Potential PPO Services

The PPO envisions developing and maintaining a single interoperable framework with well-defined API's to manage services common across the four platforms. A non-exhaustive list of services that will be needed at a minimum are provided below in Table A.

The PPO ***could*** provide some or all of the services listed, but individual proposers should recommend their desired approach in their full proposals (i.e., request what services they would like the PPO to provide and budget for those services they already provide or plan to provide on their own). Each awarded platform will have the flexibility to develop some number of additional prototype and production services that it will control. This list might include additions to align with the specific technical architecture being proposed, but all services should be clearly articulated. The PPO envisions that the resultant PAWR services suite would be built using: existing testbeds services, something brand new (from small to large), or federation of some or all of the above.

During the full proposal-writing stage, the PPO anticipates proposers will discuss with the PPO where the implementation work for the services framework is most easily performed. Table A should be used as a checklist document to clearly articulate which services the proposers are considering offering on their own vs. asking the PPO to provide.

Table A

Tools and Services	Goals	
Research Platform Architecture and Setup	secure; safe; interoperable with best of breed Industry solutions where appropriate; software-defined where reasonable	Design and deploy an architecturally-consistent blend of industry-provided, donated, and purchased wireless resources that are capable of executing advanced wireless research experiments
Researcher authentication	Use existing authentication mechanisms	Adopt a researcher authentication technology (such as InCommon used in GENI) that allows for ease of use by both academic and industry researchers. It may be necessary to create an additional InCommon domain for industry research.
Gateway authentication	Isolate experiments from the world and allow them to be controlled only by members of their project	Adopt gateway-based isolation for the experiment. The software which gives access via the gateway to the experimenter might be patterned after GENI wireless.
Defining Experimental Projects	Facilitate collaboration between investigators at the same and different institutions, between industry and academia, and for educational purposes	Extend an existing Project framework such as is present in the GENI Portal, in APT, in JetStream (and XSEDE generally), in CloudLab, and Chameleon.
Experiment lifecycle	Facilitate ease of use	Adopt and extend tools that facilitate the user lifecycle.
Scheduling	Maximize useful results from the Platform while keeping urgency in mind	Consider assisted scheduling tools
Profiles	Ease of use (don't start from scratch)	Create basic experimental configurations that will be the basis for experimenters to use or modify. These may include standard services for provisioning as well as measurement services.
Namespace Management	Avoid experiments from being confused with each other in log files and configuration files	Define a metadata namespace standard (including unique identifiers such as epoch+project-name+experiment ID+date/time)
Component images	Ability to easily create experiments from known components	Provide known working VM images and known working wireless parameter files for radios (including SDRs)
Service chains	Ability to experiment based on known interoperable components	Define known working service chains such as are present in EPC configurations as profiles (see above).
Measurement Framework	Reduce error by using existing instrumentation and measurement best practices	As part of the design of the Research Platform, a series of measurement points will be identified.
Experiment archiving	Facilitate primary and secondary scholarly analysis	For archiving experimental data and the configurations which generated them: define policies, standards, and implement a

		mechanism (e.g., iRods)
Safety and Security Compliance	Ensure technical safety and security compliance	Safety (including RF emissions) and security standards and practices will be developed such as software licensing checks.
Spectrum use coordination	Avoid spectrum interference	Field any issues raised by spectrum owner or other nearby wireless operator
Common equipment software	Avoid experimental dependency on software versions	Adapt and maintain open source controller software with virtualization and layer 2/3; track manufacturer critical updates; create and maintain equipment configurations and playbooks
Sliceable Resources	Allow multiple experiments to be run simultaneously when possible	Duplicate key components and virtualize others so that each experiment can run in its own domain on the same research platform as other experiments.
Share Software and Profiles	Allow easy software, image, and profile sharing	Establish GitHub repository for software, profiles, images. Find and manage open source images of interest.
UE Lending Program	Facilitate UE lending between Research Platforms	Consider the value of a UE lending program between Research Platforms
Playbook support	Wiki-like support anyone can update but all changes are tracked	Establish and maintain Wiki-based infrastructure for playbooks
User support	Provide self-help with expert backup	Oversee and intervene in user-based discussion groups (e.g., Google Groups) being used by experimenters.
Federation	Allow super-experiments to run on PAWR + other distributed platforms (academic or industry)	Allow super-experiments to run across PAWR platforms and CloudLab, Chameleon, XSEDE (often Jetstream), GENI, and others including international federations.
Experiment Support / Management	Enable research and experiment teams to perform their work with minimal knowledge of underlying capabilities or infra structure	NOC type setup to support researchers and experimenters with support and or troubleshooting issues- on call as needed
Ticketing System	Document and Archival capabilities for issues or defects	Allow experimenters and test groups to login any issues or defects
Status system	Easy access to research /experiment groups to know the network or system status	Status of Network availability and or capability availability should be easily accessible for groups to ensure there are no surprises when testing or validation efforts begin

Data Management Plan

This data management plan is intended to capture, protect, and preserve records and data generated during the Platforms for Advanced Wireless Research (PAWR) program. It addresses both the Project Management Data that will be developed over the course of the PAWR Project Office (including internal and external interactions, inputs, decisions, and actions) and Research Platform Data gathered or provided to the PAWR Project Office on the PAWR Research Platforms (including their configurations, management structures, performance characteristics, and utilization). Because the PAWR Project Office is managing a unique collaboration among government, the wireless industry, academia, and civic partners, it is particularly important to be able to capture lessons learned from the interactions among these stakeholders and the PAWR Project Office.

The data are expected to be useful for four purposes:

A. Transparency and data-driven decision-making by all parties (as it happens)
B. Evaluation and lessons learned (guiding mid-course corrections)
C. Archival history and re-analysis (for the record)
D. Supporting OMB A-133 audits (to meet federal standards)

The PPO Project Director is responsible for designating data custodians for all the types of data described in this data management plan, and periodically reviewing compliance with data management. In addition, the evaluation of the PPO will have as one of its focus areas an annual review and update of the project's data management practices.

The following seven categories correspond to the CISE recommendations for data management plans.

1. *The types of data, metadata, samples, physical collections, software, curriculum materials, and other materials to be collected and/or generated in the course of the project.*

   Project Management Data:

   a. Important or formal documents received or sent by the Project Office that play a role in significant management decisions of PAWR will be preserved. Many of these may be exchanges with the National Science Foundation and other government partners (including the FCC), the Industry Partners, the Research Platforms, the civic, academic, and industry partners of the Research Platforms, and wireless researchers. These documents may be in electronic or paper form and may include memoranda of important input or decisions reached. Documents to be preserved should be sent (or copied) to PAWR-records@us-ignite.org for preservation.
   b. Internal Project Office documents and records that set context or play important roles in decision-making will be preserved including project plans, risk registers, progress reports, board and committee meeting packets (including agendas) and subsequent minutes, actions items, and/or trackers that are produced. Key

Performance Indicators (KPIs) are included. Not included will be personnel evaluations, letters, and actions, and routine business correspondence not related to stakeholders (e.g., routine invoicing and bill payment).

c. Documents received or sent by the Project Office with respect to allocating time on the Research Platforms for research or any other purpose, and information received on how those allocations were used and the research results obtained including references to any publications or presentations which resulted from the allocation.
d. The summarized results of surveys of stakeholders and research users; this should be transparent if those results do not reveal any proprietary information.
e. Software tools generated by the PPO staff in the performance of their duties. These should be transparent data and open sourced (e.g., via GitHub) where reasonable. Pointers to the open sourced data will be provided in the PPO Transparency Wiki.

Research Platform Data:

a. Data generated and disseminated during the Research Platform Outreach and Selection Process.
b. Data sent to or received from the Research Platforms of all kinds including schedules, security plans, organizational data, plans and timelines, configurations, results of commissioning or calibration tests, correspondence with the civic or academic partners,, and all other documents described under the commissioning and operations phases in the proposal. Also included are key performance indicators and actual utilization data including records of failures, downtimes, re-configuration, and maintenance. Not included are the data generated by individual researchers (which should be covered by their own data management plan), personnel evaluations, letters, or actions, or routine correspondence (e.g., setting up meetings) that is not involved in decision-making or evaluation. Note that Research Platforms will be required to have their own data management plans that will provide equivalent transparency and preserve the same broad sets of information as this data management plan.

Any other data that may be useful for understanding context, decision-making, or evaluating PAWR may be sent to PAWR-records@us-ignite.org for preservation.

2. *The standards to be used for data and metadata format and content (where existing standards are absent or deemed inadequate, this should be documented along with any proposed solutions or remedies).*

In general, information being preserved will be kept in its original form to avoid losing any contextual or product-specific information. The US Ignite PPO plans to use Microsoft Office document formats and Google G-Suite document formats. Project Management data including Earned Value Management data will be kept in Oracle Primavera or a similar project management system. Information exchanged with stakeholders will usually be in Portable Document Format (PDF) for maximum compatibility. Document metadata will

include authors and dates. It is anticipated that all information will be kept in widely-used standard formats.

3. *The physical and/or cyber resources and facilities (including those supplied by third parties) that will be used to store and preserve the data after the grant ends.*

For external and transparent data, the PPO intends to use a Wiki or similar technology which permits and records updates and changes and attributes them to a responsible individual (often the data custodian). The Wiki will be backed up by a commercial service on a weekly basis if not more often.

One reason for the choice of a Wiki format is to permit Research Platforms and Researchers to use this method of data management for their own data; this will permit all PAWR data to be searched in a single search of a single database. Wiki branches will be created upon request to satisfy the needs of Research Platforms and Researchers. Research Platforms may be required to use the PAWR Wiki for their own transparent information.

For internal data, the PPO intends to use Google Drive technology which can limit access to named individuals or roles or categories of individuals. In addition, the Google G-Suite records updates and changes in a document history that can be reviewed and undesirable changes revoked if necessary. Final preservation copies from online sources such as G-Suite and Wikis will be converted to an open document standard like PDF for archiving. Google Takeout supports direct export of G-Suite documents to standard document types including Portable Document Format (PDF). Wikis and other online documentation tools will support publishing to a standard document format as well for inclusion in the archive.

The PPO will work with its academic partners to provide long-term storage at an academic or nonprofit library or via the RENCI DataNet Federation, providing an endowment to do so, if necessary to ensure the materials remain open to the public for a minimum of ten years after the conclusion of the PPO.

4. *The policies for access and sharing including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, or other rights or requirements.*

Transparency information will be posted to a PAWR Wiki or equivalent which will also record the person posting, date, and time. Any modifications will also be tracked and can be revoked if malicious.

Transparency information includes publicly available information on the PPO and the Platforms to include (among other things):

An easy on-ramp to learning about and using PAWR Research Platforms
Descriptions and configurations of the Research Platforms
Information on how to obtain an educational, trial, or startup allocation on a Research Platform

Information on how to successfully apply for a large allocation on a Research Platform
The Technical Report Series
Upcoming events and how to attend them
Presentations and recordings (when made) of previous events
PPO personnel and contact information
This Data Management Policy and other similar governing policies of the PPO

The PAWR Industry Consortium and Committees and other stakeholders will be asked what other materials should also be made transparent. For example, the Research Committee will be asked if granted allocations should be made transparent. Similar to NSF practice, we expect that proposals themselves will not be made transparent.

Other management information which may not otherwise be made transparent will nevertheless be preserved for the purposes of gathering lessons learned, aiding evaluation, and preserving an historical record of the PPO. Access to these records will be available to their authors, those with whom the materials were originally shared, and designated evaluators. After 24 months and in consultation with the National Science Foundation, consideration will be given to making the materials publicly available in an archive where they do not involve specific personnel actions or evaluations and do not disclose proprietary information.

Intellectual property of any stakeholder or the PPO should be so designated on any document so that proprietary or sensitive information can be protected as need and/or for the length of time specified.

5. *The policies and provisions for re-use, re-distribution, and the production of derivatives.*

   Transparency information may be freely re-used, re-distributed, or used in the production of academic derivatives when the source of the original information is properly acknowledged.

6. *The plans for archiving data, samples, and other research products, and for preservation of access to them after the award ends.*

   Research products will be the subject of individual data management plans for each academic or joint academic-industry research product. Industry research will be archived and preserved following the policies of the industry researcher and their company. However, the PPO encourages all research to be made available transparently along with the raw research data.

7. *The roles and responsibilities of all parties with respect to the management of the data (including contingency plans for the departure of key personnel from the project) after the grant ends.*

This data management plan will be reviewed and amended by the PPO Project Director and Co-PIs in consultation with the PAWR Industry Consortium, Research Committee, and the National Science Foundation. At the internal project management kickoff, the record-keeping responsibilities of the PPO will be emphasized with specific time given to identifying appropriate information to be preserved, methods of preservation, and taking care with sensitive, personal, proprietary, or otherwise protected information.

As new staff members come on board the PPO, an important part of their onboarding process will be the review of the data management plan and a discussion of the kinds of documents they are likely to handle which require preservation and/or special handling due to their nature.

A part of the PPO evaluations should include feedback on execution of the data management plan.

After the grant ends, all of the transparent information will continue to be made public as described above. Proprietary and protected information will be kept in those categories unless there is a time limit specified for proprietary data (and the PPO will encourage not less than 24 months).

PPO Constituents' Contributions and Benefits

Academic Researchers:

Agree To	Receive
Extend to the proposed PAWR projects expertise administering wireless research platforms	Access to at-scale wireless research platforms
Contribute to the PAWR platforms expertise designing wireless research experiments	Expanded opportunities to access wireless research funding from NSF, Federal Agencies and Non-Government sources
Apply host university's experience and proven processes for managing Federal grant funds effectively (if the academic researcher is acting as the prime recipient for PAWR funds)	Greater potential to accelerate breakthroughs in advanced wireless technologies
	Opportunity to engage industry early in the innovation process and develop research with input related to industry trends and expressed topic areas of interest
	Partnerships with federal agencies on new technologies and spectrum trials

Local Governments:

Agree To	Receive
Provide a point-person in municipal government to help facilitate the deployment of the PAWR platform	Millions of dollars of direct investment in the economy of the community hosting a PAWR platform
Set-forth clear and transparent processes for accessing local government infrastructure in the deployment of a PAWR Platform	Recurring economic benefit from attached industry and government-funded research on PAWR platform
Consider contributing wireless facilities and infrastructure controlled by a responding municipality, thereby reducing the cost of deploying and operating a PAWR platform	Potential for new job creation as wireless companies opt to locate or maintain a base of operations in communities that host PAWR platforms
Encourage engagement with key stakeholders across a community from local government agencies and community Anchor Institutions (CAIs), the private sector and from not-for-profit entities including economic development and accelerator organizations.	Opportunity to test and refine innovative approaches to city services utilizing wireless applications
	National visibility for the community as a leader in wireless innovation

Industry Participants:

Agree To	Receive
Provide equipment and know-how that will reduce the deployment cost and/or increase the effectiveness of the PAWR platforms	Access to new city-scale wireless research platforms for company-specific research
Contribute expertise designing wireless research experiments	Opportunity to help select best, most flexible research platforms needed to meet the needs of academic and industry researchers
Share experience identifying fundamental wireless research topics	Ability to hire from an expanded pool of wireless experts
	Ability to accelerate deployment of breakthroughs in wireless technology

Conflict of Interest Standards

The PPO will remain scrupulous in preventing conflicts of interest (CoI) throughout the PAWR program, with such conflicts as defined by federal guidelines. The PPO will use NSF CoI standards (as defined in the PAPPG, Exhibit II-2) to screen for potential conflicts within the PPO and identify disqualifying CoIs for potential reviewers of each proposal. In addition to these NSF CoI guidelines, reviewers will be explicitly asked to disclose any pending or existing contracts with PAWR Industry Consortium members, states or local municipalities. The PPO will maintain secure records of all reviewer disclosures. The management of the screening will be the responsibility of the Program Director. As noted above, selection of proposals for award would be by the determination of the PPO using the results of the proposal review process. At that point, the CoIs of both program staff and reviewers will have been addressed previously and will not influence platform selection. A non-exhaustive set of examples of potential conflicts and how they are being mitigated are outlined below.

- Industry representatives seek advantage by actively participating in community-university teams proposing to become a PAWR platform: Industry Consortium members of the PAWR program have been prohibited from being named in community-university RFP responses. Informal consultation has been permitted.

- Industry members of the Proposal Review Committee have had a working relationship with the proposal personnel: Industry members of the Committee will be asked to recuse themselves from reviewing such proposals, even if they may not have published outcomes from such working relationships.

- Industry members of the Proposal Review Committee seek advantage by judging proposals in cities where they have active outdoor testbeds or where they have a significant corporate presence: Industry members of the Committee will be asked to recuse themselves from judging proposals from communities where their companies have active, outdoor testbeds or have a significant corporate presence.

- Academic members of the PPO team favor proposals from their universities: Home universities for academic members of the PPO team are prohibited from proposing to become one of the PAWR platforms.

- Academic members of the Proposal Review Committee seek advantage by judging proposals from their home universities: Members of the Proposal Review Committee will be selected from universities that have not submitted a proposal in response to the currently issued RFP.

- Proposing community-university teams seek advantage through communication with the PPO or NSF after the RFP is released: PPO and NSF communication with potential proposers after

the RFP is released will be strictly limited to answering questions outlined in the RFP. Continually updated FAQs posted on the RFP website will serve as an additional vehicle to communicate PPO responses to questions on the RFP.

- Industry or university researchers seek advantage in scheduling research on the platforms: Scheduling guidelines ensuring 50/50 industry and academic platform participation and explicit time allocations within each 50% shall be defined by the PAWR Research Committee (with the industry component determined by the relative proportion of cash and in-kind contributions made).

- PPO team members seek to benefit inappropriately from selected community-university teams: All team members must follow the federal government's General Procurement Standards (2 CFR 200.318). The PPO will ensure that platforms perform in accordance with the terms, conditions, and specifications of their contracts or purchase orders (2 CFR 200.318 (b)). These standards require that:
  - A PPO team person will not participate in the selection, award, or administration of a contract under a grant if the PPO team person, any of the person's family members or partners, or an Organization which employs or is about to employ any of these persons, has a financial or other interest in the Organization selected for the contract as this would give rise to an inappropriate conflict of interest.
  - A PPO team person will not solicit or accept gratuities, favors, or anything of monetary value from any partners or contractors unless of de minimis value as defined by the IRS code. If any person violates the code, they will be subject to disciplinary action.

- Platform sub-awardees seek to benefit inappropriately from selected community-university partners: All sub-awardee team members must follow the federal government's General Procurement Standards (2 CFR 200.318). The sub-awardee will ensure that platforms perform in accordance with the terms, conditions, and specifications of their contracts or purchase orders (2 CFR 200.318 (b)). These standards require that:
  - Sub-awardee employees, officers or agents will not participate in the selection, award, or administration of a contract under a grant if the employee, any of the employee's family members or partners, or an Organization which employs or is about to employ any of these persons, has a financial or other interest in the Organization selected for the contract as this would give rise to an inappropriate conflict of interest.
  - Sub-awardee employees will not solicit or accept gratuities, favors, or anything of monetary value from the PPO contractors unless of de minimis value as defined by the IRS code. If any employees violate the code, they will be subject to disciplinary action.

Intellectual Property and Licensing Guidelines for the Platforms for Advanced Wireless Research (PAWR)

1. A single Intellectual Property (IP) Policy will apply to all platforms and their use. The policy shall be stated in each platform award terms and conditions.

2. Research to be conducted on the platforms will be classified into four tranches:
   a. Research sponsored in whole or in part by NSF;
   b. Research sponsored by the entire Industry Consortium that is not in tranche (a);
   c. Research sponsored by individual member companies of the Industry Consortium, that is not in tranche (a) or (b); and
   d. All other research.

3. Rights to inventions made during research in tranche (a) shall be governed by standard NSF policy (pursuant to the Bayh-Dole Act), as described in the current *Proposal and Award Policies and Procedures Guide*, Chapter XI.D.)[1], with the following additional condition: Each member of the Industry Consortium, the PPO, and NSF shall be granted a royalty-free, non-exclusive, non-sub-licensable license for non-commercial use of the invention.

4. Publication of results from research in tranche (a) shall be governed by standard NSF policy as specified in the current *Proposal and Award Policies and Procedures Guide* Chapter XI.E., without additional restrictions.

[1] Institutions receiving NSF funding for research covered by this policy are reminded that, in view of the US Supreme Court decision in Stanford v. Roche, employee assignment agreements should include a present conveyance of rights ("I hereby assign" rather than a promise or intent to assign) in order to effectively convey patent rights to the institution, allowing the institution to meet its responsibility under the Bayh-Dole Act to provide the agency with a license to patented inventions.

NSF Workshop Report on “Large-scale Networking Platforms Communities of Practice”

http://www.winlab.rutgers.edu/events/tbcopws/tbcopws-report.pdf