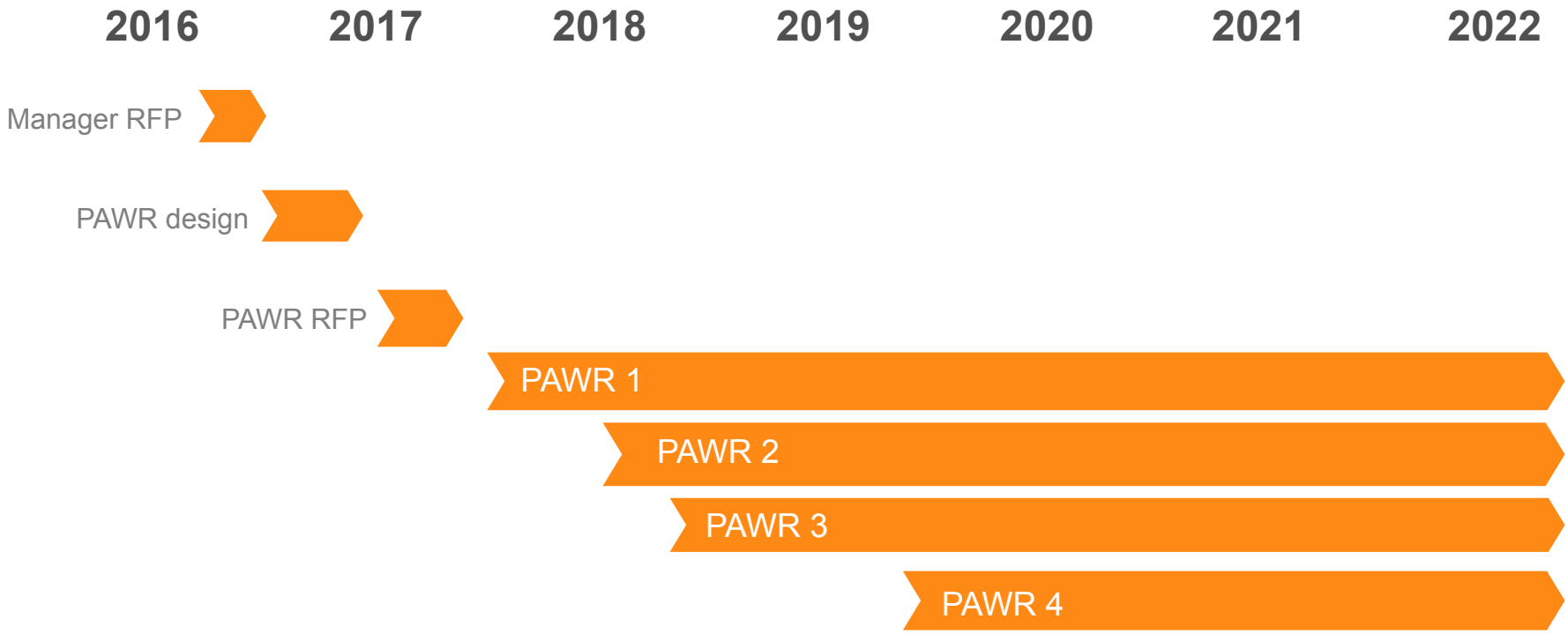
3
- **Completion of single PAWR reference design and development of RFP**
  - Non-profit will lead industry board in designing architecture based on research goals and available resources
  - RFPs will be created, challenging respondents to achieve PAWR goals (e.g., minimum number of research topic areas)

4
- **Issuance of RFPs and submission of proposals**
  - Non-profit will issue RFP and publicize program to encourage responses
  - Focus will be on joint responses from local coalitions made up of universities, municipalities, and/or companies

5
- **Evaluation of proposals and PAWR award**
  - PAWR Steering Council plus other experts will evaluate responses and select winners
  - Awards will be made to local coalitions to create and manage PAWRs with oversight from PPO

6
- **Research conducted on platforms**
  - Proposed 50/50 split between government-funded open research and private research
  - Research results and IP ownership governed by agreed-upon principles; private research results owned by sponsors

Proposed PAWR Timeline



PAWR Project Office (PPO) Solicitation NSF 16-585

- Platforms for Advanced Wireless Research (PAWR): Establishing the PAWR Project Office (PPO)
  - http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf16585
  - Up to $5M to plan, manage and run the 4 city-scale platforms
- PPO, working closely with wireless research community and industry consortium, will assume responsibility for the advanced wireless research platforms, specifically their:
  - Design
  - Development
  - Deployment
  - Operations

PAWR PPO Solicitation

- Solicitation seeks organizations seeking to serve as PAWR Project Office
- PPO will require:
  - Dedicated project staff with expertise in collaborative research with and ability to provide services to wireless research community
  - Effective management of advanced networking infrastructure projects with a large wireless communication component (including planning, deployment, & operations)
  - Effective management of large-scale wireless & software intensive projects (including planning, deployment, implementation & lifecycle management)
  - Technical report editing and web-based publications
  - Communication and outreach to broader scientific community & genreal public

PPO Management

- Lead Principal investigator (PI) will serve as “Project Director” of PPO
  - This individual will work full-time on project
  - PI will have direct day-to-day involvement in program
- Project Director/PI qualifications & duties:
  - Have established track record of leadership & management of teams and projects of this scale & scope
  - Will work closely with NSF program officers and PAWR Industry Consortium to keep all parties informed of PPO activities
  - Will serve as an *ex officio* member of PAWR steering council (board)

PAWR Design & Development Phase:
Identifying Advanced Wireless Research Platforms

- PPO will develop a Request for Proposals (RFP) and run subsequent merit review, comparable to NSF
- RFP will be issued within 6 months of PPO establishment and will:
  - Fund no more than **four** advanced experimental wireless research platforms across the country
  - Articulate the desired capabilities of these research platforms
  - Describe the contributions that the PAWR Industry consortium will offer to selected awardees
  - Describe the deployment & operational support and oversight that PPO and PAWR Steering Council will provide to awardees
  - Re-issue the RFP annually on an as-needed basis to reflect the nature of contributions from Industry Consortium (annual deadlines anticipated for submission for the first 3 years)

PAWR Design & Development Phase :
Pre-Deployment Requirements

- PPO will work closely with sub-awardees organization(s) to support the design, development, deployment, and operations of corresponding research platforms and will provide:
  - Common guidelines
  - Management structures
  - Operational interfaces
- Once PPO identifies potential awardees following steps must be taken, prior to deployment, constituting the final design baseline for that advanced wireless research platform (see next slide)

Specific Pre-Deployment Steps:

- Submit a deployment-ready research platform execution plan;
- Submit a deployment-ready PAWR research platform design, specifications, and scope of work;
- Finalize a detailed deployment plan with a bottom-up cost estimate and contingency calculations linked to risk assessment;
- Submit a detailed plan for technical and financial status reporting;
- Demonstrate successful development and prototyping of technologies essential to the platform;
- Finalize change control processes;
- Finalize a risk analysis and mitigation plan, including a security plan that protects PAWR from malicious attack or malevolent use;
- Finalize processes essential to robust software design, development and management throughout the life-cycle;
- Finalize annual operations and maintenance costs;
- Finalize the intellectual property model;
- Create the core management organization responsible for the overall deployment of the wireless research platform and finalize the staffing plan for additional staff needed to support the deployment and initial operations effort;
- Finalize commitments with academic, industry, inter-agency and international partners; and
- Establish a final baseline.

PAWR Deployment Phase and Initial Operations

- NSF will approve final design baseline for each advanced wireless research platform and PAWR deployment activities will begin!
- Contingent upon the successful performance of PPO during design stages, it is expected the PPO will assume all responsibly for PAWR deployment and operations
  - *Separate sub awards will be issue by the PPO for PAWR deployment and operations for each advanced wireless research platform*

PPO Award Information

Preliminary Proposal Due Date: Sept 20, 2016

Full Proposal Deadline: November 23, 2016

(by 5pm submitter's local time)

- **Award type**: Cooperative Agreement
- **Estimated number of awards**: 1
- **Anticipated Funding amount**: Administrative project management operations costs are not to exceed $1 million/year for 5 years
- **Proposals should:**
  - Provide a framework for pursuing design, development, deployment, and operational activities
  - They should **NOT** identify specific activities or associated sub awardees

PAWR PPO: Who Can Submit?

- Universities and two- and four-year Colleges (including community colleges)
  - Accredited in and having a campus located in the US acting on behalf of their faculty members
- Non-profit, non-academic organizations
  - Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

PAWR PPO: Personnel Requirements

- An individual may participate as PI, co-PI, or senior personnel in **no more than one proposal** submitted in response to this solicitation.
  - If an individual exceeds limit, only the proposal with the earliest date will be accepted—all others will be returned without review

PAWR PPO: Preliminary Proposal

- Required by September 20, 2016
- Required components:
  1. Cover sheet that includes:
     a. Indication of PI & Co-PIs
     b. Overall budget total
     c. Project title with the following nomenclature: “PAWR Pre-proposal: <Project Title>”
  2. Project Description (4-page limit) with clearly labeled sections:
     a. Project title
     b. Investigator information: PI, Co-PI, and senior personnel with institutional and departmental affiliation
     c. Concise description of program management activities that are key to the goals & milestones of PAWR program (including description of management needs and significant costs)
     d. Organizational & management structure, as well as qualifications of PPO staff
  3. Biographical sketch (2-page limit): required for PI and Co-PI

PAWR Full Proposal

- Title: “PAWR Full Proposal: <Title>”
- Project Description: must not EXCEED **30 pages** including charts, figures, graphs, maps, and photographs
- Supplementary Documents:
  - A list of Project Personnel and Partner institutions

PWAR PPO Section Requirements: Project Description (up to 30 pages)

- Section 1: Contributions of key personnel in the past 5 yrs (up to 3 pages)
  - Note qualifications and contributions made that demonstrate ability to work effectively with US wireless research community, experience with advanced networking infrastructure, and effective management of large projects
- Section 2: PPO Project Development Plan
  - 2.1: Scope of Work
  - 2.2: Risk Mitigation Plan
  - 2.3 Project Schedule (with Gantt Chart identifying key milestones and major activities)
  - 2.4 Management Plan, Organizational Structure, and Project Staffing
  - 2.5 PPO Facilities

PAWR PPO Review Process

- NSF: Panel with ad hoc reviews as appropriate:
  - Intellectual Merit & Broader Impacts
  - See NSF 16-1; Proposal and Award Policies and Procedures Guide (PAPPG) for more information
  - Additional Review Criteria—see next slide
- NSF reverse site visits as needed

PAWR PPO: Solicitation-Specific Review Criteria

- In consideration of a proposal's Intellectual Merit and Broader Impacts, the following review criteria will guide the reviewers' evaluation:
  a. Capabilities of the proposing team: does the proposing team demonstrate strong experience — managerial, technical, and administrative — in projects similar in scope to that proposed here?
  b. Do the goals, milestones, and activities proposed in the Project Development Plan cover all the essential aspects of PAWR design and development?
  c. Does the submitting organization provide a reasonable plan for risk mitigation? Are some foreseeable risks not adequately addressed?
  d. Does the project schedule appear reasonable? Were the key milestones identified?
  e. Does the submitting organization provide an adequate management plan?

PAWR PPO REMINDER: Deadlines

- **Preliminary Proposal Due Date: Sept 20, 2016**
- **Full Proposal Deadline: November 23, 2016**

(by 5pm submitter's local time)

- The intent is to give about 4 months in which to prepare full proposals.

PAWR PPO FAQs

- Formal FAQ will be posted on solicitation website in late August.
- Questions answered today are informal and serve to clarify. The solicitation is the official word. The Formal FAQ is an advisory document, and is not binding.