LG-70-18-0210 Abstract: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

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Abstract

In 2014, the Association of Tribal Archives, Museums and Libraries prepared a report, *Digital Inclusion in Native Communities: The Role of Tribal Libraries*, which discusses the challenges Tribal Libraries face in bringing basic broadband access to their citizens in addition to creating public spaces that provide Wi-Fi connections. The report illustrates how **Tribal Libraries play a critical role as community anchor institutions (CAIs)** in providing their community members with access to the internet (ATALM, 2014). The FCC defines Community Anchor Institutions (CAIs) "as schools, libraries, hospitals and other medical providers, public safety entities, institutions of higher education, and community support organizations that facilitate greater use of broadband by vulnerable populations, including low-income, the unemployed, and the aged" (FCC, 2011, p. 38). TV Whitespace (TVWS) represents an emerging, low-cost wireless technology that has the potential of expanding Tribal Libraries' ability to extend their Wi-Fi signals beyond the building and beyond library hours to public spaces such as subsidized housing, schools, clinics, museums, senior centers, and other CAIs (Rebmann, Te, & Means, 2017). As part of their role as CAIs, Tribal libraries can leverage TVWS to provide convenient WiFi access for the community in new places never before served. Parks, shelters, playgrounds, senior centers, and post offices are just a few places that can serve as candidates for new library hotspot locations. With its goals for addressing challenges associated with Native American equity through digital access and inclusion, **the project responds to the IMLS Community Anchors project category through its goals to promote digital inclusion and enhance equity and access**. Along similar lines, it addresses the IMLS National Digital Platform's call for Diversity and Inclusion:

> *NDP work must be inclusive of the diverse communities and sovereign tribal nations that make up the United States (National Digital Platform at Three, 2017).*

This project, involving Dr. Kristen Rebmann of San Jose State University's School of Information (SJSU-iSchool), Alana McGrattan of the Tribal Libraries Program of the New Mexico State Library (TLP-NMSL), Gar Clarke (Tribal Liaison) of the New Mexico State Department of Information Technology Office of Broadband & Geospatial Initiatives (DoIT/OBGI), Donald Means of Gigabit Libraries Network (GLN), and Dr. Elizabeth Belding of University of California, Santa Barbara's Department of Computer Science (UCSB-CS) will collaborate with Tribal Libraries across New Mexico to explore dramatically improving Tribal internet connectivity, equity, and inclusion through the design and implementation of several TV Whitespace (TVWS) networks statewide. **The proposal respectfully requests a $249,882 to address challenges associated with Native American digital access and inclusion through a two-year, four-part work plan involving professional development, technology implementation via a subaward program, evaluation research, and model development/dissemination.** The project is structured with a lead project director, four project partners, and three Tribal library partners. A two-year project, the requested grant period runs from 10/01/2018 through 09/30/2020.

Each of the four phases associated with this project address IMLS' National Leadership Grants for Libraries Community Anchors and National Digital Platform **project categories** by positioning TV White Space technology as a communications technology that is supportive of Tribal Libraries' role as Community Anchor Institutions striving for information equity, access, and inclusion. Our project will **transform national efforts to improve access to digital content and services** through the adoption of new networking technologies and infrastructure (TVWS frequencies) recently released by the Federal Communications Commission (FCC). The project makes national impact through the adaptation of our models (to new users and institutions) and via efforts to provide digital access to underserved community members in areas of critical need.

LG-70-18-0210 Narrative: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

San Jose State University Research Foundation

Statement of National Need

In 2014, the Association of Tribal Archives, Museums and Libraries prepared a report, *Digital Inclusion in Native Communities: The Role of Tribal Libraries*, which discusses the challenges Tribal Libraries face in bringing basic broadband access to their citizens in addition to creating public spaces that provide WiFi connections. The report illustrates how **Tribal Libraries play a critical role as community anchor institutions (CAIs)** in providing their community members with access to the internet (ATALM, 2014). The FCC defines Community Anchor Institutions (CAIs) "as schools, libraries, hospitals and other medical providers, public safety entities, institutions of higher education, and community support organizations that facilitate greater use of broadband by vulnerable populations, including low-income, the unemployed, and the aged" (FCC, 2011, p. 38). TV Whitespace (TVWS) represents an emerging, low-cost wireless technology that has the potential of expanding Tribal Libraries' ability to extend their WiFi signals beyond the building and beyond library hours to public spaces such as subsidized housing, schools, clinics, museums, senior centers, and other CAIs (Rebmann, Te, & Means, 2017). As part of their role as CAIs, Tribal libraries can leverage TVWS to provide convenient WiFi access for the community in new places never before served. Parks, shelters, playgrounds, senior centers, and post offices are just a few places that can serve as candidates for new internet hotspot locations. With its goals for addressing challenges associated with Native American equity through digital access and inclusion, **the project responds to the IMLS Community Anchors project category through its goals to promote digital inclusion and enhance equity and access**. Along similar lines, it addresses the IMLS National Digital Platform's call for Diversity and Inclusion:

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The project is structured with a lead project director, four project partners, and three Tribal library partners. The project has two primary audiences: underserved populations associated with New Mexico's Sovereign Tribal Nations and the library professionals that serve them. Our project addresses challenges in access and inclusion by raising awareness of TVWS networking in the Tribal library community and supporting practitioners' abilities to use TVWS to expand internet access to underserved, Native American, and rural populations. Intrinsic to this primary goal is the need to raise awareness and assist practitioners in developing competencies supportive of TVWS implementations in their own communities.

What is TV Whitespace?

TVWS spectrum refers to radio frequencies that were released by the Federal Communications Committee in 2008 to provide license free access for the public. An important benefit of TVWS is that it does not require line-

LG-70-18-0210 Narrative: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

San Jose State University Research Foundation

of-sight to support signals and has strong propagation qualities. Frequencies associated with TVWS reside in the lower radio frequency bands. For this reason, signals can travel for several miles and typically pass through geographic and community obstructions such as trees or buildings.

The power (and value) of TVWS lies in the fact that it is **uses free public spectra**. Access to TVWS frequencies is **free and requires no subscription fees** other than the initial equipment investment. Whereas traditional WiFi networks can only reach patrons in the immediate vicinity of the library, TVWS-enabled implementations can support internet hotspots in places like: **subsidized housing, schools, clinics, parks, shelters, senior centers, and museums**. The range of TVWS-enabled networks is measured in 100s or even 1000s of meters (Chavez et al, 2015), thus augmenting the number of patrons that libraries can serve via wireless connections to the internet. Furthermore, unlike technologies that require line-of-sight between units, TVWS signals possess non-line-of-sight characteristics enabling them to travel through obstructions like buildings, trees, and even over small hills. TVWS remote **hotspots also can be easily (and strategically) moved** to support occasional community needs or in response to crisis situations.

How a TVWS network operates with a Tribal library-led installation (see Figure #1).

Once a Tribal library decides that they are ready to design and implement a TVWS network, they should follow several steps:

1. **Identify their current connection** to the internet and several community spaces where WiFi access is needed. Make sure that the library's backhaul (broadband connection) is at least 30 megabits per second (Mbps) or faster.

Figure 1. Tribal Connectivity via TVWS. Modified Infographic from TVWS Equipment Manufacturer and Collaborator Carlson Wireless Technologies

2. **Investigate channel availability and noise floor.** Several equipment suppliers provide access to tools and resources to help individuals determine channel availability and coverage in their area. Spectrum Bridge, Inc. provides a tool to search for open channels based upon user-provided information: http://whitespaces.spectrumbridge.com/whitespaces/home.aspx. Libraries can enter the name of their town or zip code into the database for instant results. Important to remember is to search for fixed devices, as mobile
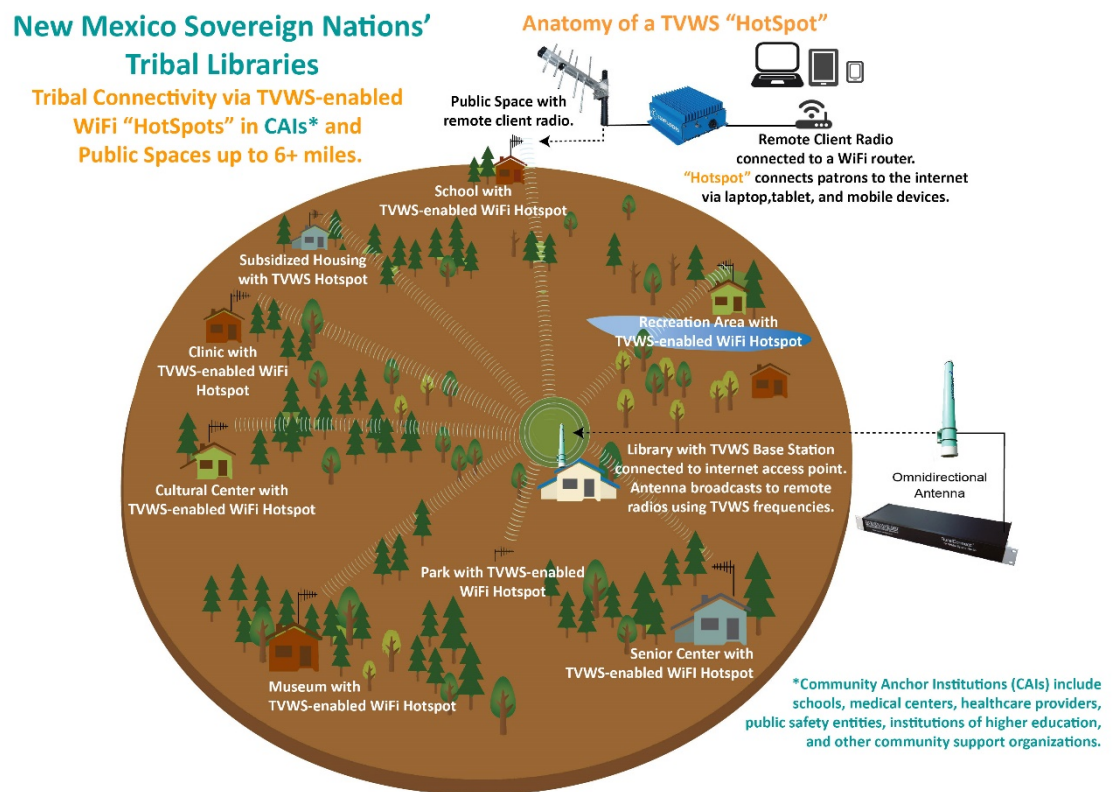
LG-70-18-0210 Narrative: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

San Jose State University Research Foundation

devices are not yet available. Relevant channels are in the range of 14 to 51. Noise estimates should achieve a noise floor threshold of -90 dBm or smaller (-100 would be more optimal than -90 and so on).

3. **Work with a TVWS equipment supplier** to install a TVWS base station that is integrated with their wired connection to the internet. This step allows the library to gain access to public TVWS frequencies by which they can broadcast and receive internet connections from paired TVWS-enabled remote hotspots.

4. **Install TVWS-enabled remote WiFi hotspots** and publicize the new TVWS-enabled remote hotspots that now provide WiFi connections to patrons in community spaces previously out of the library's reach.

Project Design

Project goals and outcomes for this proposal include: (1) to realize the potential of using **TVWS to promote equity through digital access and inclusion**, (2) to provide **professional development opportunities for Tribal Library professionals** relating to TVWS technology and its applications through an online, open-access course, (3) **to deploy 3 TVWS networks** involving Tribal Libraries, (4) to develop **a model for collaborations between Native American Sovereign Nations and their respective states for TVWS-enabled Tribal Connectivity**, and (5) **to study TVWS performance and usage** within an operational network. SJSU's-iSchool, TLP-NMSL, NM-DoIT/OBGI, GLN, and UCSB-CS will collaborate with Tribal Libraries across New Mexico to explore the improvement of Tribal internet connectivity, equity, and inclusion through the design, implementation, and evaluation of several TVWS networks statewide. There are no risks associated with this project beyond what one would encounter in everyday activities but activities will involve human subjects during the professional development phase and the evaluation phase of the project due to the inclusion of survey and interview methods. **Research protocols will be developed and submitted to SJSU's Institutional Review Board for coverage and protection of any human subjects involved in project activities.**

This project will extend the efforts of several grant-funded projects:
- 2017 Microsoft funding: Supported several TVWS networks in Michigan libraries.
- 2016 IMLS grant: Supported 5 new TVWS networks (ME, GA, Yakama Nation – WA, NE, & SD).
- 2016 National Science Foundation (NSF) EAGER (Early-Concept Grants for Exploratory Research) and NSF NeTS (Networking Technology and Systems) grants: Supported TVWS investment for Tribal Connectivity.
- 2015 Knight Foundation grant: Funded basic TVWS orientation and analysis tools for libraries.

Importantly, the 2016 IMLS and NSF-funded grants (described above) represented **very early efforts at addressing Tribal connectivity** using TV Whitespace technology. This project builds upon these efforts by focusing on Native American libraries as settings. Microsoft funding focused on state-lead coalitions. This project complements and extends these efforts by developing a national model **for collaborations between Native American Sovereign Nations and their respective states for TVWS-enabled Tribal Connectivity.** This project also builds upon previous efforts (funded by Microsoft, IMLS, NSF, the Knight Foundation) to evaluate (access and inclusionary) impact of the implementation of TVWS networks. In that project, measures of patron internet usage were found to increase via a TVWS implementation. We would like to adopt a similar model to measure improvements in community access. Our target for increase in library network is +20%. This measure will indicate that meaningful increases in access and information use are occurring.

Pre-Grant Activities

To ensure that the project reflects Tribal partnership across all phases, prior to submitting this proposal, grant partners have begun the process of communicating with Tribal libraries in New Mexico to identify sites with

LG-70-18-0210 Narrative: *Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion*

San Jose State University Research Foundation

technical feasibility for TVWS. An assessment of Tribal Libraries and available Channels for TVWS was conducted. Alana McGrattan and Gar Clarke are currently assessing this information and contacting the candidate tribes. This work is in concert with Tribal assessments McGrattan and Clarke are conducting using an IMLS Toolkit which provides a discussion path between Tribal Librarians and IT Support. See Supporting Document #9 for details of the assessment and the Toolkit.

Sequence of Activities via Strategic Directions, Key Performance Indicators, and Associated Deliverables

The project extends prior TVWS research and projects through a four-part work plan involving professional development, technology implementation via a subaward program, evaluation research, and model development/dissemination. Director, **Kristen Rebmann, PhD, MLIS,** is an Associate Professor at San Jose State University's School of Information (SJSU-SOI). She is committed to work in all phases of the project. **Don Means** represents Gigabit Libraries Network (GLN) and is committed to work in all phases of the project. **Alana McGrattan** of the Tribal Libraries Program of the New Mexico State Library (TLP-NMSL) and is committed to working on the project in all phases of the project. **Gar Clarke** (Tribal Liaison) of the New Mexico State Department of Information Technology Office of Broadband & Geospatial Initiatives (NM DoIT/OBGI) and is committed to working on the project in all phases of the project. **Dr. Elizabeth Belding** of University of California, Santa Barbara's Department of Computer Science (UCSB-CS) and is committed to working on the project in all phases of the project. See Figure 2 for a timeline of project activities.

Grant Year 1 Phase 1 and Phase 2 D = Deliverable | M = Milestone	Oct. 2018	Nov. 2018	Dec. 2018	Jan. 2019	Feb. 2019	Mar. 2019	Apr. 2019	May 2019	Jun. 2019	Jul. 2019	Aug. 2019	Sep. 2019
Design and Obtain SJSU IRB Approval for TVWS Course				D								
New Mexico (NM) Tribal Library Outreach				M								
Workshop Planning and Scheduling												
TVWS Course Runs					M	M	M					
NM Tribal Outreach & Plan Development												
Select NM Tribal Subaward Recipients									M			
Collect Baseline Usage Data								M	M	M	M	M
Subawards Distributed $$$									M	M		
TVWS Subawards Go Live									D	D	D	D

Grant Year 2 Phase 3 and Phase 4 D = Deliverable | M = Milestone	Oct. 2019	Nov. 2019	Dec. 2019	Jan. 2020	Feb. 2020	Mar. 2020	Apr. 2020	May 2020	Jun. 2020	Jul. 2020	Aug. 2020	Sep. 2020
TVWS Subawards Go Live	D	D										
Author Surveys and Interviews					M							
Gain SJSU IRB approval for Data Collection.					M							
Publications Planning & Writing												
TVWS Subawards Site Visits						M	M	M	M	M	M	M
Data Collection: Reports, Usage Statistics, Surveys						M	M	M	M			
Analyze Datasets												
Author Vignettes/Case Studies (5)										D		
Develop *Model for Tribal TVWS Implementation*											D	
Develop *Model for Tribal-State TVWS Collaborations*												D
Develop *TVWS How-To Document*												D

Figure 2. Timeline

Strategic Direction and Activities for Phase 1: Professional Development and Site Planning/Selection

Phase 1 involves the development of an online open course (hosted by SJSU-iSchool) for Tribal Library

LG-70-18-0210 Narrative: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

San Jose State University Research Foundation

professionals to raise awareness of TVWS technology and scenarios for its deployment in Tribal Library and Native American community contexts. This online open course will be supplemented by an in-person workshop for Tribal Library Professionals in New Mexico. We hope to share our course content with Sustainable Heritage Network (SHN) as we did in a previous project. See Supplemental Document #11 for links to videos Kristen Rebmann made for SHN.

National Impact: This initial phase of the project will create **a freely available resource for continuous learning** and contribute to the cultivation of a digital library workforce (tenets of the IMLS National Digital Platform).

> *"Work in NDP focal areas supports the education and training of librarians to lead the way in the design, development, implementation, and maintenance of digital tools and services." (NDP at Three, 2017)*

Phase 1 will also involve TVWS network planning on the part of New Mexico Tribal libraries. **At the time of the writing of this grant proposal, several Tribal Libraries have been identified as sites that possess technological feasibility for and expressed interest in developing their own TVWS network implementations.**

Phase 1: Roles and Commitments. All team members are key players in this phase of the grant. Kristen Rebmann will work as the TVWS course designer, content author and instructor during grant year 1 and on course maintenance during year 2. Don Means will work as course content author and instructor during grant year 1 and on course maintenance during year 2. Gar Clarke, Alana McGrattan, and Elizabeth Belding will advise and provide feedback to iSchool and GLN team members on the relevance of curricula during year 1. All collaborators will participate in marketing the course widely. All team members will play a role in developing and teaching the face-to-face workshop in New Mexico. See Figure 2 for a timeline of project activities.

Phase 1: Key Performance Indicators (KPIs).

1.1. Curricula that prepare Tribal professionals to understand scenarios for library implementations of TVWS.
1.2. Online, open course (via Canvas Network) designed and implemented.
1.3. Face-to-face workshop held in New Mexico.
1.4. Collection of course-level data relating to course/workshop participation and learning outcomes.

Strategic Direction and Activities for Phase 2: Tribal Technology Investment and Implementation
Phase 2 initiates TVWS investment via subawards to (3) Tribal Libraries across the state of New Mexico. Gar Clarke, Alana McGrattan, Kristen Rebmann, Don Means, and Elizabeth Belding will collaborate with New Mexico's Sovereign Nations to further explore sites identified (prior to grant start date and in phase 1) as possessing existing backhaul that can support TVWS networks. New Mexico team members Gar Clarke and Alana McGrattan will work with these Tribal libraries to develop plans for possible development through subaward funding. Over the course of these site analyses, **Gar Clarke, Alana McGrattan, Kristen Rebmann, Don Means, and Elizabeth Belding will identify 3 sites with the greatest technical feasibility and potential for inclusion impact.** These sites will receive equipment subawards in the amount of $25,000 to pursue TVWS implementations in Phase 2. See Figure 2 for a timeline of project activities.

National Impact: These new TVWS networks will support the strategic extension of WiFi into new community spaces and will **augment the number of patrons able to access library programs, services, and the internet**. As part of their role as CAIs, Tribal libraries will have the opportunity to leverage TVWS to close the "homework gap" or provide convenient WiFi access for the community in new places never before served. The portability of access points might support distributed programming and wireless connections to community-based

LG-70-18-0210 Narrative: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

San Jose State University Research Foundation

activities and events. Libraries might also use TVWS to improve disaster response planning (also) due to the portability of TVWS hotspots. By moving with populations in crisis, TVWS hotspots can potentially provide digital access to people under evacuation.

Phase 2: Roles and Commitments. Kristen Rebmann, with support from the SJSU Research Foundation, will distribute subaward funds and coordinate implementation efforts with library subaward recipients during grant year 1. Gar Clarke, Alana McGrattan, and Don Means will coordinate with Tribal Libraries on the activation of their TVWS networks and implementation of site plans. Elizabeth Belding and Kristen Rebmann will coordinate with Tribal partners, Gar Clarke, and Alana McGrattan to develop a plan for monitoring Tribal TVWS network usage. All collected data about network usage will be fully anonymized and will not include user data, ensuring full privacy of network users. All data collection processes will receive IRB approval. Dr. Belding has extensive prior experience in the collection and analysis of IRB-approved network usage data for other networks, including in two Tribal communities. All team members will contribute to efforts at monitoring site progression.

Phase 2: Key Performance Indicators (KPIs)

2.1. Collection of TVWS network plans from several potential Tribal library systems.
2.2. Three (3) Tribal Libraries selected for TVWS investment and implementation.
2.3. Subaward funds distributed.
2.4. Three (3) TVWS-enabled networks implemented.
2.5. TVWS network monitoring plan.
2.6. Monitoring of TVWS-enabled network usage begins.

Strategic Direction and Activities for Phase 3: Evaluation Research

Phase 3 collects information from partner Tribal Libraries in the form of technology performance, network usage impact, reports, surveys, and interviews to evaluate the process and impact of the Tribal TVWS installations. **National Impact:** Led by UCSB-CS, and in collaboration with SJSU's-iSchool, TLP-NMSL, NM-DoIT/OBGI, and GLN, datasets collected in Phase 3 will assist in **developing a national model for effective deployment of TVWS** to improve Tribal Connectivity in support of digital equity, access and inclusion. Phase 3 will also collect datasets that will support the **development of a model for collaborations between Native American Sovereign Nations and their respective states for TVWS-enabled Tribal Connectivity**. See Figure 2 for a timeline of project activities.

Phase 3: Roles and Commitments. Elizabeth Belding, Kristen Rebmann, Don Means, Gar Clarke, and Alana McGrattan will work collaboratively to author guidelines that libraries and community anchor institutions will follow in reporting on the process of implementing their subawards. Guidelines will include the inclusion of planning documents for each subaward site that address TVWS technology integration. Reporting protocols will be designed with the goal of capturing processes of implementation, Tribal-State collaborations, and the usage impact of TVWS implementations. Kristen Rebmann, Don Means, Elizabeth Belding, Gar Clarke, and Alana McGrattan will travel to/observe TVWS implementation sites, survey/interview subaward recipients, and collect subaward recipient reporting documents during grant year 2.

Phase 3: Key Performance Indicators (KPIs)

3.1. Monitoring of TVWS-enabled network usage continues.
3.2. Measurable increases in library network usage at subaward sites (target: +20%).
3.3. Guidelines for reporting documents authored and sent to subaward recipients.
3.4. Surveys authored and distributed to subaward recipients.

LG-70-18-0210 Narrative: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

San Jose State University Research Foundation

3.5. Information sharing protocols authored for dialog with (and among) subaward recipients.

3.6. Technology performance monitoring reports for each subaward site (for mission-specific uses).

3.7. Network usage impact reports

3.8. Reporting documents for each subaward site.

Strategic Direction and Activities for Phase 4: Model Development and Dissemination

Phase 4 initiates model development, analyses of Phase 3 datasets, dissemination of results. Evaluation of the process and impact of the selected TVWS (subaward) implementations also occurs during this phase. Led by Kristen Rebmann, Don Means, and Elizabeth Belding, analyses of datasets collected in Phase 3 will explore the issue of TVWS/WiFi to improve Tribal internet access/inclusion and the role TVWS might play as a sustainable, resilient wireless infrastructure. See Figure 2 for a timeline of project activities.

Phase 4: Roles and Commitments. Kristen Rebmann, Elizabeth Belding, Don Means, Gar Clarke, and Alana McGrattan will work collaboratively in grant year 2 to analyze TVWS-enabled network usage statistics and other subaward datasets in support of the creation of several deliverables. These artifacts include three vignettes/case studies, a model for using TVWS technology as a component of Tribal library-lead approaches to digital access and inclusion, a model for Tribe-State TVWS collaborations, and a how-to document to assist Tribal libraries initiating TVWS implementations on their own. **National Impact:** Analyses of datasets collected in Phase 3 will produce documents in support of **a national model for effective deployment of TVWS-WiFi** to improve Tribal Connectivity in support of digital equity, access and inclusion. Phase 4 will also **develop a model for collaborations between Native American Sovereign Nations and their respective states for TVWS-enabled Tribal Connectivity**.

Phase 4: Key Performance Indicators (KPIs)

4.1. Three vignettes or case studies written to describe subaward configurations.

4.2. A TVWS implementation model (via open access, peer-reviewed publication) for Tribal libraries to serve mission-specific (access & inclusion) goals.

4.3. A model (via open access, peer-reviewed publication) for collaborations between Native American Sovereign Nations and their respective states for TVWS-enabled Tribal Connectivity.

4.4. A how-to document (via open access, peer-reviewed publication) for Tribal libraries who would like to initiate new TVWS implementations on their own.

Communication for Input, Instruction, Consensus, and Dissemination

The project integrates different forms of communication at each phase with each of its intended audiences. We have two primary audiences: underserved Tribal and rural populations and Tribal library professionals. We plan to reach Tribal and rural, underserved populations via a new networking/communications technology: TVWS. Our goal is to use Phase 1 (our professional development course on TVWS) to engage in outreach to Tribal library practitioners. We intend to reach the library community further by attending conferences such as the *Association of Tribal Archives, Libraries, and Museums, Association for Rural & Small Libraries Annual Conference, the American Library Association Annual Conference, the Schools, Health and Libraries Broadband Coalition's Annual Conference,* and the *Broadband Communities Annual Summit.* These professional conferences will allow us to spread the message about Tribal TVWS implementations and disseminate phase 3 findings as part of our process of authoring more formal articles for publication.

LG-70-18-0210 Narrative: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

San Jose State University Research Foundation

The TVWS subaward program in Phase 2 will cultivate research-library-community collaborations and technology adoption. **From Phase 2 onward, our key audience (the public) will be reached by increased digital access and inclusion mediated by the TVWS implementations. Subaward recipients will also market the new TVWS hotspots to community members.** In Phase 3, Tribal libraries will share documents in the form of technology performance, network usage impact, reports, surveys, and interviews as a means of evaluating the process and impact of the Tribal TVWS installations. Phase 4 will communicate with IMLS and the broader library community via professional publications, presentations at conferences, and resources designed to communicate the findings of datasets collected in phase 3. We have prior experience publishing in open access journals and anticipate disseminating (technology oriented) project results in journals that use this publishing model. *Information Technology and Libraries, The International Journal of Information, Diversity, & Inclusion,* and *Journal of New Librarianship* are just a few venues (of many) that we might consider for article submissions. Phase 4 deliverables include: three vignettes or case studies written to describe subaward configurations, a TVWS implementation model for Tribal libraries to serve mission-specific (access & inclusion) goals, a model for collaborations between Native American Sovereign Nations and their respective states for TVWS-enabled Tribal Connectivity, and a how-to document for Tribal libraries who would like to initiate new TVWS implementations on their own. We feel these reports would be ideal for distribution via open access, peer-reviewed publications.

Project Personnel and Financial Resources

As mentioned previously, the proposal respectfully requests a $249,882 to address challenges associated with Native American digital access and inclusion through a four-part work plan involving professional development, technology implementation via a subaward program, evaluation research, and model development/dissemination. The project is structured with a lead project director, four project partners, and three Tribal library partners.

> **Estimated Budget:** Director Salary and Fringe: $37,319; Subawards (technology and support) to Tribal libraries: $75,000; Consulting fees: $74,000; Travel to conferences and sites in New Mexico: $12,000; Indirect costs: $51,563. **Total Requested: $249,882.** Please see IMLS budget document and justification for details.

Project Director, Kristen Rebmann, PhD, MLIS, is an Associate Professor at San Jose State University's School of Information. Kristen has 3+ years conducting TVWS-related research, 15+ years of experience implementing and evaluating technology integration at the community level and 11+ years' experience as a distance educator. Her research background includes TVWS network implementations, community-based research, distance education, and programs/services design for diverse populations. Her experience in teaching includes courses in services for diverse users, learning design for new literacies, ethnographic research methods, and information retrieval. She received the SJSU School of Information's 2018 Faculty Distinguished Scholar Award, 2013 Outstanding Professor Award, and 2012 Faculty Distinguished Service Award.

Alana McGrattan, MA, MLS is the Tribal Libraries Program Coordinator at New Mexico State Library (since 2013). Working under the Department of Development at NMSL, Alana also provides consulting and professional development with librarians and tribal administration. She serves the 19 Public Libraries on Indian Reservations in New Mexico and collaborates with Jean Whitehorse at the Crownpoint Outreach Center of NMSL in developing and implementing programs at the Navajo Chapter Houses in Northwestern New Mexico. Alana is also serving on the advisory panel for the Indigenous Digital Archives which is a collaboration of the Museum of Indian Arts and Culture, New Mexico State Library and Indian Pueblo Cultural Center.

LG-70-18-0210 Narrative: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

**San Jose State University
Research Foundation**

Don Means represents the Gigabit Libraries Network (GLN), founded by Means in 2013 as a global collaborative of innovative libraries. Through his work with GLN, he has 5 years exploring TVWS/WiFi capabilities in support of library missions. With over 25 years of experience in ICT (in 2012) Means launched the "Libraries WhiteSpace Project" to advocate for library community leadership in utilizing new long range license free spectrum to dramatically expand access to library WiFi in communities everywhere. In 2007, Means initiated the "Fiber to the Library" campaign to assure gigabit fiber connections all US libraries as the fastest, most economical and equitable way to deliver "next generation" broadband into every community and has served as an advisor to the Librarian of Congress on digitization strategy.

George "Gar" Clarke is the New Mexico (NM) Broadband and Geospatial Program Manager with the State Department of Information Technology (NM DoIT). He facilitates the deployment of broadband availability by creating collaborative projects to enhance broadband adoption within New Mexico. Tasks include providing coordination, planning, technical assistance, data acquisition, and capacity building assistance to communities. He coordinated the development of the NM Broadband Program that birthed the Office of Broadband Initiatives and provided the foundation for the NM Broadband for Education Initiative. Gar has overseen the development of Broadband Strategic Plans and Studies that have focused on statewide implementation, policy considerations, businesses, utilities, education, health, and regional interests. Lastly, he coordinates the data acquisition and development of the New Mexico Broadband Map that is an important state resource for planning broadband projects.

Elizabeth Belding, PhD is a Professor in the Department of Computer Science at the University of California, Santa Barbara. Elizabeth's research focuses on mobile and wireless networking, including network performance analysis, TV white space deployments and performance, and information and communication technologies for development (ICTD). Elizabeth applies her wireless network expertise to a wide range of contexts, and is particularly interested in improving Internet and cellular accessibility in developing and resource-challenged communities worldwide. Most recently, she has been working with Native American communities around the US. Elizabeth is the author of over 140 technical papers on wireless networking and has served on over 70 conference technical program committees.

SJSU Research Foundation: Our key players in terms of the management of the project's financial management include: **Natalie Babella and Kristen Rebmann.** Natalie works as a Sponsored Programs Manager for SJSU's Research Foundation and has many years of experience managing grant finances**.** Natalie is a staff member overseeing the management of project budget and finances. Kristen Rebmann has experience working with grant-funded research since 2001. The grant will fund release time, summer pay, and fringe benefits for Kristen Rebmann (Phases 1-4), consulting time for Don Means (Phases 1-4), Elizabeth Belding (Phases 1-4), and Alana McGrattan (Phases 1-4). Work completed by Gar Clarke and Natalie Babella is already part of their normal work activities. Work processes and artifacts produced for professional development (Phase 1), subawards for TVWS equipment and support (Phase 2), and travel to conferences, the phase 1 workshop, and TVWS implementation (subaward) sites (Phases 1-4) are all funded by the grant. Subaward recipients will identify equipment and supplies needed to support their proposals (phase 2). Selected Tribal library subaward recipients will use funds to purchase equipment and technology support. San Jose State University facility and administrative indirect costs are also included. San Jose State University provides facilities, equipment, and supplies as part of the indirect costs as articulated in the budget for all phases.

LG-70-18-0210 Narrative: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

**San Jose State University
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Diversity Plan

This project represents a partnership among Tribal libraries, university researchers, state-level information technology and library professionals, and library advocates. It addresses issues of economic and cultural diversity with the goal of ensuring all Americans are served by the national digital platform through its focus on digital access and inclusion. The IMLS 2017 *National Digital Platform at Three* document states that ***"NDP work must be inclusive of the diverse communities and sovereign tribal nations that make up the United States" (National Digital Platform at Three (NDP), 2017).*** Through the provision of library-led, expanded, broadband access we hope to empower diverse communities. **In short, our Tribal library-led TVWS networks will strive to reach rural and Tribal communities.**

Our team recognizes that issues of digital access are unique to Tribal communities as are the impacts to underserved populations. With this in mind, our project emphasizes that need for Tribal leadership in every phase. Professional Development Phase 1 of the project engages with Tribal library communities not only to raise awareness of TVWS technology but to create a conversation about the needs of Tribal communities and how they might benefit most from new forms of broadband access. Phase 2 implements TVWS networks to reach Tribal populations and rural residents living in New Mexico. Phase 3 increases dialog between our New Mexico partners and researchers via network usage reporting, surveys, and interviews so that our team can learn from their experiences, technology configurations, usage, and inclusion impact. Phase 4 responds to the many voices of our partners via the dissemination of case studies and national models for technology implementation and Tribal-State collaborations. **It is our intent that the voices and strategies of our subaward recipients will inform and guide future implementations of TVWS technology in the Sovereign Nations across New Mexico and beyond (nationwide).**

Sustainability

We hope to use this project to further develop our agenda of increasing access and inclusion based upon early and evidence-based adoption of new networking technologies like TVWS. We have benefitted greatly from our previous efforts of implementing TVWS networks and plan to take what we learn from this project to create more refined models for implementations in rural and Tribal contexts. Previous efforts have also placed us in ongoing communication with early adopters. These forms of communication are crucial for sustainable implementations of technology. We feel that the learning materials, models, and how-to document will benefit from continued revision beyond the grant period. There is potential for these resources to be updated continually in support of an informed, sustainable, adoption path for TVWS technology in rural and Tribal spaces.

Overall National Impact

Each of the four phases associated with this project will address IMLS' National Leadership Grants for Libraries Community Anchors and National Digital Platform **project categories** by positioning TV White Space technology as a communications technology that is supportive of Tribal Libraries' role as Community Anchor Institutions striving for information equity, access, and inclusion. Our project will **transform national efforts to improve access to digital content and services** through the adoption of new networking technologies and infrastructure (TVWS frequencies) recently released by the Federal Communications Commission (FCC). We hope to make national impact through the adaptation of our models (to new users and institutions) and through our efforts to provide digital access to underserved community members in areas of critical need.

LG-70-18-0210 Schedule of Completion: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

San Jose State University Research Foundation

Grant Year 1 Phase 1 and Phase 2 D = Deliverable | M = Milestone	Oct. 2018	Nov. 2018	Dec. 2018	Jan. 2019	Feb. 2019	Mar. 2019	Apr. 2019	May 2019	Jun. 2019	Jul. 2019	Aug. 2019	Sep. 2019
Design and Obtain SJSU IRB Approval for TVWS Course				D								
New Mexico (NM) Tribal Library Outreach				M								
Workshop Planning and Scheduling												
TVWS Course Runs					M	M	M					
NM Tribal Outreach & Plan Development												
Select NM Tribal Subaward Recipients									M			
Collect Baseline Usage Data								M	M	M	M	M
Subawards Distributed $$$									M	M		
TVWS Subawards Go Live									D	D	D	D

Grant Year 2 Phase 3 and Phase 4 D = Deliverable | M = Milestone	Oct. 2019	Nov. 2019	Dec. 2019	Jan. 2020	Feb. 2020	Mar. 2020	Apr. 2020	May 2020	Jun. 2020	Jul. 2020	Aug. 2020	Sep. 2020
TVWS Subawards Go Live	D	D										
Author Surveys and Interviews					M							
Gain SJSU IRB approval for Data Collection.					M							
Publications Planning & Writing												
TVWS Subawards Site Visits						M	M	M	M	M	M	M
Data Collection: Reports, Usage Statistics, Surveys						M	M	M	M			
Analyze Datasets												
Author Vignettes/Case Studies (5)										D		
Develop *Model for Tribal TVWS Implementation*											D	
Develop *Model for Tribal-State TVWS Collaborations*												D
Develop *TVWS How-To Document*												D

LG-70-18-0210 Digital Product Form: Native American Community Anchors: TV Whitespaces for Tribal Connectivity, Equity, and Inclusion

San Jose State University
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DIGITAL PRODUCT FORM

Introduction

The Institute of Museum and Library Services (IMLS) is committed to expanding public access to federally funded digital products (i.e., digital content, resources, assets, software, and datasets). The products you create with IMLS funding require careful stewardship to protect and enhance their value, and they should be freely and readily available for use and re-use by libraries, archives, museums, and the public. However, applying these principles to the development and management of digital products can be challenging. Because technology is dynamic and because we do not want to inhibit innovation, we do not want to prescribe set standards and practices that could become quickly outdated. Instead, we ask that you answer questions that address specific aspects of creating and managing digital products. Like all components of your IMLS application, your answers will be used by IMLS staff and by expert peer reviewers to evaluate your application, and they will be important in determining whether your project will be funded.

Instructions

   X   Please check here if you have reviewed Parts I, II, III, and IV below and you have determined that your proposal does NOT involve the creation of digital products (i.e., digital content, resources, assets, software, or datasets). You must still submit this Digital Product Form with your proposal even if you check this box, because this Digital Product Form is a Required Document.

If you ARE creating digital products, you must provide answers to the questions in Part I. In addition, you must also complete at least one of the subsequent sections. If you intend to create or collect digital content, resources, or assets, complete Part II. If you intend to develop software, complete Part III. If you intend to create a dataset, complete Part IV.

Part I: Intellectual Property Rights and Permissions

A.1 What will be the intellectual property status of the digital products (content, resources, assets, software, or datasets) you intend to create? Who will hold the copyright(s)? How will you explain property rights and permissions to potential users (for example, by assigning a non-restrictive license such as BSD, GNU, MIT, or Creative Commons to the product)? Explain and justify your licensing selections.

Phase 1 of the project will result in the creation of an online, open course relating to TVWS technology. Phases 2 and 3 will create datasets. Phase four will create models, reports, a how-to document, case studies, and publications. We intend to make project materials freely available and attribute all work to our project staff. Attribution will be given to IMLS for their support. We support open access and intend to share datasets created via the project though we have not identified a repository or a license for these materials.

A.2 What ownership rights will your organization assert over the new digital products and what conditions will you impose on access and use? Explain and justify any terms of access and conditions of use and detail how you will notify potential users about relevant terms or conditions.

According to the SJSU Research Foundation, SJSU does not assert copyright if investigators intend to make digital content or datasets open access. We don't anticipate any barriers to the provision of our open course materials and datasets as a freely available resource.

A.3 If you will create any products that may involve privacy concerns, require obtaining permissions or rights, or raise any cultural sensitivities, describe the issues and how you plan to address them.

No. Reporting processes and data collection will be covered, however, via human subjects approval of our quantitative and qualitative research methods. SJSU's Institutional Review Board will review our project protocol for human subjects compliance.

Part II: Projects Creating or Collecting Digital Content, Resources, or Assets

A. Creating or Collecting New Digital Content, Resources, or Assets

A.1 Describe the digital content, resources, or assets you will create or collect, the quantities of each type, and format you will use.

Phase 1 of the project will result in the creation of an online, open course relating to TVWS technology. Digital content will be produced in the form of instructional videos, webcasts, and course content in audio and text/print formats.

A.2 List the equipment, software, and supplies that you will use to create the content, resources, or assets, or the name of the service provider that will perform the work.

Our project will use Canvas Network to create a course site that links participants to learning materials in multiple modalities. Among those materials will be live webinars in Zoom. Recordings of these webinars will be freely available. We anticipate that viewers will access recorded materials on many different types of devices (desktops, phones, tablets, etc.).

A.3 List all the digital file formats (e.g., XML, TIFF, MPEG) you plan to use, along with the relevant information about the appropriate quality standards (e.g., resolution, sampling rate, or pixel dimensions).

Course content and learning resources will appear in video, audio, and print formats. Live participation in webinars will be available via Zoom. Recordings of course webinars will be available in Zoom MP4 formats. Course content in text formats may appear in Microsoft Word and Adobe Acrobat files in addition to the format native to the Canvas Network course management system.

B. Workflow and Asset Maintenance/Preservation

B.1 Describe your quality control plan (i.e., how you will monitor and evaluate your workflow and products).

We will follow the workflow as outlined in our Schedule of Completion for the creation of our online open course. Our timeline for meeting planned milestones and deliverables will help us monitor and evaluate our progress

B.2 Describe your plan for preserving and maintaining digital assets during and after the award period of performance. Your plan may address storage systems, shared repositories, technical documentation, migration planning, and commitment of organizational funding for these purposes. Please note: You may charge the federal award before closeout for the costs of publication or sharing of research results if the costs are not incurred during the period of performance of the federal award (see 2 C.F.R. § 200.461).

We support open access and intend to share digital assets created via the project though we have not identified a repository or a license for these materials. We intend to maintain open access to the course in Canvas Network during the award period. Will maintain open access to course materials after the award period by sharing materials with Sustainable Heritage Network and archiving them on a project website.

C. Metadata

C.1 Describe how you will produce any and all technical, descriptive, administrative, or preservation metadata. Specify which standards you will use for the metadata structure (e.g., MARC, Dublin Core, Encoded Archival Description, PBCore, PREMIS) and metadata content (e.g., thesauri).

N/A.

C.2 Explain your strategy for preserving and maintaining metadata created or collected during and after the award period of performance.

N/A.

C.3 Explain what metadata sharing and/or other strategies you will use to facilitate widespread discovery and use of the digital content, resources, or assets created during your project (e.g., an API [Application Programming Interface], contributions to a digital platform, or other ways you might enable batch queries and retrieval of metadata).

N/A.

D. Access and Use

D.1 Describe how you will make the digital content, resources, or assets available to the public. Include details such as the delivery strategy (e.g., openly available online, available to specified audiences) and underlying hardware/software platforms and infrastructure (e.g., specific digital repository software or leased services, accessibility via standard web browsers, requirements for special software tools in order to use the content).

N/A.

D.2 Provide the name(s) and URL(s) (Uniform Resource Locator) for any examples of previous digital content, resources, or assets your organization has created.

N/A.

Part III. Projects Developing Software

A. General Information

A.1 Describe the software you intend to create, including a summary of the major functions it will perform and the intended primary audience(s) it will serve.

  N/A.

A.2 List other existing software that wholly or partially performs the same functions, and explain how the software you intend to create is different, and justify why those differences are significant and necessary.

  N/A.

B. Technical Information

B.1 List the programming languages, platforms, software, or other applications you will use to create your software and explain why you chose them.

N/A.

B.2 Describe how the software you intend to create will extend or interoperate with relevant existing software.

N/A.

B.3 Describe any underlying additional software or system dependencies necessary to run the software you intend to create.

  N/A.

B.4 Describe the processes you will use for development, documentation, and for maintaining and updating documentation for users of the software.

  N/A.

B.5 Provide the name(s) and URL(s) for examples of any previous software your organization has created.

  N/A.

C. Access and Use

C.1 We expect applicants seeking federal funds for software to develop and release these products under open-source licenses to maximize access and promote reuse. What ownership rights will your organization assert over the software you intend to create, and what conditions will you impose on its access and use? Identify and explain the license under which you will release source code for the software you develop (e.g., BSD, GNU, or MIT software licenses). Explain and justify any prohibitive terms or conditions of use or access and detail how you will notify potential users about relevant terms and conditions.

  N/A.

C.2 Describe how you will make the software and source code available to the public and/or its intended users.

  N/A.

C.3 Identify where you will deposit the source code for the software you intend to develop: N/A.

Name of publicly accessible source code repository:

URL:

Part IV: Projects Creating Datasets

A.1 Identify the type of data you plan to collect or generate, and the purpose or intended use to which you expect it to be put. Describe the method(s) you will use and the approximate dates or intervals at which you will collect or generate it.

Phase 3 collects information from subaward recipients in the form of quantitative data (usage statistics before & after TVWS installations) and qualitative data (reports, planning documents, and surveys). In meeting grant reporting guidelines, each Tribal library will develop mission specific uses for the TVWS equipment. Kristen Rebmann, Elizabeth Belding, and Don Means will travel to/observe TVWS implementation sites, record usage statistics, survey subaward recipients, and collect subaward recipient reporting documents during grant year 2. Surveys will be conducted electronically using Qualtrics software.

A.2 Does the proposed data collection or research activity require approval by any internal review panel or institutional review board (IRB)? If so, has the proposed research activity been approved? If not, what is your plan for securing approval?

We will seek human subjects approval of our quantitative and qualitative research methods. SJSU's Institutional Review Board will review our project for human subjects compliance during the early part of phase 1 and 2 of grant year 1 and phase 3 of grant year 2.

A.3 Will you collect any personally identifiable information (PII), confidential information (e.g., trade secrets), or proprietary information? If so, detail the specific steps you will take to protect such information while you prepare the data files for public release (e.g., data anonymization, data suppression PII, or synthetic data).

No collection of personally identifiable information is planned. Surveys will collect information that is associated with subaward site locations.

A.4 If you will collect additional documentation, such as consent agreements, along with the data, describe plans for preserving the documentation and ensuring that its relationship to the collected data is maintained.

Consent agreements will be saved electronically in Qualtrics for survey data collection and consents will be included with other (in print) datasets.

A.5 What methods will you use to collect or generate the data? Provide details about any technical requirements or dependencies that would be necessary for understanding, retrieving, displaying, or processing the dataset(s).

Quantitative network usage data will be collected from subaward recipients' equipment and associated applications. Survey data will be collected using Qualtrics. Survey data will be archived/shared in a delimited text file or excel spreadsheet. Analyses of survey data will be done using Qualtrics and Excel. Written reports from subaward recipients will be in .doc, .docx, or .pdf format. Qualtrics datasets will be maintained in a password-protected account associated with project director, Kristen Rebmann.

A.6 What documentation (e.g., data documentation, codebooks) will you capture or create along with the dataset(s)? Where will the documentation be stored and in what format(s)? How will you permanently associate and manage the documentation with the dataset(s) it describes?

Survey questions and planning/reporting documents will be saved as .doc/.docx and .pdf files. Survey data will be shared in a delimited text file or excel spreadsheet. Multiple datasets will be associated with each other based upon site locations.

A.7 What is your plan for archiving, managing, and disseminating data after the completion of the award-funded project?

We will use a portion of phase 4 in year two of the grant to develop a plan with additional details for archiving/managing datasets. Phase 4 will communicate with IMLS and the broader library community via professional publications, presentations at conferences, and resources designed to share the findings of datasets collected in phase 3. Please see our narrative for more details regarding plans for dissemination.

A.8 Identify where you will deposit the dataset(s): To be determined.

Name of repository: To be determined.

URL:

A.9 When and how frequently will you review this data management plan? How will the implementation be monitored?

We will review this data management plan during April, May, and June of grant year 1 and October, November, December, January, and February of grant year 2. We chose this time frame as it corresponds with grant activities (in the Schedule of Completion) associated with writing sharing applicant guidelines (year 1) and obtaining Institutional Review Board approval (year 2).