Transportation Equity for RITI Communities in Autonomous and Connected Vehicle Environment: Opportunities and Barriers

FINAL PROJECT REPORT

by

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This report summarizes the results of a study conducted to document the safety and mobility needs of Rural, Isolated, Tribal, or Indigenous (RITI) communities and to identify autonomous and connected vehicle technology that have the potential of addressing these needs. A review of the administrative structure for the five Native American Tribes in Idaho revealed that none of the tribes has a department dedicated to transportation services. Two of the five tribes, however, have a department dedicated to Information Technology (IT) services.
Based on the results of focus group discussions and the follow up in-depth interviews, some of the major transportation safety and mobility problems and need areas for RITI communities include: safety of school-age children walking to school, lack of safety pedestrians facilities (sidewalks) in the community, inefficient emergency response services, issues with paratransit scheduling and reliability of service, roadway maintenance issues, aggressive driving in community roadways, struggle of low-income families with no car ownership, snow removal and clean up especially for local roads, and not having enough driver education programs available for the community. In terms of major barriers to Autonomous and Connected Vehicle implementation in RITI communities, the interviewed citizens believe that lack of communication infrastructures, cost of smart phone use, difficulties to use internet and/or smart phones, lack of electrical power coverage in some roadway areas, privacy and safety issues in car sharing operations, cost of expanding communication and power networks, and the lack of human resources in the community to support these technologies are some of the major barriers to the wide-spread implementation of such advanced technology.</td></tr>
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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^{o}F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^{o}C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^{o}C	Celsius	1.8C+32	Fahrenheit	^{o}F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This report summarizes the results of a study conducted to document the safety risks and mobility needs of Rural, Isolated, Tribal, or Indigenoous (RITI) communities have and to identify autonomous and connected vehicle technology that has the potential to address these mobility and safety needs. To achieve the study objectives, two focus group meetings and in-depth follow-up interviews were conducted with the help of the Native American Student Associations at the University of Idaho (UI) in Moscow and Idaho and Lewis and Clark State College (LCSC) in Lewiston, Idaho.

A review of the administrative structure for the five Native American Tribes in Idaho revealed that none of the tribes has a department dedicated to transportation services. All tribes, however, have a well-developed transportation strategic safety plan. Transportation services in the tribal areas are managed across different departments. Two of the five tribes have a department dedicated to Information Technology Services (ITS). From a communication infrastructure point of view, the study found that the percent of cell phone coverage area for the four major cell phone providers in Idaho ranges from 13 percent to 58 percent with an overall coverage area of 69 percent. Most of the RITI communities in Idaho are covered by a Broadband wired or wireless internet services. The speed of the coverage, however, ranges from 8 to 100 Mbps with several RITI communities in the lower ranges of the broadband network download speed.

Based on the results of the focus group discussions and the follow up interviews, some of the major transportation safety and mobility problems and need areas for RITI communities include safety of school-age children walking to school, lack of safe pedestrian facilities(sidewalks) in the community, inefficient emergency response services, issues with paratransit scheduling and reliability of service, roadway maintenance issues, aggressive driving in community roadways, struggle of low-income families with no car ownership, snow removal and clean up especially for local roads, and not having enough driver education programs available for the community.

In terms of major barriers to Autonomous and Connected Vehicle implementation in RITI communities, the interviewed citizens believe that the lack of communication infrastructure, cost of smart phone use, challenges using internet and/or smart phones, lack of electrical power, privacy and safety issues in car sharing operations, cost of expanding communication and power networks, and the lack of human resources in the community to support these technologies are major barriers to wide-spread implementation of such technology. They believe, however, that smart mobility applications such as, smart shopping, mobility-on-demand services, smart paratransit, school bus real-time tracker, and real-time information about roadway conditions for users can improve the safety and mobility in their communities.

CHAPTER 1. INTRODUCTION

1.1. Project Scope and Objectives

The fair and just distribution of travel-related benefits and costs is a key for transportation equity. With transformative autonomous and connected vehicle technologies on the horizon, their safety-assistive interaction features promise significant crash reduction benefits to all communities and, of particular significance, in areas inhabited by RITI communities. Wireless connectivity within the transportation system has recently been approved by USDOT as “ready for deployment”. Forecasts estimate 250 million wireless-enabled cars by 2020, and vehicle manufacturers have already introduced several commercial products. Moreover, significant leaps have been achieved in bringing vehicle automation to reality in the very near future. In order to ensure a fair-share of benefits from these significant investments to transport-disadvantaged RITI communities, it is critical that we understand the equity impacts of these fundamental changes to our transportation systems and policies and identify any barriers that might prevent RITI communities from fully benefiting from these new safety-assistive technologies.

1.2. Project Goal and Objectives

The long-term vision of the research effort described in this report is to ensure full utilization of the safety-assistive interaction features in autonomous and connected vehicles to improve the safety of RITI communities. As a first step to pursue this vision, the goal of this project is to conduct outreach to RITI communities in Idaho, identify key safety challenges they encounter, assess heritage, infrastructure, and resource constraints, and determine solutions to address some of these challenges by using autonomous and connected vehicle technologies. To this end, the objectives of this project are exploratory in nature and can be summarized as follows:

1) Quantitatively determine the safety risks and mobility needs of these communities and identify autonomous and connected vehicle (ACV) technology opportunities that have the potential to address these mobility and safety needs.
2) Assess the heritage/culture constraints and acceptability of various ACV-enabled safety solutions for the targeted RITI communities.
3) Identify the communication infrastructure, human resources, and technological components needed to achieve the end goal of the designed ACV-enabled solutions.

The project outcomes have a broader national impact through documenting the mobility and traffic safety improvement opportunities for RITI communities that might result from the implementation of ACV-based technologies. It also identifies barriers that RITI communities, throughout the nation, might face when implementing ACV technologies.

1.3. Research Approach

1.3.1. Identifying Safety Needs and ACV Opportunities

The project team implemented multiple outreach activities to determine the safety risks and needs of the RITI groups, and the impact of such issues on future ACVs, both from the inclusivity aspect as well as the aspect of designing tailored technological solutions to their needs. The following is a list of the outreach activities that were conducted throughout this project:

a) Interviews with representatives from stakeholders, targeted groups and community assistance organizations were done to gather information and develop the content of the focus group questioning (described in the next point). These brief interviews investigated the perceived transportation safety and equity challenges and existing solutions for the targeted RITI communities. The targeted audience consisted of individuals from rural, isolated and tribal communities, as well as members from the city bodies.

b) Three focus groups with stakeholders and targeted community groups were conducted as follows:

   1. Focus Group 1 was conducted with individuals from rural communities. The questions of this focus group primarily targeted: (1) Determining the major challenges they have with transportation safety and equity. (2) Determining the types of technology-assisted safety solutions they currently consider helpful, and the challenges they have with them. (3) Determining their perspectives on various types of ACV-based technologies for their safety. This included providing examples of novel safety-enhancing technological solutions and asking their views on them. It also included their perceived impacts of such solutions on them and others. (4) Determining how, when, and why different options of ACV-based safety-enhancing technologies will be more and less likely to be accepted.
   2. Focus Group 2 was conducted with individuals from tribal communities. The questions and investigated challenges were quite similar to those used in Focus Group 1, in addition to investigating the tribal and heritage related safety challenges, and their limitations on any/some potential ACV-based solutions.
   3. Focus Group 3 was conducted with individuals working with the designated cities' administration and transit. The questions were targeted towards: (1) Determining their views on the major transportation safety and equity challenges and potential solutions for RITI community using ACV-based technologies. (2) Determining their views and ideas about the various types of ACV-based technologies and plans to implement them in the near future. (3) Determining their foreseeable challenges and impacts if particular ACV-based technologies are implemented.

b) A wider acceptability survey focused on members from the rest of the society (basically non-RITI members driving, walking, riding the bus or dealing with any feature of the transportation system). The survey questions primarily focused on determining the likely reactions of these members regarding the impacts and changes that various potential ACV-based safety-enhancing solutions for the targeted groups may cause.

As part of the above activities, the project team also assessed the overall "friendliness" of transportation technology to the RITI communities. As a template, the 5 A's of friendly transportation (developed by the Beverly Foundation, 2001), which include Availability, Accessibility, Acceptability, Affordability, and Adaptability were employed and utilized in this effort. In addition to assessing the views of these targeted groups about the overall friendliness of the transportation technology, the project team attempted to gauge the level of acceptability of various forms of technology for interactive communications through ACV systems and gathered initial assessment data on the perceptions of the "affordability" of the costs that might be incurred to the targeted groups' individuals for accessing these technologies.

1.3.2. Identifying Potentials for Autonomous and Connected Vehicle Enabled Solutions

Multiple synthesis activities were used to determine the current transportation safety policies, existing ACV-based safety solutions, and their suitability for RITI areas and cultural constraints. Synthesis activities conducted included a current transportation system services evaluation covering policies, regulations, safety, and licensing programs, and outreach and education activities. A literature survey on autonomous and connected vehicle mobility and safety solutions was conducted to identify the existing state-of-the-art technologies, their fitness to RITI-inhabited areas, and gaps in knowledge to tailor existing solutions or build dedicated solutions for these areas.

1.3.3. Building a Database of Existing and Required Resources

A database of the available and needed infrastructure and human resources to operate successful advanced mobility solutions-based safety solutions in RITI-inhabited areas was created and maintained. The base-line data activities included in the database cover current infrastructure (installed communication infrastructure, penetration rates of communication systems/devices, etc.), and current human resources (availability of IT certified or trained individuals).

The outcome of this project will help federal, state, tribal, local transportation agencies, and other entities that focus on improving safety on rural highways gain in-depth knowledge on the characteristics of traffic crashes in RITI and similar communities throughout the nation. It will also help identify gaps in crash data collection practices and policies for these communities as well as gaps in traffic exposure measures that can be used to effectively measure crash rates in rural communities. Finally, the outcome of this project will help aid and guide the state of Idaho's efforts to improve safety on Idaho's RITI roadway network through the identification of effective crash countermeasures that have the highest possible return on investment for these communities.

1.4. Report Organization

This report is organized in five chapters. After the chapter 1 introduction, chapter 2 presents an overview of smart mobility opportunities for RITI communities, the study methodology and data sources. Chapter 3 documents autonomous and connected vehicle resources in tribal areas in Idaho followed by chapter 4 summarize findings from the focus group meetings and in-depth interviews. Chapter 5 includes the study findings and conclusions.

CHAPTER 2. SMART MOBILITY OPPORTUNITIES FOR RITI COMMUNITIES

2.1. Overview

Smart City initiatives integrate and utilize big data, communication technology, and Internet of things (IoT) to more efficiently manage the city's assets and services in a secure and reliable environment to provide a better quality of life for all citizens. Services include systems such as schools, libraries, transportation systems, hospitals, power plants, water supply networks, waste management, law enforcement, and other community services. In a smart city environment, informatics and technology are used to improve the efficiency of services. Smart city applications include Smart Energy, Smart Data, Internet of Things (IoT), Smart Health, Smart Home, and Smart Mobility.

Smart Mobility applications are the key for improved mobility through the use of advanced devices, big data analytics, and extensive networks of wireless and wired communication. Examples of smart mobility applications include (Musa 2018), (Mohanty, Coppali &Kougianos 2016), (Sumalee & Ho 2018):

- Smart cards and integrated fare payment and management systems
- Real-time data to users and Integrated multimodal operations
- Centralized traffic management and control
- Ridesharing and on-demand vehicle services
- Electric vehicles smart charging system
- Smart parking
- Bike sharing

2.2. Smart Mobility Applications in Rural Areas:

Several smart mobility applications have been implemented recently in rural areas throughout the nation. Examples of these applications include (Chmielewski 2018), (Vulgarakis & Bararsani 2016), (Shaheen et al. 2018):

a) Pick-up planner: Customers input a pick-up address, desired time of pick-up, and the destination using a smart phone application that is connected to private taxi operators, on-demand service providers, and public transportation and social service agencies.
b) Mobility-on-demand: Users can book a vehicle for a specific number of hours or days through a smart phone application. The application provides the users with different options for pick-up and return location and times.
c) Smart shopping: Smart phone applications that provide users with on-line shopping options with curb side pickup or delivery. Alternatively, these can assist users in rural areas to carpool for shopping-based trips.
d) Demand responsive transit and paratransit: This type of services is implemented in rural areas where a fixed bus schedule is not viable. Demand responsive transit systems require passengers to request a journey booking through a smart phone application.
e) Ridesharing (carpooling): Smart phone applications that allow users to post requests for a ride from a specific origin to a destination. They get matched with car owners with the same origin-destination trip.
f) School bus tracker: This technology enables parents or guardians in rural areas to monitor the location of the school bus for their children. The parent can know at what time their children will arrive at school or when they will be back at home after school.

2.3. Smart Mobility Implementation Challenges in Rural Areas:

The following are smart mobility implementation challenges in rural areas:

Networking and Communication:
Communication is one of the critical technology trends in smart cities that is needed to connect to infrastructure, people, devices and gathering data. Different technologies are used, like Low-Power WAN technologies, 4G networking and 5G networking, and are expected to play an important role in the near future.

Cloud and edge computing:
Cloud computing is required in smart cities because of the massive data being generated, captured and analyzed. New infrastructure sensing capabilities, private data sources and citizen data which are accessed and handled by cities need to be stored in the cloud since they need to be analyzed and processed for enhancing the performance of different components.

Cyber-physical systems and the IoT:
These are defined as the connection of physical devices to the internet, which is critical for growth in smart cities. Some of the infrastructure is now being connected through open standard protocols such as IP and HTTP and accessible through web technologies like RSET. Sensors in different infrastructure need to sense the data and send it to users or operators. Since a huge amount of data is expected for collection, networking and cloud computing are essential elements in smart cities.

CHAPTER 3. AUTONOMOUS AND CONNECTED VEHICLE RESOURCES IN TRIBAL AREAS IN IDAHO

3.1. Overview

There are five federally recognized Native American Tribes in the state of Idaho. They are (from North to South): Kootenai Tribe, Coeur d'Alene Tribe, Nez Perce Tribe (Nimiipuu), Shoshone-Bannock Tribes, and Shoshone-Paiute Tribes, Figure 3-1. Table 3-1 lists the Tribe's location and land (University of ODaho Office of Tribal Relations 2018).

Figure 3-1 Native American Tribes in the State of Idaho

Table 3-1 Native American Tribes in Idaho: Location and Land[8]

Tribe	Location	Land
Kootenai Tribe	Boundary County	13 acres
Coeur d'Alene Tribe	Benewah and Kootenai Counties	345,000 acres
Nez Perce Tribe	Clearwater, Idaho, Latah, Lewis, and Nez Perce Counties	770,453 acres
Shoshone-Bannock Tribe	Bannock, Bingham, Caribou, and Power Counties	521,519 acres
Shoshone-Paiute of the Duck Valley Indian Reservation	Owyhee County in Idaho	289,819 acres

3.2. Tribal Resources

In the following sections, the outline of each tribe and its administrative organization that might provide support for autonomous and connected vehicle applications will be presented.

3.2.1. Kootenai Tribe of Idaho

The Kootenai Tribe of Idaho is led by an elected nine-person board that rotates based on a four-year term. Considerations include the family groups within the community as the Kootenai Tribe is comprised of three distinct families. The Tribe maintains seven governmental departments. Transportation does not operate as one distinct department. Instead, the community of Boundary County exercises cross-deputization, meaning the City of Bonners Ferry Police Department is allowed to work and respond in the reservation jurisdiction. The Kootenai Tribe of Idaho published its Strategic Transportation Safety Plan in 201 (Transporation Safty for Tribes 2018). Key Goals and Strategies include:

> "*The Kootenai Tribe of Idaho envisions a transportation system that provides mobility and safety for all users that is fiscally sustainable and has the least impact on Tribal cultural and environmental values. The transportation system will provide safe, convenient and maintainable access to Tribal housing, Tribal fish hatcheries, mitigation project areas, economic enterprises and cultural sites*."

The transportation-related administrative departments in the Kootenai tribe are listed in Table 3-2.

Table 3-2 Kootenai Tribe Administrative Departments

Department	Included Programs	Responsibility
Administration and Finance		"The Administration and Finance office oversees a wide range of Tribal affairs including economic development, financial services and housing, and also serves as a liaison with the Gaming Commission. The staff, which includes a Finance Director (CPA) and an Administrative Director, works closely with the Tribal Council. The program oversees the Kootenai Tribe's fiscal activities and facilitates economic development for the Tribe.
Environment	-GIS -Watershed Management Plan	"The Kootenai Tribe of Idaho helps to administer an environmental program that works to improve air quality, water quality and to promote recycling to reduce solid waste."
Kootenai Valley Resource Initiative		"The Kootenai Valley Resource Initiative (KVRI) is a community-based, collaborative effort in the Kootenai River Basin. The Kootenai Tribe was instrumental in working with local governing bodies to form the KVRI to restore and enhance the resources of the Kootenai Valley. The mission of the KVRI is to improve coordination of local, state, federal and Tribal programs to restore and maintain social, cultural, economic and natural resources.

3.2.2. Coeur d'Alene Tribe (Schitsu'umsh)

Located approximately 108 miles south of Bonners Ferry and the Kootenai Tribe of Idaho, The Coeur d'Alene Tribe maintains a Tribal Council comprised of seven members. Transportation services are managed across different departments. The transportation-related administrative departments in the Coeur d'Alene tribe are listed in Table 3-3.

Table 3-3 Coeur d'Alene Tribe Administrative Departments

Department	Included Programs	Responsibility
Education	Summer Youth Program, Higher Education, Flexible Learning, Pre-College,	"The general mission of the Coeur d' Alene Tribe Department of Education is to implement the Tribe's commitment to education which includes the enhancement of the social, moral, and economic well-being of the Coeur d' Alene Tribe and its membership."
Finance		"The Coeur d' Alene Tribe finance department provides a full range of accounting support services to tribal departments and programs.
Human Resources		Assist all tribal departments with employee acquisition, as well as assist employees in their benefits and work development activities
Information Technology	-IT Government Services -Geographic Information System (G.I.S.) -Tribal Radio Station	The I.T. Department is responsible for maintaining all computer systems within the Tribal government as well as implementing network security and Tribal communications.
Natural Resources	-Air Quality -Environmental Programs Office -Land Services	
Public Works		Building of safe and healthy communities and sustainable economic and community development; Facilitating public participation; Promoting educational and innovative planning concepts; and Developing regulatory guidelines to ensure the tribe's vision and mission.
Tribal Police		The Coeur d' Alene Tribal Police department has been granted authority to enforce those Laws and Regulations as are set forth by the Coeur d' Alene Tribal Council and the United States of America.
Social Services	-Career Renewal -Housing -Indian Child Welfare -Older Americans -Stop Violence	Assist in filling current gaps in services offered by other agencies.

3.2.3. Nez Perce Tribe

The Nez Perce Tribe maintains seven departments. Transportation services are managed across different departments. The Nez Perce Tribe opened a new facility for their public transit system. The Appaloosa Express update occurred in October of 2018. This facility is located on U.S. Highway 95 near Sweetwater, it includes two offices and a reception area, seven bays for buses and an attached wash bay. A fixed route bus line serves numerous locations. The Appaloosa Express provides transportation between Lapwai, Lewiston, Kooskia, Kamiah, Greer, Lenore, and Orofino. The transportation-related administrative departments in the Nez Perce tribe are listed in Table 3-4.

Table 3-4 Nez Perce Tribe Administrative Departments

Department	Responsibilities and Included Programs	Responsibility
Communications		"The communications program manages internal and external communication for the Nez Perce Tribe and handles media inquiries. Additionally, the department manages the website, social media accounts, Nimiipuu Tribal Tribune, newsletter, and mass emails."
Education		Adult Education, Early Childhood Development, Students for Success Program, Higher Education Scholarship Program -State Tribal Education Partnership, Youth Mentoring Program
Human Resources		Recruiting employees, employee assistance, overseeing training, overseeing risk management"
Natural Resources	-Environmental Restoration and Waste Management -Emergency Management -Air Quality Program -Land Services Program -Water Resources	
Technology Services	-Information Systems -Telecommunications -Wireless -KIYE Radio	

3.2.4. Shoshone-Bannock Tribe

Located near Pocatello, Idaho, the Shoshone-Bannock Tribe utilizes four governmental departments, which include natural resources, services, health, and education. Transportation services are managed by the services department. The transportation-related administrative departments in the Shoshone-Bannock tribe are listed in Table 3-5.

Table 3-5 Shoshone-Bannock Tribe Administrative Departments

Department	Responsibilities and Included Programs
Financial and Revenue	-Office of Finance -Tribal Planning
Services	-Transportation -Utilities
Tribal Government	-Administration - Public Affairs -Human Resources

3.2.5. Shoshone-Paiute Tribe

Located at the border of Idaho and Nevada, the Shoshone-Paiute governmental framework is composed of twenty-four individual departments that serve members in both Idaho and Nevada. Leadership is represented through the Tribal Business Council. Although the Tribe does not maintain a distinct transportation department, in 2017 the Shoshone-Paiute Tribe received funding from the U.S. Department of Transportation to begin the first Shoshone-Paiute Transportation Program.

3.3. Communication Infrastructure Resources

3.3.1. Sources of Data Used in the Analysis

The analysis presented in this section was conducted with the software suite ESRI ArcGIS 10.2.2 using both the ArcMap and ArcCatalog Products. A Geodatabase was created to store the data layers and perform analysis, and feature classes were created within the Geodatabase to store feature classes for a given topic of interest. All features in the database use the North American Datum of 1983 as the Geographic Coordinate System and are projected in an Idaho Transverse Mercator Projection.

Census Data

Census TIGER files (Topologically Integrated Geographic Encoding and Referencing) were downloaded from the U.S. Census Burau website (U.S. Census Burau 2018). Three of the seven feature classes were selected for this project: Blocks, Block Groups, Census Tracks, Counties, Incorporated Places (I.P.'s), Census Designated Places and County Subdivisions. Population estimates for Idaho in 2016 were obtained from the U.S. Census Bureau and were integrated with the Census Incorporated Places Shapefile. The attribute table field calculator was then used to determine Urban and Rural I.P.'s where Rural areas have a population less than 2,500 residents and Urban areas have a population greater than or equal to 2,500 residents.

Cellphone Coverage Data

The Federal Communications Commission was the primary source of data for Cellphone Coverage and Broadband Internet Information. Fixed Broadband as well as Wireless Broadband Internet providers are required to submit information about the quality, quantity and spatial distribution of their services on a bi-annual basis.

Wired and Wireless Broadband and Internet Data

Data from 2016 were made available for the entire nation as well as individual states. The data file for the state of Idaho was used for the analysis of Broadband at the Census Block level. This data file included 859,165 records organized in 18 columns. The columns data describe the service provider, owner, block code, Tech Code, Advertised Upload and Download speed, and whether the service is available to the public was well as businesses. A Census Block can be serviced by multiple Internet providers and Internet Providers can provide multiple services. This means that although there are only 149,842 Census Blocks in Idaho, we have 859,165 records of Internet Availability. Records were summarized by Max Advertised Upload and Download Speed to reduce the number of records to produce and one to one relationship between the table and the TIGER census block shapefile, allowing us to join one to the other.

Figure 3-2 through Figure 3-6 show the network coverage for the four different network providers in the US in Idaho (coverage area is shown in purple). Figure 3-7 shows Wireless Broadband Internet Coverage in the State of Idaho. The results are summarized in Table 3-6. The table shows the percentage of the coverage area to the total area of the state of Idaho (83,508 square miles)

Table 3-6 Cell Phone Networks Coverage Area in Idaho

	Cell Phone Coverage Area in Idaho (Square Miles)			
Cell Provider	**AT&T**	**Verizon**	**T-Mobile**	**Sprint**
3G/4G LTE	48,763	44,598	33,313	10,721
Percentage Coverage Area	58 %	53 %	40%	13%

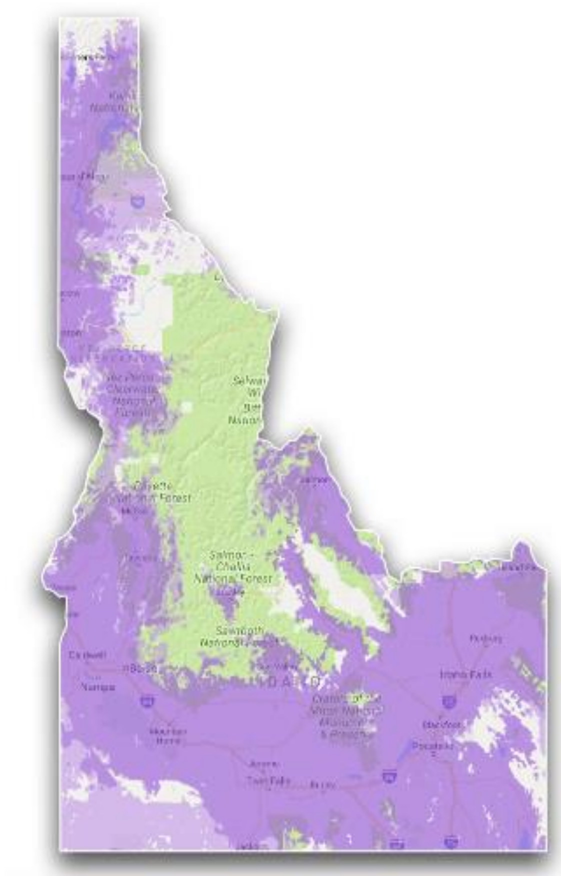

Figure 3-2 Cellular Network Coverage for AT&T in Idaho

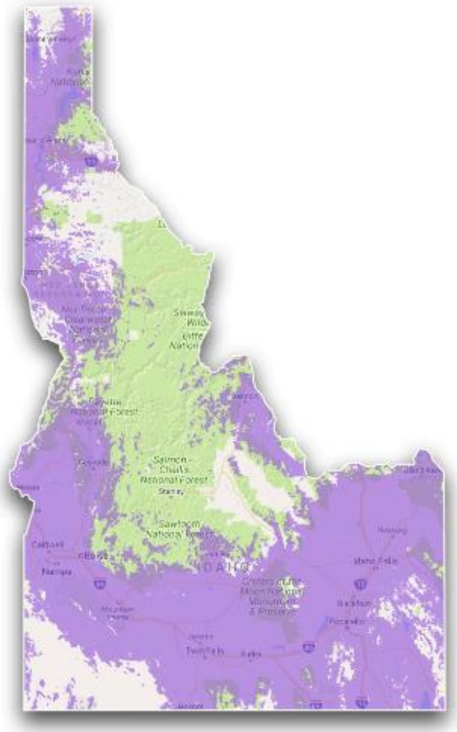

Figure 3-3 Cellular Network Coverage for Verizon in Idaho

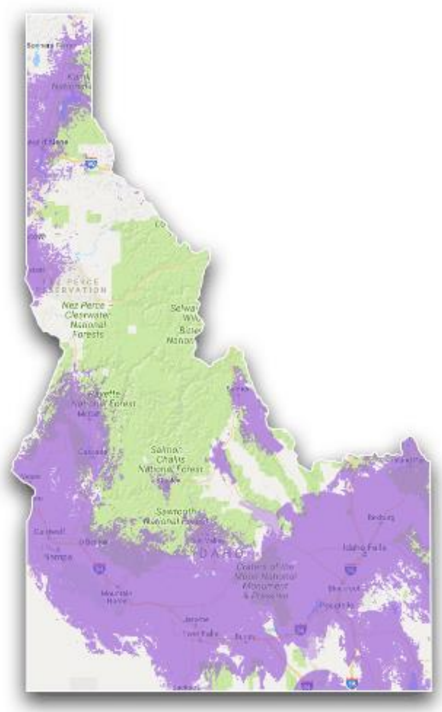

Figure 3-4 Cellular Network Coverage for T-mobile in Idaho

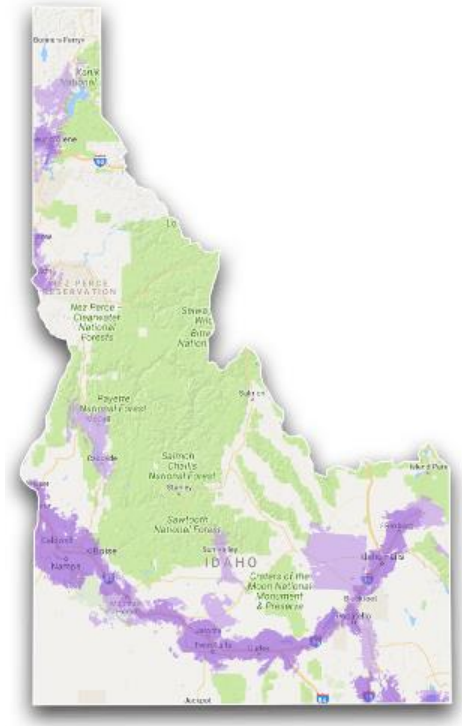

Figure 3-5 Cellular Network Coverage for Sprint in Idaho

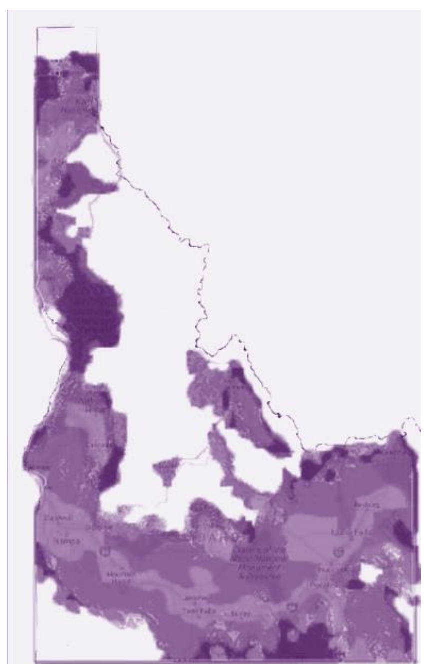

Figure 3-6 Cellular Network Coverage for the four different providers in Idaho

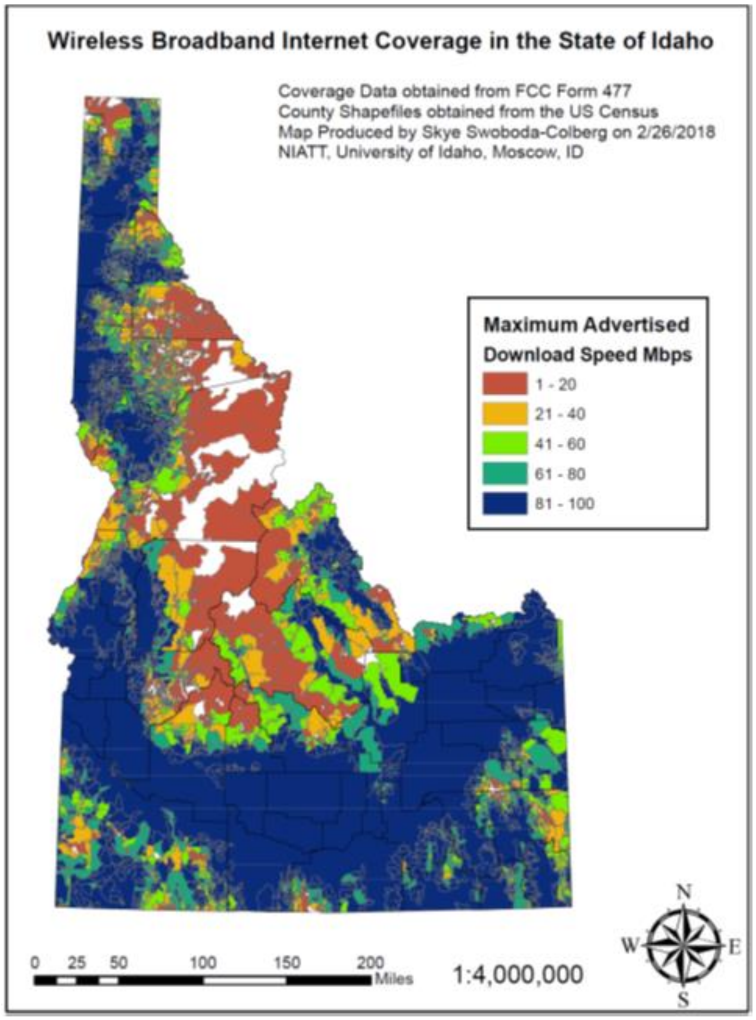

Figure 3-7 Broadband Internet Coverage in the State of Idaho

CHAPTER 4. FINDINGS FROM FOCUS GROUP DISCUSSIONS AND IN-DEPTH INTERVIEWS

4.1. Overview

This chapter presents the findings from focus group discussions and in-depth interviews with RITI citizens focusing on Tribal communities in Idaho. Two focus groups meetings were conducted with the help of the Native American Student Associations at the University of Idaho (UI) in Moscow, Idaho and Lewis and Clark State College (LCSC) in Lewiston, Idaho. Meeting attendees included both students and Native American Tribe citizens and officials. Before the focus group discussions, a short presentation was used to inform the meetings' attendees about autonomous and connected vehicle technology and smart mobility applications that could improve the safety and mobility for RITI communities. The focus group discussion then concentrated on three major topics: needs assessment and major safety and mobility problems Facing RITI Communities, major barriers to autonomous and connected vehicle implementation in RITI communities, and smart mobility opportunities for RITI communities in Idaho. Several students from UI and LSCS served as ambassadors to their communities and conducted in-depth interviews with community members to get their feedback about the three topics. In total, 46 responses were received as a result of the focus group discussion and in-depth interviews. Findings from these responses are summarized in the following sections.

4.2. Need Assessment – Major Safety and Mobility Problems Facing RITI Communities

Based on the results of the focus group discussion and the follow up interviews, the following were identified as major transportation safety and mobility problems and need areas for RITI communities (the number in parentheses represents total number of responders who listed the specific item as a major problem or concern):

- Safety of school-age children walking to school (29)
- Lack of safe pedestrian facilities (sidewalks) in the community (24)
- Inefficient emergency response services – very long response time (24)
- Issues with paratransit scheduling and reliability of service (19)
- Roadway maintenance issues (19)
- Aggressive driving in community roadways (14)
- Struggle of low-income families with no car ownership (12)
- Snow removal and clean up especially for local roads (12)
- Not enough driver education programs (9)

4.3. Major Barriers to Autonomous and Connected Vehicle Implementation in RITI Communities

Based on the results of the focus group discussion and the follow up interviews, the following were identified as major barriers to Autonomous and Connected Vehicle implementation in RITI Communities:

- Lack of communication infrastructures (many roadways in the community do not have cell coverage) (34)
- The cost of use smart phones – not everyone can afford it (34)
- Challenges to using internet and/or smart phone especially for elderly population (30)

- Lack of electrical power coverage in many areas in the community, especially on local roadways (21)
- Privacy and safety issues in car sharing operations (14)
- Cost of expanding communication and power networks (12)
- Lack of human resources in the community to support these technologies (9)

4.4. Smart Mobility Opportunities for RITI Communities

Based on the results of the focus group discussion and the follow up interviews, the following were identified as smart mobility application opportunities for RITI Communities:

- Smart shopping (26)
- Mobility-on-demand (23)
- Smart paratransit (23)
- School bus tracker (19)
- Real-time information about roadway conditions to users (17)

CHAPTER 5. STUDY FINDINGS AND CONCLUSIONS

This report summarizes the results of a study conducted to document the safety and mobility needs of RITI communities and to identify autonomous and connected vehicle technology opportunities that have the potential to address these needs. The study also identified the communication infrastructure, human resources, and technological components needed to achieve the end goal of the wide-spread implementation of smart mobility-enabled solutions in RITI communities.

To achieve the study objectives, two focus groups meetings were conducted with the help of Native American Student Associations at the University of Idaho (UI) in Moscow, Idaho and Lewis and Clark State College (LCSC) in Lewiston, Idaho. Meeting attendees included both students and Native American Tribe citizens and officials. Before the focus group discussions, a short presentation was used to inform the meeting attendees about autonomous and connected vehicle technology and smart mobility applications that could improve the safety and mobility for RITI communities.

The focus group discussion then focused on three major topics: need assessment and major safety and mobility problems facing RITI Communities, major barriers to autonomous and connected vehicle implementation in RITI communities, and smart mobility opportunities for RITI communities in Idaho. Several students from UI and LSCS served as ambassadors to their communities and conducted in-depth interviews with community members to get their feedback about the three topics. In total, 46 responses were received as a result of the focus group discussion and in-depth interviews in this study. The following are the study findings and conclusions:

- A review of the administrative structure for the five Native American Tribes in Idaho revealed that none of the tribes has a department dedicated to transportation services. All tribes, however, have a well-developed transportation strategic safety plan. Transportation services in the tribal areas are managed across different departments. Two of the five tribes have a department dedicated to Information Technology (IT) services.
- The percent of cell phone coverage area for the four major cell phone providers in Idaho ranges from 13 percent to 58 percent. Overall, 69 percent of the area of the state of Idaho is covered by some level of cell coverage ranging from 3G/4G to LTE. Most of the RITI communities in Idaho are covered by a Broadband wired or wireless internet services. The speed of the coverage, however, ranges from 8 to 100 Mbps with several RITI communities in the lower ranges of the download speed.
- Based on the results of the focus group discussion and the follow up interviews, the following were identified as major transportation safety and mobility problems and need areas for RITI communities:
    - Safety of school-age children walking to school
    - Lack of safety pedestrian facilities (walkways) in the community
    - Inefficient emergency response services – very long response time
    - Issues with paratransit scheduling and reliability of service
    - Roadway maintenance issues
    - Aggressive driving on community roadways
    - Struggle of low-income families with no car ownership
    - Snow removal and clean up especially for local roads

    - Not enough driver education programs
- Based on the results of the focus group discussion and the follow up interviews, the following were identified as major barriers to Autonomous and Connected Vehicle implementation in RITI Communities:
    - Lack of communication infrastructure (many roadways in the community do not have cell coverage)
    - Cost of the use of smart phone – not everyone can afford it
    - Challenges to using internet and/or smart phone especially for elderly population
    - Lack of electrical power coverage in many areas in the community especially on local roadways
    - Privacy and safety issues in car sharing operations
    - Cost of expanding communication and power networks
    - Lack of human resources in the community to support these technologies
- Based on the results of the focus group discussion and the follow up interviews, the following were identified as smart mobility application opportunities for RITI Communities:
    - Smart shopping
    - Mobility-on-demand
    - Smart paratransit
    - School bus tracker
    - Real-time information about roadway conditions to users

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