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FEDERAL TRANSIT ADMINISTRATION

Evolution of Intelligent Transportation Systems for Mobility Management and Coordination Serving California's Rural Frontier

JANUARY 2012

FTA Report No. 0006
Federal Transit Administration

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COVER PHOTO

Courtesy of MCTC/Sage Stage staff, Alturas, CA

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Evolution of Intelligent Transportation Systems for Mobility Management and Coordination Serving Northeastern California's Rural Frontier

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Metric Conversion Table

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
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)				
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC

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FOREWORD

The intent of this document is to benefit small operators and transit agencies serving rural and frontier rural regions; local, state and federal transportation agencies, institutions, and organizations involved funding Intelligent Transportation Systems (ITS) solutions to transportation problems; universities that research ITS innovations; and private contractors and businesses that develop and implement products to serve transit operators, transportation providers, and agencies serving riders to, from, and through frontier rural areas.

The Modoc County Transportation Commission (MCTC) prepared this report. The data contained in this report include planning information and research that carries a degree of uncertainty. While this information reflects current thinking of frontier rural transportation agencies and transit properties relative to ITS, the specific quantities, timing, and preferences identified may change in the future.

ACKNOWLEDGMENTS

The Federal Transit Administration (FTA) Office of Mobility Innovation sponsored this research.

MCTC would like to acknowledge the contributions that made this report possible. The participants included FTA officials, California Department of Transportation (Caltrans) planners, local government officials, agencies and staff, community transit representatives, and multiple stakeholder

ABSTRACT

This report documents the evolution, development, and lessons learned while attempting to identify, modify, and deploy ITS and advanced technology tools to facilitate coordination of public transit and social (human) service transportation and mobility management in a "one stop shop" located in Modoc County (northeast), California. The report summarizes efforts during three related ITS projects, addresses related transportation planning and coordination efforts, shares challenges and lessons learned and outcomes, and concludes by identifying some issues and structural obstacles that diminish usability and impede transfer of functional ITS tools for purposes of data collection, data management, and reporting.

Methodology relies on activities, events, and outcomes during a seven-year study period, which supports qualitative assessment, and recommendations. The perspective is from a frontier rural implementing agency and frontier rural agency project champion.

The report underscores difficulties inherent to demand-responsive transportation services provided in remote rural areas (observed previously); suggests future software modifications or alternates that might reduce user dissatisfaction and burdensome data entry requirements for public transit agencies, driver/operators, regional "one stops" and mobility managers; and notes complexities in handling multi-variant data elements without necessary infrastructure or common definitions and standards for data exchange, reporting, performance measurement and analysis.

EXECUTIVE SUMMARY

This report offers a unique and hands-on perspective from a frontier rural community in northeastern California, as well as fully examines the concepts of coordination and mobility management to create the physical and virtual Modoc Mobility Management Center. The report explores converting software to open source coding as well as the initiative of a project champion needed to fund a multi-faceted comprehensive ITS solution. The study reviews the importance of having the baseline infrastructure, including Internet connections, accurate maps, data standards, and willing partners with resources to commit to ongoing participation. While technology and user expectations evolve with time, especially in urban places, many of the issues explored in this study should be considered when developing future ITS solutions for rural communities.

Modoc County pioneered a variety of ITS innovations that continue to serve rural communities nationally. While many aspects of this extensive and comprehensive vision were not fully deployed, this report may assist other rural communities to consider these lessons learned before they proceed with ITS innovations. Through this project, Sage Stage, the operator for Modoc County, was the first agency to offer on-line long distance trip planning at Google Maps. Google Inc. began to understand and log the challenges needed to resolve trips within urban places and trips that connect to rural communities, possibly only once a week. Over the three years since Sage Stage schedules were deployed for trip planning at Google Maps, the engineers at Google Inc. have resolved many of the initial concerns. The Modoc County Transportation Commission also signed the first interline agreement with Greyhound. Without this early research project, rural communities might not display with ease among the variety of on-line trip planning tools or services available for their urban partners.

SECTION

1

Introduction, Initial Research/Background, and the Project

The purpose of this report is to document the evolution, development, and lessons learned while attempting to identify, deploy, and evaluate Intelligent Transportation Systems (ITS) tools through three integrated projects to facilitate coordination of transportation and mobility management services across a frontier rural or remote rural region in northeastern California. Together, these projects established the Modoc Mobility Management Center (Modoc MMC) with both physical and virtual[1] components. One project, funded by the Federal Transit Administration (FTA), Office of Mobility Innovation,[2] is the focus of this report, referenced as the Modoc MMC project. Other virtual projects are mentioned as they relate the core project, which physically established the Modoc MMC. Information contained in this report is supported by comprehensive and detailed documentation, available for inspection and review at the Modoc Transportation offices.

Modoc Transportation and its resources serve two separate entities or local transportation agencies: (1) the Modoc County Transportation Commission (MCTC or Commission) and (2) the Modoc Transportation Agency (MTA). The MCTC is a small, regional transportation planning agency established in 1972 under California law to develop the Modoc Regional Transportation Plan and administer transportation funding within Modoc County. The Modoc Transportation Agency (MTA or Agency) is a joint powers authority established in 1997 between the County of Modoc and the City of Alturas to operate "Sage Stage" public rural and intercity bus services in northeastern California.

This report is intended to benefit small agencies and transit operators (<25 vehicles) serving rural and especially frontier rural regions. The term "frontier rural" is distinguished from rural because it aptly describes rural regions that are remote or isolated (>100 miles from regional or urban centers) with sparse populations (<5 persons per square mile) and distant population settlements (towns or clusters spaced <50 miles apart).

In addition, this report is intended to benefit transit operating staff, including frontline driver/operators; local, state and federal agencies, institutions, and organizations seeking ITS solutions to solve transportation problems; universities and

[1]In this report, "virtual" means advanced technology tool or Internet presence, as compared to physical / real existence.

[2]FTA Project No. CA-26-7050-00.

organizations that research ITS innovations; and private contractors and businesses that develop and implement products to serve operators, transportation providers, and agencies serving riders to, from, and through rural and especially frontier rural areas.

Rural and frontier rural areas do not have sufficient population or resources to justify extensive investment in technologies, as compared to urban and metropolitan centers. Nationwide, total investments in rural and frontier rural technologies are a small portion of that being spent elsewhere. Further, because of inherent differences between urban and rural areas, this study demonstrated that advanced technology tools developed for urban or more densely-settled rural areas are not necessarily transferable to remote rural or frontier rural areas. Many assume that a tool built for an urban area can easily be adapted to meet the needs at a lesser scale in a rural area where there are "just fewer trips." This report shows how and why frontier rural mobility cannot be solved with tools that were developed for typical rural, urban, or metropolitan areas.

Last, this report demonstrates the critical importance of a "project champion" who is ready, willing, and able to move forward challenges that unfold for technology deployments to successful conclusions and positive results.

Modoc Mobility Management Center

The core project was initiated through an application for federal assistance prepared in July 2004 as part of the Transportation and Health and Human Services (HHS) Coordination Operational Tests. This phased program allocated $2.8 million to 11 operational tests focused on improving transit operating efficiencies from the provider's perspective. In comparison to other research projects in the group, the MMC project joined late and was very small. The budget for the MMC was derived from unused funds, representing only 5.4 percent of the whole program or $150,000 total, of which $120,000 (4/5) were federal and $30,000 (1/5) were local match funds.

The original scope of work for the MMC project (CA-26-7050) proposed three features: (1) adapt and implement the web-based Client Referral, Ridership, and Financial Tracking (CRRAFT) system developed by the Alliance for Transportation Research Institute (ATRI) at the University of New Mexico; (2) modify CRRAFT, adding an electronic payment component (swipe card) to pay for and track transit trips; and (3) establish a physical mobility management center in Alturas, California, with a customer service counter, telephone services, and World Wide Web tools to serve California's frontier rural communities. These integrated projects are summarized in Table 1-1.

Table 1-1

Summary of Integrated and Related ITS Projects

Task	Lesson Learned	Outcome
Administer CRRAFT	Could not be re-programmed to Open Source or deployed in Modoc County.	Project champion found another qualified bidder and saved tax dollars by pre-qualifying CRRAFT.
Develop general ledger for California Transit	Too many variables. Contractor was unable to match use case with an accounting system that was bulletproof for an audit. In addition, without fully functioning precise capture of trip length, data to support cost accounting were not collected.	Project champion found another qualified bidder and saved tax dollars by pre-qualifying CRRAFT.
Develop accounting system that could manage projects across multiple funding sources	Too many variables that affect rider, trip, etc. Contractor was unable to implement use case for multitude of complexities in frontier rural area.	This function is still critically needed as relational database that can measure trips by agency that funds trip.
Demonstrate smart cards in Modoc County	Project champion secured subsequent funding and testing began.	Lack of frontier rural basic technologies made fully functional swipe card unachievable.
"One stop shop"	This report discusses virtual and physical vision of MMC, the focus of this grant.	United We Ride and many others initiatives undertook this vision.

Source: CA-26-7050 Project - Statement of Work No. 1

Opportunities arose to fund related advanced technology projects ahead of MMC project implementation; these projects became (virtual) building blocks for the Modoc Mobility Management Center. As such, Modoc Transportation revised its grand scheme to deploy CRRAFT-for-Modoc in two phases. Phase I intended to (a) convert CRRAFT to an open source platform to meet California requirements administered by the California State Department of Transportation (Caltrans) and (b) develop a general ledger accounting system for rural California transit operators. Phase II proposed to expand CRRAFT-for-Modoc by (a) demonstrating an electronic card (swipe card) enhancement for fare collection and (b) modifying the transit accounting system to serve small rural California regional transportation planning agencies (RTPA), adding more projects and funding options.

The unique circumstance that two separate agencies were able to share the same staff, location, and resources afforded opportunities to manage distinctly different authorities and funding to benefit transportation needs of Modoc County citizens and rural travelers in general. As coordination is requisite for project success, inherent sharing of MCTC (transportation planning) and MTA/Sage Stage (transit operations) resources enhanced purposeful collaboration to yield many benefits for the public. The MCTC and MTA governing boards decided to co-locate

resources within one facility and use the same administrative and management staff, augmented by third-party contract driver/operators and occasional outside consultants. Together, these two distinct local institutions are referred to as Modoc Transportation within this report.

This decision fostered better and more coordinated transportation services by implementing a "one stop shop" that promoted long-term sustainability for both local agencies. Currently, Modoc Transportation collaborates and coordinates with many and assorted local governments, social service agencies, organizations, and tribes, which have provided non-transportation funding to supplement and augment many projects, transportation planning activities, and transit services. As a way of life in frontier rural communities, "circling the wagons" and working together proves to be less expensive, more dependable, and most successful. The MCTC (or Commission) uses annual planning funds to develop grant applications and support efforts to ensure adequate sustainable funding for public and social service transportation serving frontier rural regions. The Commission and Agency (MTA) Board of Directors adopted the following mutual mission statement and continue to dedicate resources and efforts accordingly:

> Provide the citizens of Modoc County with lifeline public transportation services and coordinate options, both within and outside the region, to facilitate rural mobility and access to basic living activities.

The Modoc MMC was intended to function in two ways: physically, by providing a central location for MCTC and MTA staff and resources, including vehicles and equipment, and virtually, by providing mobility options, coordination services, and access to trip-planning information via the World Wide Web. The MMC project had progressive goals and objectives. Short-term goals were to demonstrate a "one stop shop" for frontier rural and regional transportation or mobility management center, provide more effective coordination of transportation services, increase transportation or travel options, and broadly disseminate information using integrated web-based systems. Longer-term goals were to consider the feasibility of designing, possibly building, and potentially owning a facility that could improve coordination; access statewide and longer distance transit trip planning information systems; and enhance regional economic development. Broader goals were to modify and demonstrate a combined or model center using advanced technologies that coordinate rural transportation resources and provide for more effective and efficient operations.

Following are overviews of related projects that either predated or concurrently evolved with the MMC project.

CRRAFT-for-Modoc Design Document

To ensure that technical details and specifications were defined and clearly iterated, MCTC funded a separate design document to define CRRAFT modifications

for the Modoc County region. This project is identified as "CRRAFT-for-Modoc"; it included technical details, equipment specifications or capacity requirements, conceptual structure, and integration edges with another related project, the Rural California Trip Planning Tool (also known as Rural TPT or CALnections project), the Modoc County regional ITS architecture, and the core MMC project. The Alliance for Transportation Research Institute (ATRI) at the University of New Mexico in Albuquerque) was responsible for articulating design details so that the CRRAFT-for-Modoc modifications project (i.e., development and integration of general ledger accounting system and conversion to an open-source, MySQL platform) and core project implementation would be successful. MCTC's annual overall work program for FY 2004/05 used local funds for this initial design document.

CRRAFT-for Modoc: Phase 1

In cooperation with MCTC, the MTA operator of Sage Stage public transit and Caltrans modified an existing FTA 5311(f) capital project to begin implementation of the CRRAFT-for-Modoc project. Both Modoc regional agencies (MCTC and MTA) expressed their growing commitment and support for deploying purposeful ITS technology projects to help get people where they need to go.

Precursor Projects

The Commission's project champion successfully articulated the need to better serve frontier rural transportation for the Modoc County region. MCTC staff provided leadership to facilitate cooperation and coordination among transportation planning agencies in three neighboring counties—Modoc, Lassen, and Plumas counties, the Tri-County group—to receive assorted grant funding for different rural transportation and research projects. After an initial formative study during 2000, the Tri-County group partnered with California's statewide County Medical Services Program to conduct a Non-Emergency Medical Transportation (NEMT) Coordination Study for the three-county region. The NEMT project was funded through the Caltrans Environmental Justice Program. The Tri-County project was the first effort funded through the Caltrans program, which focused on process—an inclusive participatory process. The project identified needs and opportunities for development of county-level coordination centers offering a menu of options to help plan, provide, and support non-emergency medical transportation requiring local, regional, and intercity—which includes interstate—travel.

The MTA submitted an application with the Alturas Chamber of Commerce for technical assistance[3] from the U.S. Department of Agriculture Rural Transportation Technical Assistance Program, which was selected and administered through the Community Transportation Association of America (CTAA). This unique

[3]The application for technical assistance provided by CTAA had value, but funds were neither received nor administered locally.

opportunity, yielding a written concept of operations, was one of only five selected nationally for participation in the program during FY 2005/06. During this deployment, the MCTC became aware of the requirement for an ITS Architecture and consequently issued a purchase order to Iteris, Inc. to develop an ITS architecture for the Modoc County region to map connections between the evolving regional and national ITS systems.[4]

As user expectations increased, technologies evolved, and additional funding became available through various sources, the overall goals and objectives for the Modoc MMC were modified to include:

- Rent larger facility.
- Purchase computer and advanced technology equipment.
- Provide web connections, licenses, and fees to ensure adequate technical support.
- Hire dedicated staff to provide mobility management services, train drivers and local agency staff and public users, and work with key stakeholders, institutions, and rider groups to meet local and intercity transportation needs.

MCTC was to demonstrate a frontier rural MMC. The Modoc MMC was to centralize and coordinate transportation services and mobility options in a physical and virtual "one stop shop." MCTC co-located with the MTA/Sage Stage in a larger (rental) facility in order to expand services by consolidating operations and using advanced ITS tools.

The Modoc MMC would meet the needs of four primary stakeholders: (1) public users, care providers, and agencies or case workers needing transportation for their clients; (2) public intercity transit operators and passenger carriers who are often asked to help arrange trips to adjacent systems so that passengers get where they need to go; eventually, the Modoc MMC hoped to include (3) other transportation providers, such as human services, Native American Nations, and assorted transportation providers, including regional transportation planning agencies and coordinated transportation services agencies and (4) various funders including federal, state, and local government entities and programs.

In the simplest terms, the Modoc MMC proposed to offer frontier rural travelers both a staffed MMC and a virtual, on-line website to plan, book, and pay for a trip. This sounds simple, yet many challenges arose during implementation in the frontier rural to alter and modify both vision and outcome. Modoc County is an excellent test bed of a "frontier rural" environment.

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[4]In 2008, Modoc's Regional ITS architecture was integrated within a combined Caltrans District 2 ITS architecture, including seven northern California counties (Lassen, Modoc, Plumas, Shasta, Siskiyou, Tehama, and Trinity). However, since the former was not produced using Turbo, the Modoc ITS architecture continues to be updated and redundant.

By 2003, the CRRAFT system was an operational tool effectively serving portions of New Mexico. Oregon's traveler information initiative TripCheck.com-Transportation Options, a static search tool for transportation options and participating providers, would deploy a bi-state trip planner with Washington State with a travel options function to search by city-to-city/county-to-county. Washington State peeled off separately but did not deploy any trip planning solution. TripCheck.com offers listings for city-to-city trip options and lists available transportation options. After investigating other existing advance technology efforts and tools through peer-to-peer trips, including southern California's TripMaster,[5] by 2004, when this grant application was submitted by MCTC, the Los Angeles Metropolitan Transit Authority's TripMaster and CRRAFT were well under way and MCTC's team was motivated to work closely with ATRI and assure the success of CRRAFT in the field, serving California's frontier rural communities.

The Concept of Operations (ConOps) was developed over two years. In August 2006, the Mobility Action Plan (MAP version 1.0) was a robust, comprehensive, and integrative plan that defined several projects recommending support from multiple funding sources. While each project was separate and distinct, they were related and interdependent building blocks that collectively would plan, manage operations of, invoice for, and report on transit trips. The MCTC took the initiative and leadership to pull it all together. It needed a fully-integrated approach to implement the MMC and actively and successfully identified funding for these projects that became the virtual MMC:

1. AVL/Swipe Card (funded through an FTA 5311f capital grant) would offer vehicle tracking and fare collection using electronic fare media.
2. Google Transit Trip Planning would determine if any technology solution could offer intercity, interstate, and international trip planning.
3. A Greyhound Interline Agreement would maximize the ease of public travel; MTA has signed an agreement to partner with Greyhound and offer convenient ticket sales from the MMC.
4. Rural trip planning.

For the transportation provider, the MMC would create the physical center. The "one stop" MMC would support day-to-day activities as well as non-regular activities such as planning. The MMC also intended to serve employment/social service case workers, health care providers, and their clients as they provide trips using their own fleets or as they schedule trips on public transportation vehicles. Finally, the MMC would provide the public with better resources for planning a trip.

The MMC would include as many sources of rides as possible. First, it would include regularly-scheduled services, whether public or private. Second, it would

[5]For more information, see http://socaltransport.org or contact the Southern California Association of Governments, 818 W. Seventh Street, Los Angeles, CA 90017, (213) 236-1800, www.scag.ca.gov.

include specialized transportation options. These could include regularly-scheduled services or special trips. Third, it would incorporate carpools and other shared rides in private vehicles. Finally, the MMC's vision would include private services from taxis, limousines, and similar types of on-demand transportation services.

ATRI, in partnership with the agency project champion, determined on June 5, 2005, that CRRAFT would no longer be the technology solution. However, the project champion did not accept defeat and was willing to pursue another solution. The agency project champion sought another technology to meet the need and began working with HBSS[6] (hereafter, Contractor) for the CALnections and AVL/Swipe Card.

1. The AVL/Swipe Card would offer on-board data collection to assure accurate trip reporting. The AVL/Swipe project was funded through 5311f and would demonstrate the ability for bus drivers who self-dispatch a swift and easy way to add, cancel, and count fares and riders. In addition, with the swipe card, the billing for partner agencies that pay for trips could manage the accounts of their clients. With the speed of technology innovation, this project's demonstration has completed its useful life.
2. Google Transit on Google Maps offers integrated trip planning for scheduled transit services to adjacent areas. Modoc County was a pioneer to offer intercity, frontier rural travel at Google Maps, which had not yet been tested by Google's engineers. Sage Stage trip planning began at Google in December 2007. At the time Sage Stage went live, Google Transit was challenged to best manage trips that are less frequent than daily or hourly. MCTC hired the Marcy Jaffe Company (MJC)[7] to prepare the data for the required "General Transit Feed Specification" (GTFS). MJC worked to resolve issues and prove that infrequent intercity travel connecting with Reno's transit systems would display for on-line trip planning at Google Maps. Google's engineers have further updated their trip planning algorithm to better manage frontier rural connections, in part due to this pioneering initiative through MCTC's MMC.
3. The Greyhound Interline Agreement offered a new relationship for Sage Stage that would increase ridership to the intercity bus travel hubs of Reno, Nevada; Redding, California; and, to a much lesser extent, Medford, Oregon via Klamath Falls. The resulting Interline agreement was the first in the nation for Greyhound with a frontier rural public transit operator. The successes of the agreement with Greyhound include:
    - Travelers can save time at the busy Reno terminal when travel times are longer due to extreme weather and long travel distances. The rider may not miss their bus.

[6]HB Software Solutions.

[7]Marcy Jaffe Company, mjcaction.com, prepared the General Transit Feed Specification (GTFS) for MTA/MCTC Sage Stage, which launched in 2007.

- Staff at the Reno Greyhound terminal now have accurate schedule and contact information for travelers heading north and within the Sage Stage service area. This information was available before the Interline Agreement, but the relationship that MTA has built with First Group America greatly assists travelers.
- Announcements are made at the terminal that Sage Stage will promptly depart.

4. The Rural Trip Planning Tool (TPT), aka CALnections.com (funded through the Caltrans Division of Research), is a web-based trip planning pilot intended to display trip connections among the five counties of Inyo, Lassen, Modoc, Mono, and Plumas using their respective four public transit providers. The vision was that the tool would ultimately serve all rural or non-metropolitan California counties. The tool would connect riders traveling along the US 395 corridor with systems developed by Los Angeles Metro's TripMaster and the Bay Area region. Unlike typical urban areas where transportation options are plentiful, this project included the human services/social service transportation providers' client-based and other non-scheduled services so riders who could not use public transit could possibly find options to get them where they need to go.

Coordination: Trip Planning versus Mobility Management

This section examines two different concepts or paradigms: (1) coordination and (2) mobility management. These paradigms are integrally related. They deal with aspects of the same general theme—getting people where they need to go—but from two different perspectives. "Coordination" addresses travel and transportation as institutional collaboration and resource management in terms of efficiency and effectiveness, while mobility management focuses on the individual traveler and his/her personal needs to get places. Modoc Transportation realized these forthcoming needs in 2003 when evolving the MMC. Ultimately, federal laws would "mandate" coordination. It is important to consider Modoc Transportation's unique perspective on coordination.

"Coordination" implies institutional collaboration (among agencies) with varied implications according to regional type (urban/metro, suburban, rural, and frontier (remote), complexities, and challenges. In this frontier rural test environment, where travel distances are significant and resources scarce, face-to-face stakeholder meetings (among agencies) were necessarily limited and critically on-task. Coordination is key to integrated trip planning that must engage stakeholders regularly during successful ITS deployments. However, without regular and comprehensive update methodologies to share with stakeholders, MCTC's opportunities were limited to engage stakeholders by sharing useful learning, as such partner agencies lost interest and were inclined to commit attention and resources elsewhere.

"Mobility management" is understood from the individual's perspective, relative to personal (rider) needs relative with respect to abilities or conditions (disability, age, language, or other personal needs). As such, mobility management depends on efficient management of data about conditions and whether those data are (a) protected by federal, state, and/or local laws, rules, and regulations, and/or (b) acknowledged or willingly shared by the individual.

At a time when Greyhound's network served rural and frontier rural communities, travelers could make one call to book a ticket to their destination. When Greyhound realized rural and frontier rural services were not profitable, those trips were eliminated. While those connecting "last mile" bus services may or may not have been replaced by services such as Sage Stage, the traveler has little chance of finding those connections without "coordination," which implies data sharing, using standards that were not adopted by the time this project was under way.

Project Timeline

Figure 1-1 shows the timeline of the project.

Understanding the Frontier Rural Setting

Less than one percent of the U.S. population resides in frontier rural counties, while frontier rural counties comprise 45 percent of the national land mass.[8] Rural transit agencies and transportation providers serving frontier and rural areas face many challenges: extensive travel distances, limited resources, low population densities, and lack of coordination among multiple providers. Counties with population densities of <6 persons per square mile are considered "frontier rural," as are counties with populations separated by considerable distances from central places and by limited access to goods and services.

Extensive Travel Distance

As shown in Figure 1-2 (Map of Study Area), the closest urbanized areas are more than two hours from Alturas, and a connection between the southernmost portions of the study area to the northernmost is 13.5 hours (from Lancaster CA, to Klamath Falls OR) are 660 miles apart. Connections and "lifeline" service to urbanized areas for Modoc County, operated by Sage Stage/Modoc Transportation Agency, include:

- West = Redding CA (143 miles or 3 hours via mountainous roads)
- South = Reno NV (189 miles or 3.5 hours by desolate roadway)

[8]Montana Office of Rural Health, "Rural Community-Based Home Health Care and Support Services – A White Paper," Montana State University–Bozeman, August 2001, p.1.

- North = Klamath Falls OR (100 miles or 2 hours over volcanic plateau)

Because sophisticated treatment and specialized health care are not available in Modoc County, residents must travel long distances to meet such needs, which are fundamental to the quality of life. As such, travel to manage more frequently-occurring medical conditions such as cancer, diabetes, hypertension, etc., is often referred to as "lifeline" transportation.

Figure 1-1

Timeline and Milestones: Integrating a Suite of ITS Solutions to Meet Frontier Rural Needs.

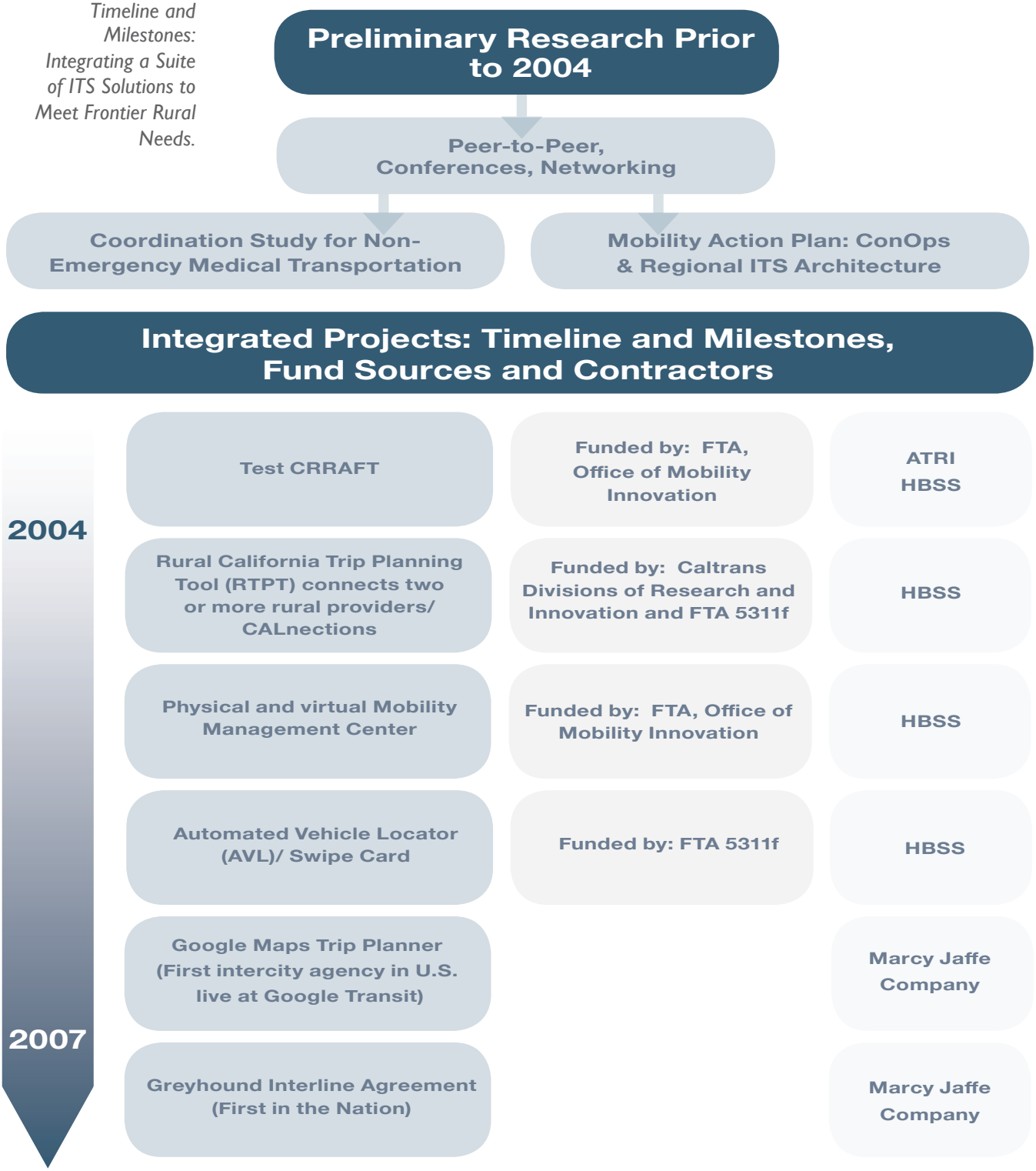
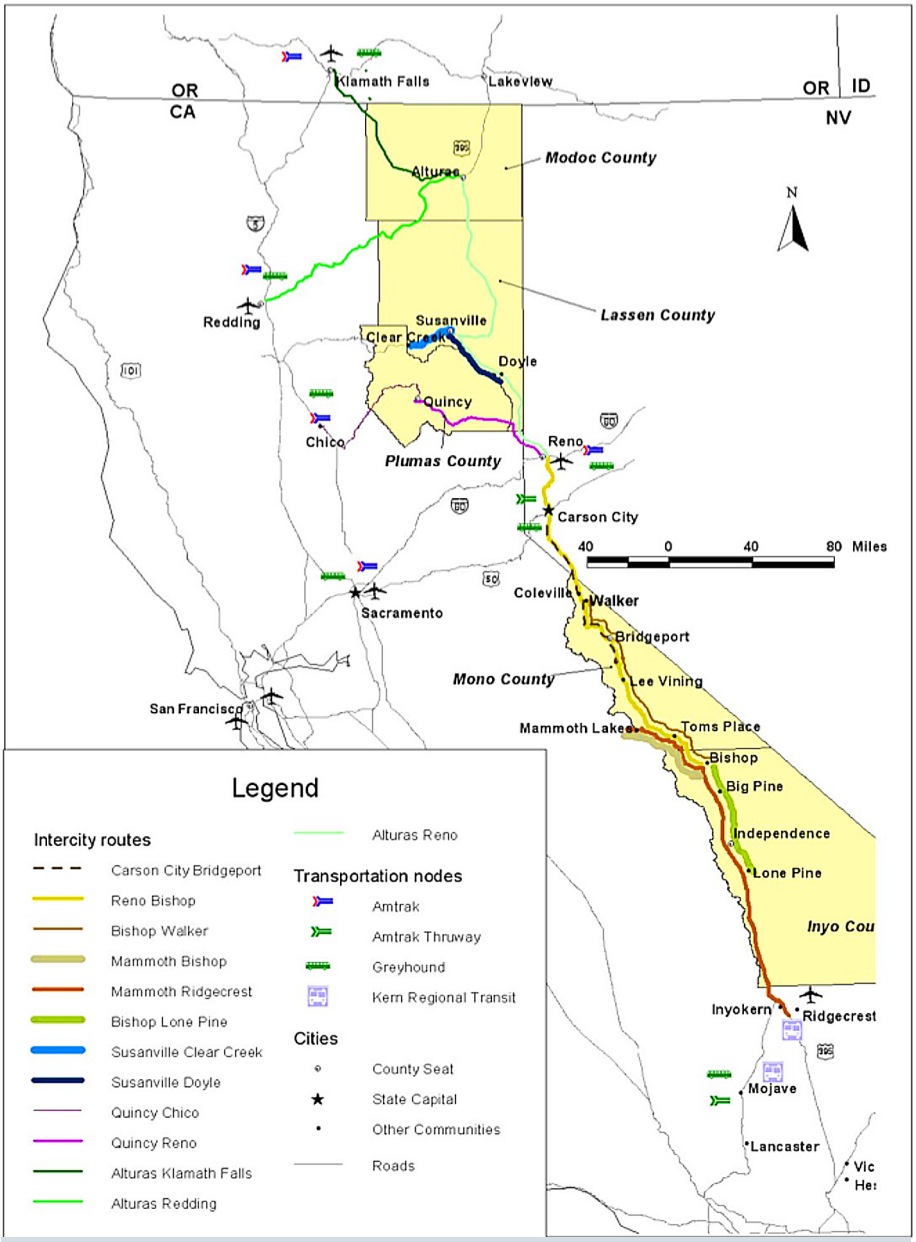


Figure 1-2

Map of Study Area Showing Intercity Frontier Rural Routes and Carriers



California Statewide Rural Intercity Bus Study Map

Internet Does Not Supply Missing Needs for Frontier Rural Life

Some hypothesized that the Internet would supply missing needs to support remote, frontier rural residents' needs, but it has not. While there have been some advances in on-line education and telemedicine, there is still a critical need to provide lifeline transportation and have services met more than 100 miles away.

Limited Resources

Limited resources result from both the local economy's capacity to contribute and pay for actual transportation costs and the limited income of local residents, which increases their need for services many hours away.

Local Economy

Mean annual earnings in Modoc County were $39,328 in 1999, as compared to the total mean annual earnings in California, which were $64,725. Modoc County's per capita median (50th percentile) annual household income was $27,522 in 1999, compared with the statewide annual median of $47,493. Further, an estimated 416 families (16%) live below the poverty level in Modoc County. This is significantly above the statewide rate (10.6%).

Limited Access to Primary Health Care

In January 2000, the Health Policy Tracking Service (HPTS) of the National Conference of State Legislatures (NCSL) identified frontier rural populations among the 10 most vulnerable populations, with limited access to primary health care. The HPTS identified insufficient health insurance, poverty, provider care mal-distribution, geographic isolation, and linguistic and cultural issues as critical factors that hinder access to primary care.[9] Frontier rural populations have high accident rates and high rates of chronic illnesses (diabetes, hypertension, and congestive heart failure).[10] Health care needs increase the critical value of Sage Stage's lifeline transportation. By serving three states, residents in Modoc County can access health care options that may be more affordable or take less travel time.

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[9] *Ibid.*

[10] *Ibid.*

Aging Population Intending to Age-In-Place Independently

Additionally, many older adults retire to rural communities that offer more affordable housing. However, transportation can be a major challenge to an older person's ability to live independently.[11] The additional benefits of having the RTPT (CALnections trip planner) to integrate non-scheduled human services transportation providers in a virtual "one stop shop" were necessary elements for the MMC to meet the future needs of baby boomers. These projects were intended to offer one stop for trip scheduling booking and paying for a trip to support those who wish to age in place with dignity.

Lack of County-Level and Interregional Coordination among Multiple Providers

Similar to public and social service transportation in urban and metropolitan areas, rural transportation serves local residents and visitors, with the majority of riders being older adults, persons with disabilities, and persons with low incomes. Trips can be local, interregional, intercity, and interstate—to regional centers hours away—that require using two or more transportation providers. This greater study project area intended to address connections through five California counties along the U.S. 395 corridor, using advanced technologies and create a common ground. Tools from the MMC would assist and offer new ways for partner agencies to best coordinate service.

Low Population Density

Population[12] for the study area counties of Modoc, Lassen,[13] Plumas, Inyo, and Mono have a population density of <1 person per square mile, compared to California's average population density of 237 persons per square mile.[14]

County	Population	Area	Density
Modoc	9,107	3,944	2.3
Lassen	29,683	4,557	6.5
Plumas	20,122	2,554	7.9
Inyo	17,293	10,203	1.7
Mono	12,927	3,044	4.3
Study Area	89,132 persons	124,302 sq. miles	0.7 persons/sq. miles

[11]AARP, 2001, "The Policy Book: AARP Public Policies."

[12]U.S. Census Bureau, Census 2000, http://quickfacts.census.gov/qfd/states/06000.html, calculated with 2009 California population of 36,961,664 divided by land area 155,959.34 square miles.

[13]Does not include ~5,000 inmate population at High Desert State Prison in Lassen County. http://www.cdcr.ca.gov/Facilities_Locator/HDSP-Institution_Stats.html.

[14]U.S. Census Bureau, Census 2000.

SECTION 2

Methodology/ Research/Approach

The Statement of Work (dated 07/04) defined this integrated and comprehensive approach as both a virtual and physical "one stop shop" Mobility Management Center (MMC).

Previous Studies

For background on previous ITS studies that offer trip planning and "one stop" solutions for transit agencies, please visit www.fta.dot.gov. There are many related projects.

Physical and Virtual Mobility Management Center Vision

The ConOps for the one-stop shop is detailed in the Mobility Applications Program (MAP) document[15] are summarized as:

Virtual and physical one stop shop for folks who need a ride (with tools for those providing the ride)

- Plan a trip
- Reserve a trip
- Make a trip
- Pay for a trip

- To improve coordination effectiveness among public and human service transportation providers through planning, delivery, and centralized information services.
- To provide more access and avenues to traveler information for potential riders.
- To efficiently generate federal, state and local mandated reports.

Suite of ITS Projects – Description

This section describes the integrated projects to create the virtual and physical MMC:

- Develop CALnections, a regional web-based trip planner and coordination tool.
- Establish the Modoc Mobility Management Center.
- Deploy TRIMSweb proprietary software with AVL/Swipe Card modification for complete MTA/Sage Stage System (8 units) plus "pilot test" (2 units) for Eastern Sierra Transit Authority intercity route in Inyo/Mono counties.
- Sage Stage offers trip planning at Google Maps/Transit and signs agreement with Greyhound.

[15]Modoc County Transportation Commission, prepared by Current Transportation Solutions, 2006.

Table 2-1

Rural Trip Planning Tool Modules[16]

Module	Description
Trip planning	• Trip planning (includes landmarks list for origins and destinations) • Process all routes for trip planner • Fixed route management (include capability to determine if an address is in a dial-a-ride service area or virtual route) • Other route management—posting a non-scheduled trip for approved providers • Other route management—posting of private rides
Client and trip management	• Client verification & eligibility • Book/edit ride • Book a standing order • Trip authorization or referral • Download trips for a day of week • Basic manifest
Scheduling and dispatching	• Complete manifest • Schedule rides • Driver route update (entering miles & times) • Basic driver management • Basic vehicle management • Basic create/manage routes • Basic archive management
Billing and cost analysis	• Billing and cost analysis • Contract (agency) management • Driver management • Vehicle management • Create/manage routes • Archive management

MCTC expected the Contractor to use Functional Prototyping[17] to review the basic objectives in this dynamic environment. Since Functional Prototyping allows for limited data accuracy, this became a challenge when testing the system. The Contractor could not invest the time needed to display accurate trip planning schedules and fares data as schedules, stops, and fares update every one to two years for this study area. During the six years of this project study period, the Contractor would have updated fares, stops, and schedules three to five times. The Contractor did not expect and did not intend to keep current that much data. There was a "catch-22" of using functional prototyping for rapid programming updates; however, without examples of precise data supporting accurate

[16]Modoc County Transportation Commission, prepared by Current Transporation Solutions, 2006, p. F-7.

[17]Functional Prototype (Model) (also called a working prototype) software that is almost complete, but still needs some fixing, but in general a testing product that is to be treated as not done. Feedback on the product is often gathered from a random selection of people. http://en.wikipedia.org/wiki/Prototype.

trip plans, MCTC determined having "inaccurate sample data" was too distracting to ask for stakeholder input. The Contactor felt if more time were available, those data details would come together. FTA and MCTC were generous with extensions; however, the details were too vast and dynamic.

Conclusion of Trip Planning Project (9/30/08)

CALnections.com has displayed some basic capacities to plan and reserve a trip, but the project concluded before the RTPT was fully functional. When the details are examined, a much more robust system would be needed to achieve the elegant simplicity of basic function "planning, booking, and paying for a trip" from the virtual MMC.

Establishing Modoc Mobility Management Center[18]

CTAA sponsored a technical assistance project for the Alturas Chamber of Commerce and its partner, the Modoc Transportation Agency, to develop an implementation plan for a mobility management center. Lisa Ballard of Current Transportation Solutions (formerly with WTI) was hired to prepare this guidance document. The report documents the vision, research, planning, financial analysis, and decision making required establishing the Modoc MMC. It also includes an inventory of agencies that provide transportation services, a description of the Unmet Transit Needs process, and a descriptive overview used to develop an open source web-based tool for this CTAA project. Ms. Ballard directed graduate students attending Montana State University in Bozeman. The intention was a coordination management tool, but it was not fully functioning at the conclusion of the project.

The Concept of Operations includes:

- The establishment of a network of service providers, consumers, and funding agreements.
- The establishment of administration protocols to ensure that the resource database was kept current and that participants were kept informed of service options, client eligibility, and rate changes.
- Ongoing outreach with participants to ensure the effectiveness of the coordination function. Participants must see benefits. This requires ongoing communication with participants to ensure effective use and a dedication to problem solving. Public transit and private-sector transportation providers must see improvements in increased productivity and revenue. Social service, faith-based, and tribal transportation providers must see that participation helps them stretch their transportation budgets. Agencies, organizations and medical providers must see coordination as a problem free mobility solution—one that allows their staff to focus more on program

[19]Modoc County Transporation Commission, 2007.

or medical care delivery and less on trying to get their clients and patients to their programs and health care.

- Annual cost projections, budget preparation, and the establishment of coordination fees and service provider rates, based on the annual budgets prepared by service providers.
- User invoice verification and payment processing for service providers.
- Driver screening and vehicle inspection verification for volunteer driver program.

Conclusion of Mobility Management Center Project (12/31/10)

This grant funded the successful implementation of the MMC, opening in a new facility in January 2005. MCTC hired a Mobility Manager to respond to rider needs and direct updates to the on-line trip planner available through Google Maps. Modoc's Mobility Manager answers up to 20 calls per week that can sometimes lead to a 30–45 minute, involved investigation to create one customized frontier rural trip plan, as integrated trip planning to all destinations is not yet available on-line for Modoc County residents.

SECTION 3

Results/Discussion/ Application

This section reviews the results of this frontier rural deployment and lessons learned in coordination and mobility management. The ITS solutions that intended to span more than one transit agency to serve frontier rural communities were attempted before adopted national data standards were available. This summary focuses on the reasons this ITS deployment was "ahead of its time" (from 2006–2010) and could not be fully implemented as envisioned in the concept of operations. This discussion also briefly investigates how ITS technologies and infrastructure have evolved after this MMC research project wound down.

How to Avoid Pitfalls in ITS Innovations Deployed for a Frontier Rural Community

Often, the Contractor stated that if the specifications were more exact and use-case scenarios available, the project would be quickly completed. MCTC's project champion supplied the Contractor with the multiple resources documents that outlined the Concept of Operations, vision, work-flow processes, output reports, and links to the near-final draft ITS national architecture, and the American Public Transit Association (APTA) developed the Transit Communications Interface Profiles (TCIP).

MCTC agreed to review any write-up the Contractor saw best to meet their internal needs for use-cases; however, with such limited MCTC staff, there was not time or resource for a small frontier rural agency to undertake another time-consuming complex use case document. This is one example of challenges the Contractor and the agency could not resolve through this ITS project or through functional prototyping. Similar ITS trip planner initiatives spent months to years developing the use-case scenarios while user expectations and technological capacities are changing so fast—as soon as the specifications are buttoned up, a new expectation pops up. Future ITS projects may consider a modified approach to detailed use-cases because technologies and user expectations are changing so rapidly. Alternatively, as with the OpenTripPlanner[19] project, a shared vision through on-line collaboration brought a next generation of multi-modal trip planner to production in just 12 months. OpenTripPlanner continues to evolve swiftly with changes in technologies and user expectations.

[19]OpenTripPlanner is fully deployed as a multi-modal trip planner for Tri-Met in Portland, OR. For more information on various initiatives and projects, visit http://openplans.org/projects/#transportation.

Future rural ITS projects should have clear, specific milestones that can be accomplished in six to nine months. Each of these milestone tasks will roll up to the larger project vision, with future data integration in-mind. This should avoid the possibility that a project is lost in a litany of uncertain requirements, the programming team is overwhelmed, or, worse, they find themselves unable to succeed.

Standards = Ways to Exchange Data Elements Were Imminent but "Not Available"

Many recognize that to share information over the Internet or to purchase something needed, a standardized way to move information between computers or a common currency to achieve our goal is necessary. In some cases, the standards evolve or offer translations and, in other cases, the standards may be mandated through federal banking regulations, for example. When this project began, the MCTC Project Team understood that federal efforts to adopt the transit data exchange standards (TCIP) would soon be in place to assure ease of data communication. This project had a limited number of data elements that needed standard definitions and, most certainly, that minor subset of data would be imminently adopted. This project would fully test those "adopted standards" in the frontier rural setting.

Underway during this project's implementation was the imminent adoption of three sets of standards: the National ITS Architecture, the California ITS Architecture, and TCIP. TCIP is an APTA standard that was an ambitious attempt to "define standardized mechanisms for the exchange of information in the form of data among transit business systems, subsystems, components and devices."[20] Each of those tireless efforts took thousands of hours, and none of these substantial efforts was adopted by 2006; this project needed to be able to test them in this application.

To meet a mandate of this research project, MCTC procured a Regional ITS architecture. Modoc County's ITS architecture would not be accepted by neighboring communities when they, too, would adopt their Regional ITS standards that met their communities' needs. Without one set of standards and a range within those standards to customize each local/regional architecture, this process could not support inter-jurisdictional data exchange. Therefore, there were challenges to the success of this project without federal mandated standards from both the agency perspective and that of the traveler.

Without standards from a partner agency's coordination perspective:

1. Partner agencies would demand, "Why do I need to supply my data in a different format?" If the answer was, "To meet the standards," the next

[20]American Public Transit Association, "Standards for Transit Communications Interface Profiles, Volume 1," TCIP-S-001 3.0.3, January 2009, p.1. Available at http://www.aptatcip.com/APTA-TCIP-S-01%203.03.htm.

question was, "What standards?" Agencies resist mandates without simple, free tools or funding to implement.

2. Consultants are reluctant to wade through hundreds of pages of draft standards. They want the specification document to function like a dictionary.
3. Consultants for this project were left to develop their "best practices" for internal data standards.
4. When the data must be procured from the next community, without national standards the communication will fail or a new expense requires that one agency pays to re-enter each agency's data to include the neighboring data. This is not sustainable.
5. Tools that could convert different data formats could be written, but what is the "standard" method in-place to collect the data? Small frontier rural transit agencies often use pencil and paper, Microsoft Excel, and very basic tools that they can afford with limited budgets and not software packages such as Hastus or Trapeze, which could output data in a variety of standardized export scripts.
6. Too much time would be invested in writing customized software to convert data from each agency into the standard format.

Without standards from the rider mobility management perspective:

1. Travelers will not be able to select from all available trip options how to get where they need to go if all transportation providers will not convert their data into the standard as well as agree to update the data.
2. Fares add significant complexities. (See Appendix A, Fares by Age). While these agencies agreed that an older adult was age 60 or older, this appendix details the variation in definition for type of traveler including child, youth, college student, or adult. For a frontier rural MMC to display total fare to display the trip by fare category, if, for example, one partner agency issues a youth pass up to age 17 and another to age 18, the traveler cannot efficiently have the youth fare returned to them without asking the rider his/her birth date. Requiring a birth date is cumbersome and may be considered an imposition on privacy. If a standard were issued for age of traveler, this challenge for data exchange would be averted. When a traveler hopes to buy a ticket at Greyhound.com, there are many questions that must be answered before he/she can see a schedule and fare.
3. Viewing trip plans on mobile devices is very helpful to the persons who have invested in constant communication; however, in the frontier rural areas, fewer residents can afford devices, and the coverage was not available during the study period to fully test. Displaying a series of static schedule documents to piece a trip together is just not functional or "user friendly." Travelers demand that the participating agency display data in ways they can use.[21]

[21] http://greatergreaterwashington.org/post/1503/irate-riders-flooding-wmata-mailboxes/.

4. Once the data including fares are standardized, software developers create new and better "apps"[22] that transit agencies or the MCTC staff may have never imagined.

The MCTC Project Team concluded that a more efficient approach for future ITS projects would have been for federal- adopted and -mandated definitions and standards. Those definitions would evolve as technologies and rider demands unfolded. The standardized data gathered would be used not only for the integrated trip planning and mobility management functions but also for trip counting and fiscal management. Many of the goals of this MMC project could not be fully tested within the constraints of the frontier rural setting without mandated data standards. FTA and APTA have begun to address these concerns. A more complete discussion of standards and new tools to implement those standards are found in the "Multimodal Trip Planner System Final Evaluation Report"[23] as well as the National Transit Institute course "Integrating Transit Applications: Defining Data Interfaces Using TCIP."[24]

Helping Travelers Get Where They Need To Go

One of the primary goals of the MMC was to help travelers get to their destination with ease. Years ago, travelers would make one phone call and get to nearly any destination through the Greyhound network. Until the 1990s, Greyhound offered regular service within their network to frontier rural communities including Alturas and Modoc County. Many rural routes were discontinued. Today, Greyhound focuses on profitable mainline routes.

Carriers such as Sage Stage are piecing together that lost network of routes to frontier rural destinations within limited and dwindling financial resources. Modoc County was the pioneer in signing the first Greyhound Interline Agreement to sell tickets on-site in Alturas and save travelers time at the ticket counter in Reno or Redding. This simple innovation has made it possible for seamless mobility for many travelers. While the interline agreement offers a seamless solution for ticketing, a traveler who visits Greyhound's website to view his/her trip options to Alturas is returned "no trip options," which remains confusing and incorrect. Greyhound has not yet identified a solution to fully integrate routes/schedules among the interline partner agencies for the Greyhound trip planner.

Travelers may not always realize they need to plan their trip from their destination to their origin. How often or how near is the "last bus" to where they are

[22]http://www.citygoround.org/apps/.

[23]http://www.fta.dot.gov/documents/MMTPS_Final_Evaluation_05-24-2011(1).pdf.

[24]National Transit Institute, "Integrating Transit Applications: Defining Data Interfaces Using TCIP," last accessed June 15, 2011, available at: http://www.ntionline.com/courseinfo.asp?coursenumber=tri27.

going? For example, in the case from Klamath Falls to Alturas, the weekly service is on Wednesday afternoon. The traveler must get to Klamath Falls by Tuesday, since the service from Medford arrives too late to connect with Sage Stage, etc. This is just one example of dissecting trips that the Mobility Managers do each day and that a traveler would need to know. Mobility Managers cobble trip plans together without one data source to view all accurate trip options. Keeping the schedules and perhaps fares accurate for a "one stop" call for any trip plan is nearly impossible. The need for the CALnections and mobility management vision remains critical for frontier rural communities; however, portions of the trip planning details are being offered through evolving Internet resources.

As Technology Evolved, Rider Expectations Evolved, Too

In the absence of the federal mandates and many years needed for the inclusive approaches from APTA and National ITS Architecture, a private company stepped up to test data exchange for on-line trip planning. Riders and innovative engineers needed to easily plan trips on transit.

In 2005, Google Labs displayed Tri-Met (Portland's regional and robust rail and transit network) for on-line trip planning. De facto and nearly overnight, the Google Labs project established the "new" data exchange standard for on-line trip planning. The specifications defined data elements would be adopted without thousands of hours of committee review. If an agency wanted to participate in the on-line trip planner, when riders demanded it, or the agency Board saw value in simplifying trip planning, the agency would "find a way" to convert its data into the specified data standard from Google Maps.

There are quite a few technological systems that evolved for successful ITS deployment of the coordination and mobility management goals of CALnections. Following are some examples:

1. *Accurate and fast-loading maps*. Procuring base maps that could display a trip plan among counties or states or nations was a very complex and costly decision process. Agreeing that local maps needed to be accurate, in frontier rural communities, at best, mapping had not fully matured. Many maps now allow for local updates, which was not possible at the time of this MMC initiative.

2. *Internet connections*. At the early phases of this project, a dial-up Internet connection was likely the only way a traveler could view trip plans. The loading of maps and viewing trip plans was much too slow. Eventually, as this project wound down, expanded higher-speed connections to the frontier rural communities began to mitigate slow connections. However, the lack of high-speed connectivity remains an issue for areas without alternatives to dial-up Internet connections.

3. *Immediate trip plan options*. Using best practices, Google Inc. will pre-process and pre-sort all available trip plans with a weekly build. Riders do not watch the computer processing for each trip option requested. Travelers expect that two clicks on the map will return one immediate list of up to three trip options.

4. *Consultants familiar with the local area.* Many hours were invested correcting "best guess" locations for bus stop locations identified among the multi-agency network, as consultants lived thousands of miles away. In recent years, loading accurate mapping data through user content mitigates this challenge.

5. *Accurate maps and location of the vehicles would return accurate trip mileage for cost accounting.* The MMC project would have tallied total mileage for the day and accurately allocate mileage by funding type. The mileage for each rider trip throughout the day could not be obtained if the bus could not be tracked without consistent coverage through frontier rural area on accurate base maps. At this writing, many of the software packages that offer trip management, when fully investigated, still report that at the end of each day the mileage of each trip leg would need to be manually entered/re-entered. For rural areas this added step may make cost-accounting very expensive.

6. *Coordination is not solely effective through data exchange*. The successes in coordination for frontier rural communities are in educating partner agencies about what trip services may be considered. MCTC has found that staff turnover at partner agencies requires patience to retrain new staff. MCTC staff must visit face-to-face with the Veterans support groups, the Native American Rancherias, the senior centers, Greyhound, and other partner agencies every three to six months to refresh their understands of available bus services. This commitment is time-consuming for limited staff in frontier rural communities.

MCTC worked closely with Inc. Google through the Marcy Jaffe Company to launch the first rural intercity connections for Sage Stage at Google Maps in 2007. In these early years, Google was focused on trip planning for urban markets—places that would have thousands to millions of potential users, not the rural frontier with weekly bus service on some routes. MCTC's pioneering spirit offered supported initiatives to serve the future Google Maps trip planner. Some of the outcomes for other rural and frontier rural communities that have benefited from MCTC's early participation in the Google Maps trip planner include the following:

1. MCTC suggested that weekly service be displayed, requiring the trip planner to look more than a few hours into the future for trip plans. About three years after Sage Stage was launched at Google Maps, a trip plan request with weekly service does not fail. In fact, in order to

consistently display the next three trip options, the Google Maps trip planner displays three weeks of the weekly service.

2. MCTC discussed with the Google Inc. team the importance of having a telephone number to call if the traveler is off-line for a portion of the trip. The agency phone number is now displayed with a link to the agency web site and the fare details for that agency.

3. Inter-agency connections between the urban and frequent Reno Regional Transportation Commission (RTC) often left the rider on the bus stop overnight, unnecessarily. MCTC's pioneering work helped Google's engineers examine how the trip planner weighed the benefits of the short, initial portion of the trip, the in-town 10-minute trip that was about to depart, and connections to the frontier rural Sage Stage bus that runs less frequently, for example, Monday, Wednesday, and Friday.

4. At least three substantial federally-funded projects built upon these successful MMC efforts and may not have been spurred without this earlier investment. More than $100,000 was invested in the Northern California Feasibility Study[25] as well as perhaps nearly the same investment for Phase II of that project managed by Eastern Sierra Transit that will build-out the MMC study area as one integrated on-line trip planner. The MCTC Project Team believes the efforts under way for CALnections spurred those investments to serve frontier rural communities. The third success was the first deployed intercity data at Google Inc., led by the Marcy Jaffe Company, to share the formatted Excel tools developed by Robert Heitzman that are now available through the National Rural Transit Assistance Program as a no-cost resource application named GTFS Builder.[26]

5. Google Inc.'s engineers update specifications and features to answer a new question the rider wants to know. Most recently, Google Inc. added real-time updates through the same trip planning interface. Riders can see if their particular trip plan will be delayed by traffic, breakdowns or weather. In deploying a real-time interface, there are new standards that allow multiple agencies to communicate on behalf of the rider. Another recent feature offers all lodging options up to a span of time on transit, defined by the rider. These data integration features are the future of ITS projects. Riders will demand that innovative companies push technology solutions to meet their needs.

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[25]http://www.dot.ca.gov/hq/MassTrans/index.html.

[26]http://www.nationalrtap.org/WebApps/GTFSBuilder.aspx.

Frontier Rural ITS Solutions May Need to be More Flexible

While the Contractors were proficient in their Commercial Off-The Shelf (COTS) software, the frontier rural setting created new challenges. At a glance, any simple Microsoft Excel spreadsheet used for ridership counts should be easy to replicate in a database and resolve into a trip-counting and accounting data-collection tool. The bus operator can quickly interpret and follow business rules that could not be replicated by this Contractor. There are many "special" details that drivers take charge of—for example, Sage Stage operators self-dispatch. The passenger calls the driver directly, and the driver negotiates with the passenger when he/she will be picked up or dropped off. The COTS software was built solely for a dispatcher to enter all data before the trip is taken, and if new riders are added, they are not added "on the fly" in one or two clicks but through the dispatcher to the Mobile Data Terminals (MDT).

Ridership for this frontier rural solution includes up to 73 trips per day for one bus operator on one date of service, which equates to 9 dial-a-ride trips in an hour. This efficiency is substantially higher than industry standards. The MCTC Project Team believes that having a dispatcher filter those calls and transmit the trips to the operator or via MDTs would have reduced this phenomenal efficiency. It is likely that another staff person would be needed to take calls, enter the trip details into the software, and re-confirm with the bus operators who go in and out of dead zones if the trips were received on an MDT. In addition, during the test phase for MMC, the drivers spent up to eight minutes per trip entering data into a handheld device to add a rider. This amount of time spent on any "automated" data collection would also make it impossible to achieve the primary function for the agency, more trips at least cost.

Summary of Conclusions

The MMC brought interested partners together and sparked lively and important conversations that led to United We Ride, Mobility Ambassadors, the first interline agreement with Greyhound, and the first intercity carrier on-line trip planning through Google Maps that serves frontier rural communities. Many agencies awaited the impending success of these well-conceived and necessary integration tools before they procured their coordination tools. Early testing of intercity trip plans at the Google Maps trip planner paved the way to future improvement to the trip planner that now display trip options that failed years ago.

ITS technologies cannot be easily transported to a frontier rural community where the infrastructure did not exist. When a Contractor assures a small community that a project is of lesser scale than the successful bigger cities and

the baseline technologies are not so very different, it is highly recommended that they prove it in the field. This study may help future ITS projects evaluate how best to fill the need to integrate many facets of data collections, reporting, and mobility management for the rural transit agency.

MCTC is thankful for the opportunity to pioneer this research project through this generous federal support.

APPENDIX

A

Fares by Age Difference

Ages of Riders (yrs)	Status	Eastern Sierra Transit	Sage Stage Dial-a-Ride	Sage Stage Inter-City	Lassen	Plumas
0-4	Accompanied child					
0-5	Accompanied child				Free	
0-7	Accompanied child					Free
0-8	Accompanied child			Discount		
0-12	Accompanied child		Discount			
5-16	Youth	Discount				
6-19	Youth				Discount	
8-16	Youth					Discount
6-18	Students to/from school or daycare		Discount			
8-14	Unaccompanied student, with permission			Discount		
	Lassen College students w/ID				Free	
15-59	Adult			Full		
17-59	Adult	Full				Full
19-59	Adult		Full			
20-59	Adult				Full	
60+	Senior	Discount	Discount	Discount	Discount	Discount
	People with disability	Discount	Discount	Discount	Discount	Discount

Glossary of Terms

AB 120	Assembly Bill 120 (Chapter 1120, Statutes of 1979), also known as the California Social Service Transportation Improvement Act
ATRI	Alliance for Transportation Research Institute, University of New Mexico, Albuquerque, NM (managed & developed CRRAFT)
AVL	Automatic Vehicle Locator
Caltrans	California Department of Transportation
COTS	Commercial-Off-The-Shelf
CRRAFT	Client Referral, Ridership and Financial Tracking system (developed by ATRI)
CTAA	Community Transportation Association of America
CTSA	Consolidated (or Coordinated) Transportation Service Agency
DR/Flex	Demand-response or flex route, operating within fixed area/zone on varied improved streets / roadways dependent upon passenger need to reach specific origins and destinations
ESTA	Eastern Sierra Transit Authority, public rural & intercity transit operator for Inyo and Mono Counties, headquarters in Bishop, CA
FTA	Federal Transit Administration
GIS	Geographic Information System
GPS	Global Positioning System
HBSS	HB Software Solutions, North Andover, MA
HPTS	Health Policy Tracking Service
ITS	Intelligent Transportation Systems
LCTC	Lassen County Transportation Commission, Susanville, CA
LTSA	Lassen Transit Service Agency, operator of Lassen Rural Bus, Susanville, CA
MAP	Mobility Applications Program included the concept of operations and program guidance document
MCTC	Modoc County Transportation Commission, Alturas, CA
MCOTS	Modified Commercial-off-The-Shelf
MDT	Mobile Data Terminal
MJC	Marcy Jaffe Company, Port Townsend, WA
MMC	Mobility Management Center
MMMP	Modoc Mobility Management Plan
MTA	Modoc Transportation Agency, operator of Sage Stage public rural and intercity bus services, Alturas, CA
NCSL	National Conference of State Legislatures
NEMT	Non-Emergency Medical Transportation
OTP	Open Trip Planner
PCTC	Plumas County Transportation Commission, Quincy, CA
RTP	Regional Transportation Plan
RTPA	Regional Transportation Planning Agency
RTPT	Rural (California) Trip Planning Tool or CALnections project
TCIP	Transit Communication Interface Profiles
TCRP	Transit Cooperative Research Program
TRIMS	Transit Resource and Information Management System
TPT	Trip Planning Tool
USDOT	United States Department of Transportation
WTI	Western Transportation Institute

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