



Application for
2016 TIGER Discretionary Grant

Regional Connection Through Technology and System Integration

NCTCOG AVE



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April 29, 2016





North Central Texas Council of Governments

From: North Central Texas Council of Governments
Date: April 29, 2016
Subject: 2016 TIGER Discretionary Grant Application

This 2016 TIGER Discretionary Grant application is submitted by the North Central Texas Council of Governments (NCTCOG), the Metropolitan Planning Organization for the Dallas-Fort Worth area, on behalf of the towns, cities, transit agencies, Texas Department of Transportation, North Texas Tollway Authority and private-sector partners that operate the roadway and transit systems within the region. This application, if awarded, will connect and integrate more than 23 different agencies to the proposed regional fiber optic cable communications network.

The North Central Texas region includes more than 6.9 million residents, and is expected to grow to nearly 10.7 million people by 2040. While the region's population is anticipated to increase by 48 percent and employment by 46 percent between now and 2040, new roadway capacity is expected to increase by only 13 percent and the rail network is expected to nearly triple. Based on these statistics, the operations and integration of the existing infrastructure is critical to keep people and goods moving within our region.

The fiber optic integration and connections between agencies will allow for data exchange, integrate system operations, balance demand between modes, and provide interoperability with future technologies. Regional partners embrace the opportunity to connect and share communication networks throughout the North Central Texas region to provide seamless transportation systems to the users. This allows for future cost savings through more efficient roadway and transit operations, sharing of resources from infrastructure and personnel, as well as integrate operations across modes to provide options and reliability to the users of our existing transportation infrastructure.

This application will expand regional communication networks, connect critical gaps, link additional agencies and implement technology to advance connected vehicles. The project will reduce congestion of idling vehicles, which reduces emissions and promotes economic vitality through improved safety and operations of the existing transportation system.

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Basic Project and Contact Information

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Project Location:

The project location is in the Collin, Dallas, Denton and Tarrant counties. This project will integrate systems to better share resources in the Dallas-Fort Worth Region, allowing data exchange, system operation, system balance between modes and interoperability with future technologies. This application will leverage and enhance the billions of dollars of traditional roadway investments and transit investments that have been made recently in Dallas-Fort Worth by operating the system in an efficient and integrated method.

Amount of Grant Requested for the Project:

The grant request amount is \$10 million.

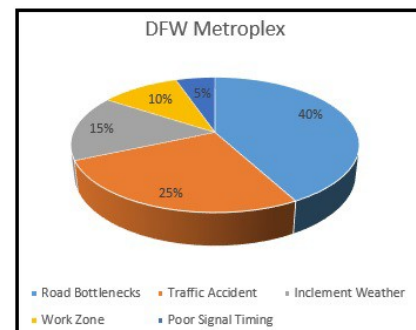


Executive Summary

With the Dallas-Fort Worth (DFW) urban area as its center, the North Central Texas region plays an important role in the State of Texas, as well as the entire southwestern United States. The region provides critical air and ground transportation hubs for the movement of people and goods throughout the United States and internationally. The North Central Texas region has an estimated 6,954,330 residents, making it the largest metropolitan area in the South. The area's population has grown by about one million since the last census was administered in 2000. This region is, by population, the largest metropolitan area in Texas, the fourth-largest in the United States, and the tenth-largest in the Americas.

In 2013, Dallas-Fort Worth had the sixth largest Gross Domestic Product (GDP) among the nation's largest metropolitan statistical areas. In addition, the region brought in nearly \$448 billion in GDP, according to information released May 26, 2015 by the United States (US) Department of Commerce's Bureau of Economic Analysis¹, compared to the United States' GDP of \$16.8 trillion.²

The North Central Texas region encompasses 5,563 lane miles of freeways/tollways, 299 lane miles of express/high occupancy vehicle/tolled managed lanes, 9,196 lane miles of regional arterials, 89 miles of light rail transit and 54 miles of commuter rail transit. The region has the second largest number of freeway-miles per capita in the nation. However, road bottlenecks create 40 percent of traffic congestion and delays, followed by traffic accidents at 25 percent, inclement weather at 15 percent, work zones at 10 percent, poor signal timing at 5 percent and other causes constitute 5 percent. The operation and maintenance of these systems is critical to provide reliable and safe transportation options for the movement of passengers and freight.



The region has identified numerous mechanisms that can be used to reduce congestion and delay, thereby reducing the emissions and fuel consumption associated with acceleration and idling vehicles, reducing the trip time, increasing safety, and improving system and travel time reliability. All of these factors contribute to improving the quality of life for residents and visitors to the North Central Texas region and to its environmental sustainability and economic viability.

Among these mechanisms are existing Intelligent Transportation Systems (ITS), incident management and a traveler information system. Additional needs include completion of

¹ DFW Had Sixth Highest GDP in the Nation. (2014, 9 17). *Biz Journals*. Retrieved 5 30, 15, from 1. <http://www.bizjournals.com/dallas/news/2014/09/17/dfw-had-sixth-highest-gdp-in-the-nation-in-2013.html>

² The World Bank. (n.d.). *Data - GDP (current US\$)*. Worldbank. Retrieved 31 5, 15, from 2. <http://data.worldbank.org/indicator/NY.GDP.MKTP.CD>



the region's ITS and implementation of new technologies to share information with motorists and between agencies. The Regional Connection through Technology and System Integration (RCTSI) project is uniquely qualified to collect, process, and disseminate information, as explained below.

Collection, aggregation, and dissemination of information from various dependable sources are essential functions of ITS. Sharing of data, video, fiber optic cable, and other resources requires agreement among the parties to ensure expectations are met and to reduce legal entanglements. The Regional Comprehensive Intelligent Transportation Systems (ITS) Memorandum of Understanding is the fundamental agreement that initiated regional cooperation in the Dallas-Fort Worth area. The signed agreement is included in Appendix C.

Project Description

The North Central Texas Council of Governments (NCTCOG) is applying for a 2016 TIGER Discretionary Grant to connect and expand the existing infrastructure to monitor, manage and balance the transportation system in real-time. This application will expand the regional communication network, connect critical gaps, link additional agencies and implement a technology to advance connected vehicles in the core four-county area, including Collin, Dallas, Denton, and Tarrant counties. The project will address areas of environmental justice concern, focus on reduction in idling vehicles to reduce emissions and promote economic vitality through improved safety and operations of the existing transportation system. These connections will open communication to key regional partners to leverage resources to improve incident response, traveler information and identification of alternative routes or modes.

This connection network can be used for better communication within and between agencies and municipalities' Transportation Management Centers (TMC) and other implemented ITS devices around the North Central Texas region, in addition to providing other benefits. The ability for North Central Texas agencies and municipalities to be connected to the regional fiber optic network will provide essential data and communication to the entire region.

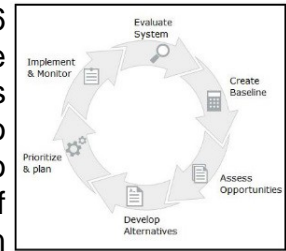
Eliminating the physical and organizational communication gaps via fiber optic connections throughout the North Central Texas region will have a synergistic effect. First, large cities can connect their developing ITS infrastructure to share benefits with the region and state. The connection will help our cities justify and reap the benefits of future ITS investments because of the regional data sharing opportunities the fiber optic network will now provide. Furthermore, our fire and police departments will be able to leverage an extensive network of communications to improve incident response, law enforcement, and infrastructure operations, helping to eliminate barriers and connect communities.

This application will provide an extensive contribution toward providing travelers and commercial vehicle operations with real-time travel information, while increasing the efficiency of our transit systems and roadway infrastructure. Benefits resulting from advanced traveler information, traffic management, and incident management



implementations will provide significant cost savings to the traveling public, as well as to public agencies.

The region has implemented over 423 miles of fiber optic cable and 226 miles of wireless communication infrastructure that constitute the existing regional communication network. In addition, the region is currently constructing 75 miles of fiber optic cable to continue to connect agencies, fill in gaps, and expand regional coverage to monitor the transportation system. The operation and maintenance of this transportation investment cost the region approximately \$39 million per year.



As indicated above, communication infrastructure has been and continues to be installed within the North Central Texas region. Traffic monitoring and incident detection and response systems are operating on portions of the freeway system in Collin, Dallas, Denton, and Tarrant counties. The Texas Department of Transportation (TxDOT) Dallas and Fort Worth Districts each manage and operate TMCs in the Dallas and Tarrant counties.

In addition, the North Texas Tollway Authority (NTTA) manages and operates the TMC for its toll road facilities, while LBJ Express and NTE Express are private-sector partners that operate two of the managed lane facilities within the region. ITS components of TxDOT, NTTA and the private-sector partners' TMCs include communication networks (fiber optic cable and wireless networks), closed-circuit television (CCTV), lane control signals, dynamic message signs (DMS), mobility assistance patrols, and vehicle detectors on limited access facilities.



City of Grand Prairie TMC

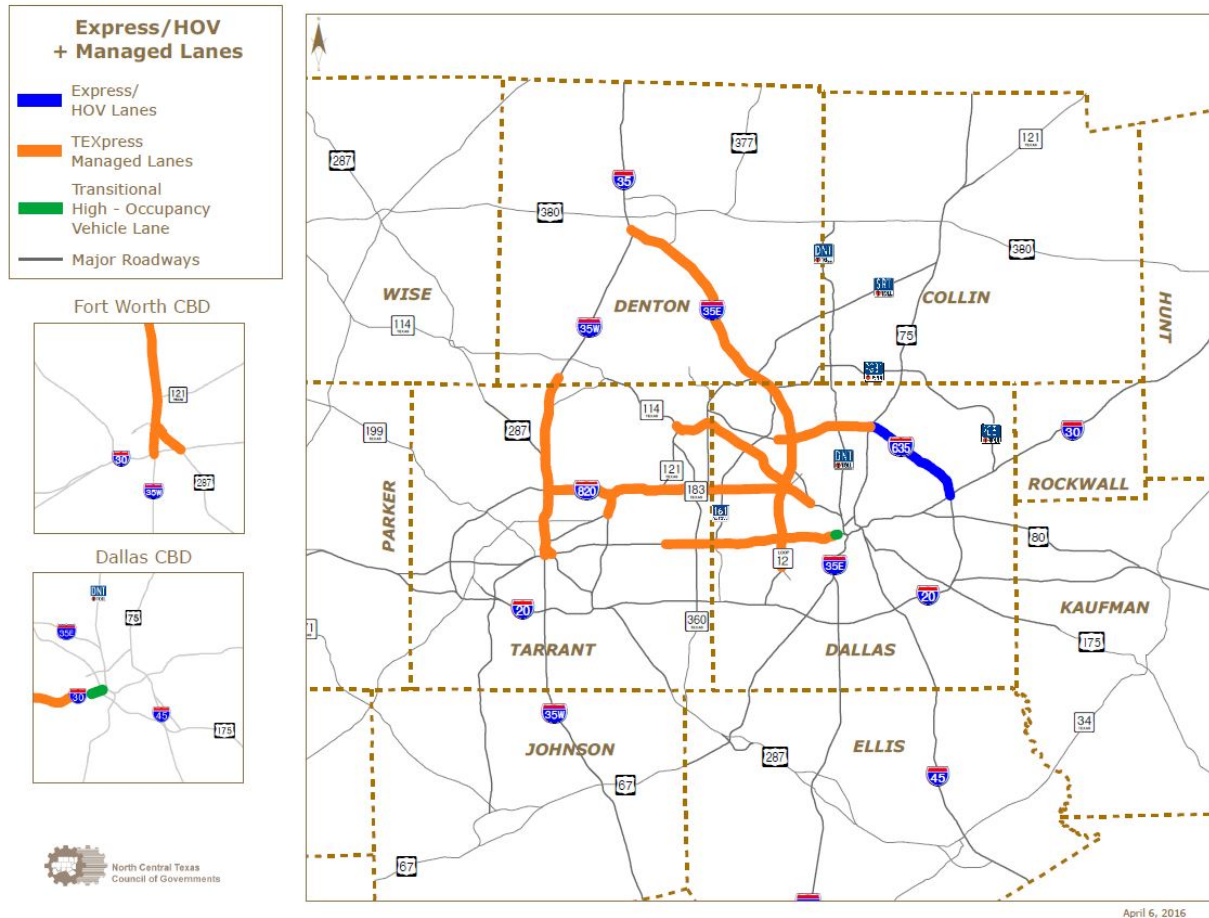
In addition to the TMCs mentioned above, there are city TMCs and transit management centers throughout the region. City TMCs manage closed-circuit television, dynamic message signs, lane control signals, and traffic signals on the arterial street system. Some cities in the region also include traffic signal preemption systems for emergency vehicles and for transit vehicle progression. The transit management center's ITS components include transit vehicle tracking, in-vehicle navigation, integrated radio system/automated vehicle location, and automated fleet maintenance systems. User expectation, anticipated funding opportunities, agency policies, and existing investments in ITS infrastructure reveal that a regional, single-site, single-agency solution is not a viable ITS alternative for the North Central Texas region. The approach for this region is a distributed model where data and video are a shared resource. This application will enhance efforts underway to establish sharing of communication infrastructure, data and video among regional partners.

To continue to advance Connected Vehicles (CV) deployment in our region, NCTCOG is proposing technology along a test corridor, the IH-30 managed lanes corridor. The vision for the region is to advance CV technology through the existing and planned managed lane facilities to allow these vehicles to operate on barrier separated facilities as the users of the system transition to operating vehicles with this capability. This will allow a safe environment



for users that operate vehicles equipped with necessary capabilities, as well as users operating vehicles without the capabilities. Users operating advanced vehicles use the managed lanes and users without advanced vehicles could utilize the general purpose lanes. A map of the managed lane system is provided below.

Dallas - Fort Worth Managed Lane System



Connected Vehicle (CV) technologies are being implemented and evaluated to provide communications between vehicles, transportation management centers and agency staff. CV can be further defined as Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I) and Autonomous Vehicles (AV). If funded, the Regional Connections through Technology and System Integration (RCTSI) project, will provide V2I, employing the most established and controllable of these technologies.





This project will deploy Vehicle to Infrastructure (V2I) technology to help ensure interoperability, improve safety and provide efficient and effective operations on IH 30 managed lanes from Cooper Street in the City of Arlington

to Sylvan Avenue in the City of Dallas, a distance of approximately 18 miles. When complete, the project will:

- Allow data and information from many sources to be combined in real-time;
- Provide real-time traveler information to drivers;
- Improve mobility and further enhance safety through vehicle interaction with the road infrastructure;
- Encourage additional carpooling and transit use of the managed lanes as well as provide a staging area for transit connections to and from entertainment districts along the IH 30 corridor.

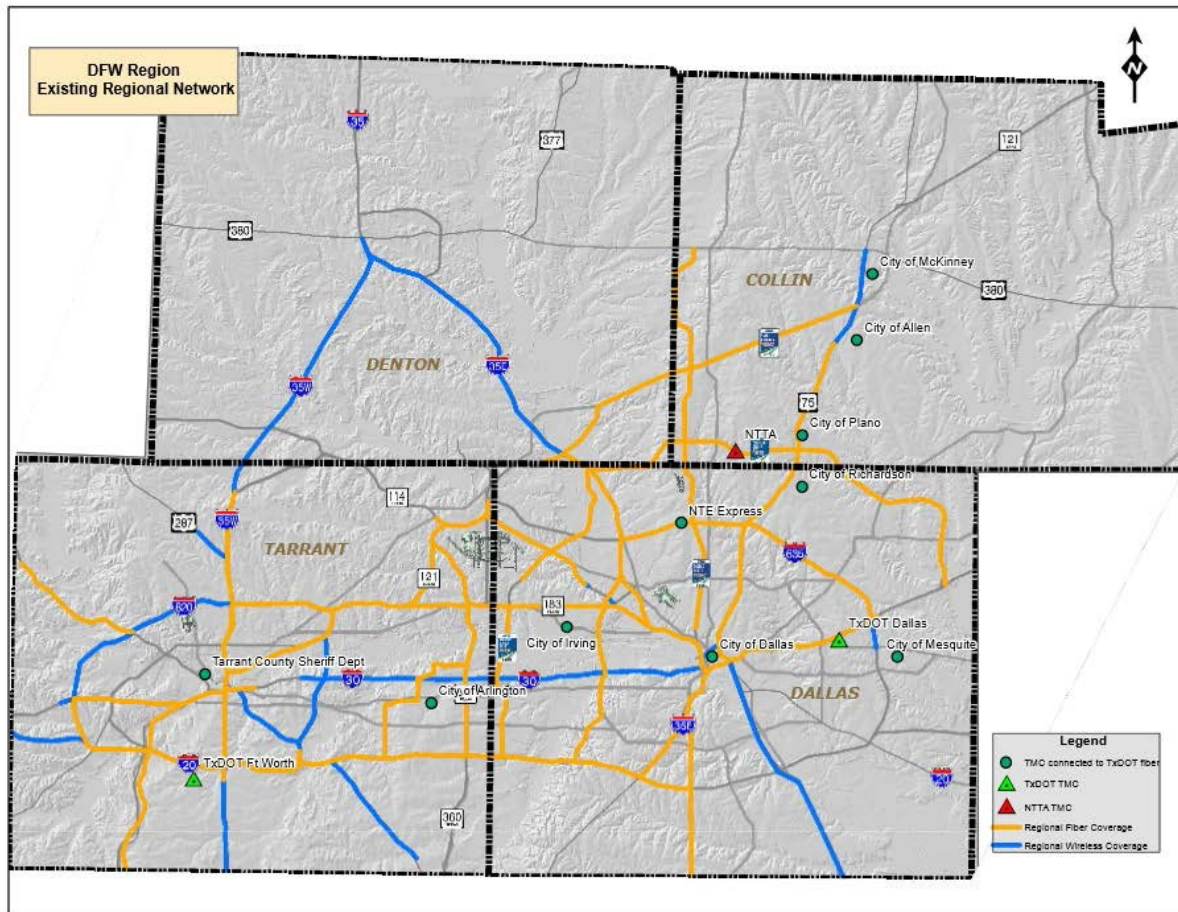
Proposed Project Components

Regional Communication Network

To leverage the existing communication infrastructure, communication switches will need to be purchased and installed to separate the network from the individual agencies' networks. Regional partners have committed to reserving and sharing at least two strands of each fiber optic link for the regional communication network. This project will create a regional network utilizing the existing 423 miles of fiber optic cable and 226 miles of wireless networks. If funds are granted for this project, an additional 134 miles of fiber optic cable will be added. To support this network, 16 switches will need to be installed. A fiber management software solution will be employed to optimize, manage and maintain the fiber optic communications infrastructure, as well as support more efficient and reliable design efforts for future improvements. The map below provides a regional overview of the existing regional communication network.



ITS Existing Network



Connecting Partners

The current network includes connections to the ten (10) partner agencies indicated below:

1. City of Plano
2. City of Mesquite
3. City of Irving
4. City of Grand Prairie
5. City of Arlington
6. City of Allen
7. City of Richardson
8. City of Dallas
9. LBJ Express/ North Tarrant Express
10. Tarrant County Sheriff's Office



As part of this project, the region plans to connect thirteen (13) additional agencies. To support this network, 16 switches will need to be installed, including:

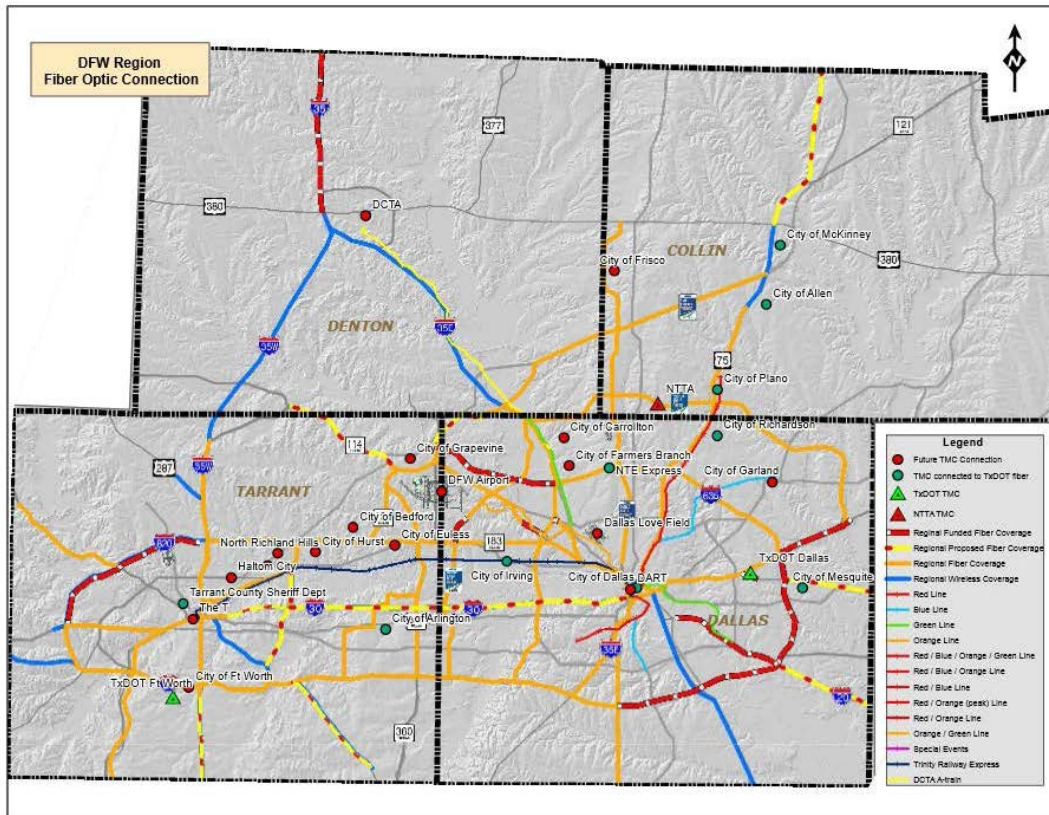
1. City of Bedford
2. City of Carrollton
3. City of Euless
4. City of Farmers Branch
5. City of Fort Worth
6. City of Frisco
7. City of Garland
8. City of Grapevine
9. City of Hurst
10. Dallas Love Field Airport
11. DART
12. DCTA
13. DFW Airport
14. The – T



TxDOT Dallas District TMC



The map below provides a regional overview of the existing regional communication network.



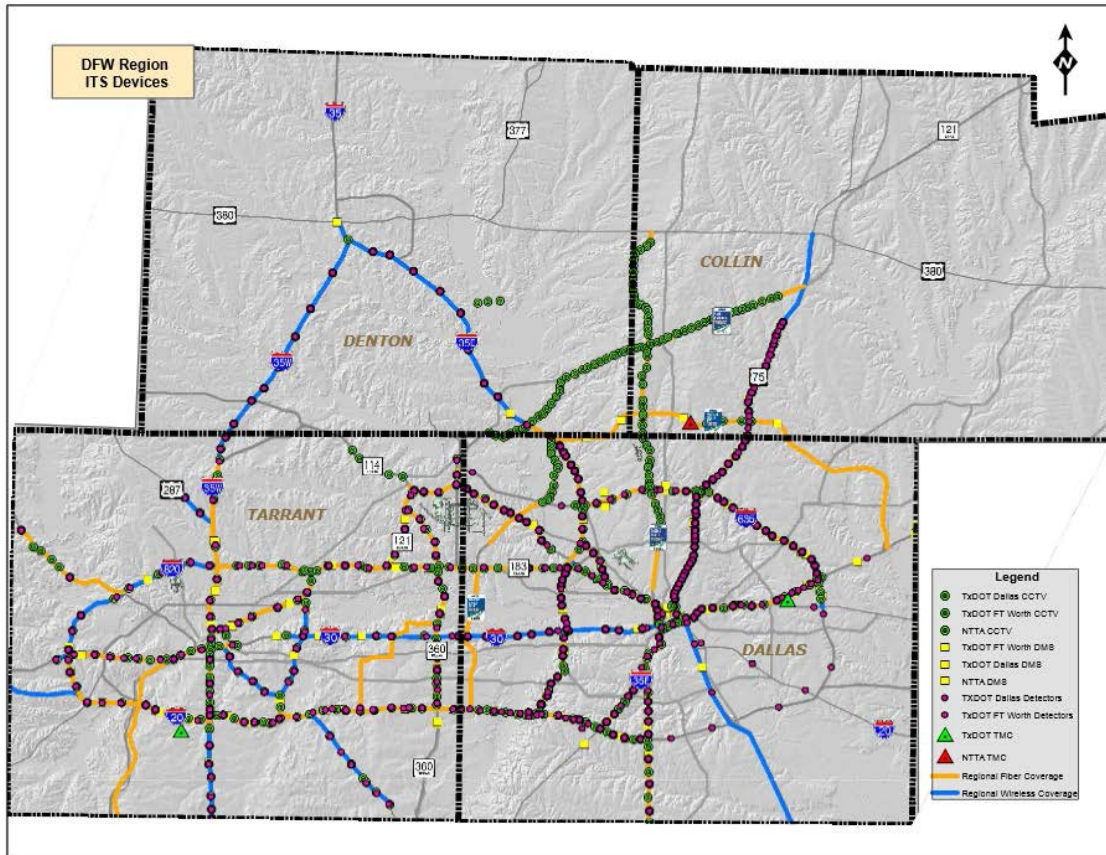
System Integration

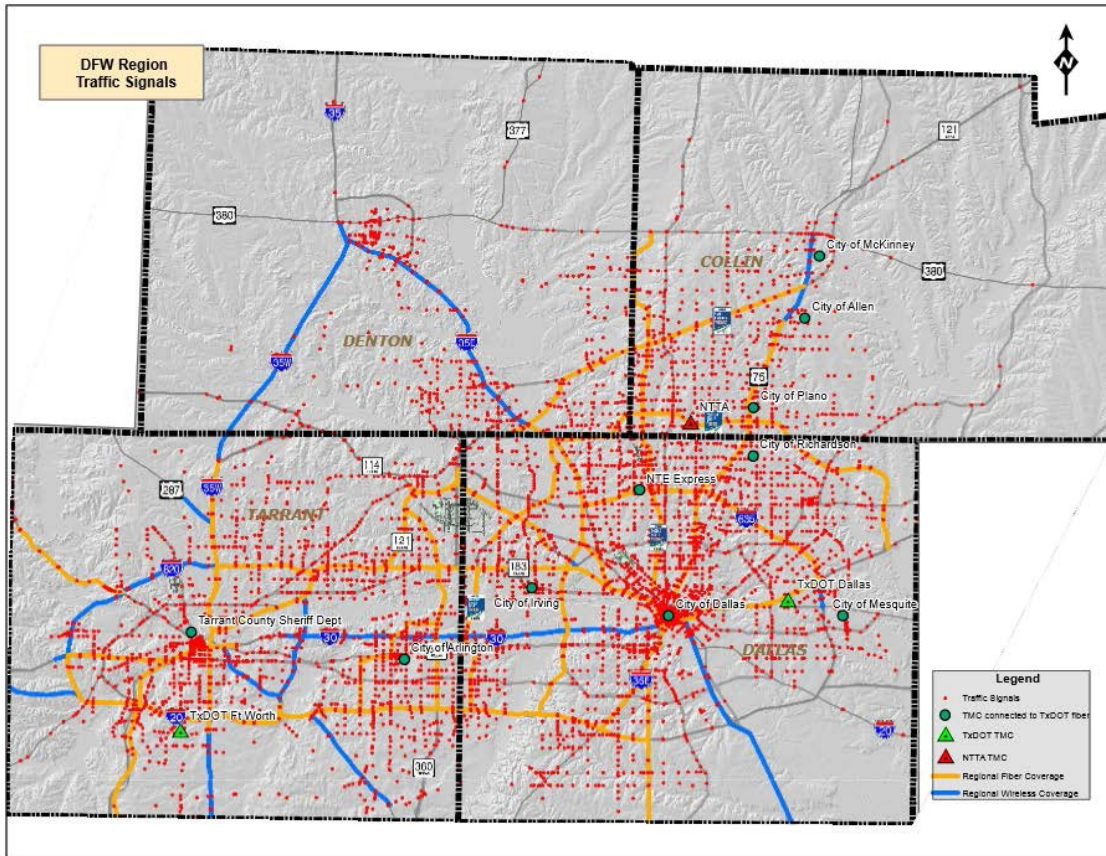
In addition to providing infrastructure connections, it is also critical to provide software integration to allow for the sharing and exchange of data and video. Approximately one (1) Existing system will need to be upgraded and approximately thirteen (13) new systems will be integrated as part of this proposal. The goals and objectives of the C2C software are outlined below:

- Provide a common repository for traffic information for the DFW region.
- Provide an internet-based graphical map interface to display traffic conditions in the DFW region.
- Provide an application that will allow agencies without a formal TMC to participate in the C2C infrastructure and information sharing.
- Provide a system which supports ITS C2C communications for command, control, and status of various ITS field devices including Dynamic Message Signs, Lane Control Signals and Closed Circuit Television Cameras.
- Provide a system which supports ITS C2C communications for command, control, and status of traffic signals on arterials.
- Utilize National ITS standards to implement the project.
- Provide a software system that is extensible to all local or regional partners. This would allow a local common repository to be created by linking individual partners, a regional common repository to be created by linking local common repositories.



By integrating these systems through a shared communication network, eliminating gaps and making critical connections, the region will leverage the existing regional infrastructure as well as new infrastructure as it comes online. This includes 589 CCTV, 147 DMS, 684 vehicle detection sites, over 5,000 traffic signals, transit vehicle locations, transit priority and traffic signal preemption. The region has been working toward a regional network for many years with a lack of funding to fully support the effort. The maps below provide an overview of the CCTV, DMS, vehicle detection sites and traffic signals in the region.





IH-30 Managed Lane Connected / Automated Vehicle Test Bed Equipment



Connected Vehicle (CV) technology provides wireless connectivity between vehicles to prevent crashes, and between vehicles and the infrastructure to enable safety, mobility, and environmental benefits. Dedicated Short Range Communication (DSRC) enables Vehicle-to-Vehicle (V2V) wireless communications. Using V2V connectivity, vehicles are able to exchange data with low latency to support a new generation of active safety and mobility applications.

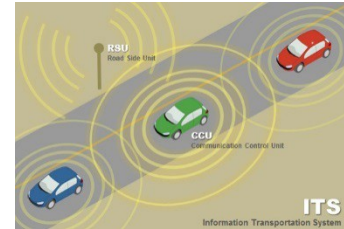
Furthermore, Vehicle-to-Infrastructure (V2I) and infrastructure to vehicle wireless communications provides a medium to exchange critical safety and operational data between vehicles and roadway infrastructure and vice versa. In addition to safety and mobility benefits, the system of connected vehicles and infrastructure will provide a wealth of transportation data for planning, operations, and maintenance of roadway infrastructure, assisting agencies in the region to implement ladders of opportunity for



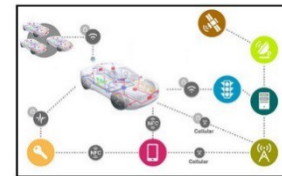
their communities.

To move these future technologies into the real-world, the North Central Texas region is establishing the IH-30 managed lane corridor as a connected and automated vehicle test bed for integrating the data and systems with traditional technologies. The technologies planned for deployment in this corridor are as follows:

Roadside Units (RSU) – Roadside units are needed to send and receive data from onboard vehicle units. On board units are needed to receive warnings from the RSUs and send position and information to RSU for V2I connectivity. These radios enable communication between vehicles and infrastructure. Roadside units can be attached to existing utility and camera poles, dynamic message signs, and toll gantries and share a power source. Backhaul communication such as fiber optic cable, which is requested as part of this project to collect information and to transmit it between the RSU and a central server.



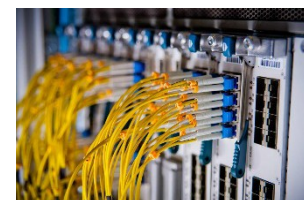
Vehicle Awareness Device (VAD) – VAD is a type of on-board unit (OBU) that securely and privately transmits vehicle speed and location to other vehicles and RSUs in the immediate area.



Aftermarket Safety Device (ASD) – ASD is also a type of OBU and is similar to VAD, but it receives speed and location from other vehicles. It uses information about the positions of other vehicles to provide drivers with audio warnings if the threat of a crash exists. Most OBUs in the market include both transmitting and receiving capabilities.

Data Acquisition Systems (DAS) – DAS is also a type of OBU, which collects video and data on driver performance allowing researchers to learn how drivers interact with the ASD and how drivers respond when warnings and information are presented to them.

Fiber Optic or Wide Area Network - Connectivity is needed to transfer large amounts of data from the RSUs and ITS devices to a central server. As part of this project, the fiber optic backhaul will be available on IH-30 to transmit data.



4G/LTE Coverage – While DSRC by design has short range but much higher bandwidth, advanced warnings may be relayed to OBUs using 4G/LTE connectivity instead of RSUs. Because IH-30 is a highly utilized corridor, it would be reasonable to assume that cellular carriers have strong signals along the corridor. There will be opportunities to utilize the technologies being deployed by the private sector.



Traditional ITS Devices – Traditional ITS devices such as Wi-Fi sensors and vehicle detectors are required to measure vehicle volume pattern, speed, and congestion levels. This information is processed in a remote server and relayed to the ASD via RSUs.

Project Parties

The RCTSI project will create a more efficient transportation management, data collection, and information sharing system for the benefit of motorists and partner agencies. The project encompasses multiple modes of transportation and a variety of facilities. It also encompasses multiple operating agencies with various responsibilities for providing transportation services. These agencies include 23 cities, four counties, two state department of transportation districts, three transit agencies, a regional tolling authority, two private Comprehensive Development Agreement (CDA) operators, a metropolitan planning organization and a large number of local emergency service providers. While the various agencies operate in a cooperative manner to the best of their abilities, there are limited systems and tools currently available for integrated, coordinated operation. These systems and tools will be greatly increased by the RCTSI project.



For example, a major incident may occur on a freeway which blocks lanes for an hour or more. Drivers may reroute based on information from Dynamic Message Signs (DMS) or from Information Service Providers (ISPs). There are opportunities for a modal shift to transit, a travel schedule shift or a route shift if there is a mechanism in place for the affected agencies to act. Even with recurrent congestion, there exists an opportunity for modal, schedule, or route shifts with exchange of information

among agencies and communication with the traveler. Such exchange of information and an action plan can better balance available capacity either in time or space. In case of either recurrent or non-recurrent conditions, agencies can act in a coordinated manner with exchange of information.

By integrating these systems through a shared communication network, eliminating gaps and making critical connections, the region will leverage the existing regional infrastructure as well as new infrastructure as it comes online. This includes 420 miles of fiber optic cable, 589 CCTV, 147 DMS, 684 vehicle detection sites, over 5,000 traffic signals, transit vehicle locations, transit priority and traffic signal preemption.

Grant Funds and Sources/Uses of Project Funds

NCTCOG is requesting a total of \$10,000,000 in assistance from the 2016 TIGER Discretionary Grant Program. The total project cost is approximately \$15,000,000. Table 1 below indicates the project costs and funding sources. In addition, Table 1 provides the funding breakdown by major task including the Regional Fiber, TMC Connections, Software Integration, and IH-30 Managed Lane Connected/Automated Vehicle Test Bed. It also differentiates between what is currently implemented, funded but not yet installed, and unfunded which would be constructed with 2016 TIGER Discretionary Grant approval.



Table 1: Project Cost & Funding

Existing Infrastructure							
	Fiber			Switches			Grand Total
	# Miles	Cost per mile *	Total	Number of Switches	Cost	Total	
Fiber Optic Communications	423	\$55,000	\$23,265,000	44	\$19,000	\$836,316	\$24,101,316
Wireless Communications	226	\$1,000	\$226,000				\$226,000
	Number of Agencies****	Cost per mile **	Total	Agencies	Cost	Total	
TMC Connections	10	\$55,000	\$1,100,000	10	\$19,000	\$190,000	\$1,290,000
	Number of Agencies****	Hardware (encoders and decoders for video)***	Software Integration	Existing Connections Needing Upgrades		Total	
Software Integration	10	\$41,600	\$240,000			\$2,816,000	\$2,816,000
Total							\$28,433,316

Funded Components							
	Fiber			Switches			Grand Total
	# Miles	Cost per mile *	Total	Number of Switches	Cost	Total	
Fiber Optic Cable	75	\$55,000	\$4,125,000	8	\$19,000	\$148,283	\$4,273,283
Total							\$4,273,283

Unfunded Components							
	Fiber			Switches			Grand Total
	# Miles	Cost per mile *	Total	Number of Switches	Cost	Total	
Roadway Fiber Optic Cable	100	\$55,000	\$5,500,000	10	\$19,000	\$197,711	\$5,697,711
Transit Fiber Optic Cable	34	\$55,000	\$1,870,000	4	\$19,000	\$67,222	\$1,937,222
Engineering (10%)							\$763,493
	Number of Agencies****	Cost per mile **	Total	Agencies	Cost	Total	
TMC Connections	13	\$55,000	\$1,430,000	13	\$19,000	\$247,000	\$1,677,000
Engineering (10%)							\$167,700
	Number of Agencies****	Hardware (encoders and decoders for video)***	Software Integration	Existing Connections Needing Upgrades		Total	
Software Integration	13	\$41,600	\$240,000	1		\$3,942,400	\$3,942,400
IH-30 Connected / Automated Vehicle Test Bed Equipment					Quantity	Unit Price	
Road Side Unit (RSU) and Accessories)					26	\$8,000	\$208,000
Vehicle Awareness Devices (VAD) and Aftermarket Safety Devices (ASD)					200	\$400	\$80,000
Data Acquisition System (DAS) Units					10	\$6,000	\$60,000
Wi-Fi/Bluetooth Sensors and Accessories					10	\$6,000	\$60,000
Vehicle Detectors and Accessories to Measure Volume and Speed					10	\$8,000	\$80,000
High-End Servers, Work Stations and Cloud Connectivity					1	\$25,000	\$25,000
Labor for High-Level and Detail Requirements, Application Deployment, and Field Operational					1	\$200,000	\$200,000
Engineering (10%)							\$71,300
Total							\$14,969,826

* Base on US DOT Equipment Unit Cost

** 2 Miles Max

***Maximum of eight encoders and decoders per agency ~ \$2,600 per device. of agencies from 16 to 13.

*****Match includes Congestion Mitigation and Air Quality Improvement funds, state funds, local funds and Regional Transportation Council local funds.

TIGER Grand Total	\$14,969,826
Rounded TIGER Grand Total	\$15,000,000
Match*****	\$5,000,000
TIGER Request	\$10,000,000



Primary Selection Criteria

The North Central Texas Council of Governments believes that the RCTSI project enhances quality of life and economic competitiveness by improving the operations of the existing transportation system. This project shares data and video across modal and jurisdictional boundaries improving mobility and safety for the users of the transportation system. This project is aligned with the Federal Highway Administration's (FHWA's) Integrated Corridor Management and Connected Vehicle vision and will implement that vision across the North Central Texas region.

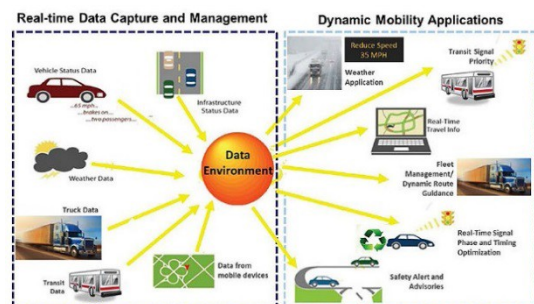


State of Good Repair

The RCTSI will contribute to optimal use of the regional transportation system network capacity in several ways. As availability of real-time travel information to motorists on a network-wide scale increases, drivers will have the information necessary to avoid delay, resulting in less congestion along high-use routes and overall better utilization of the entire transportation network.

In 2000, a communication analysis was completed with regional partners agreeing to contribute two strands of every fiber link to be part of a regional ITS fiber network. This included TxDOT, toll authorities, cities, counties and transit agencies. Since that time, a high-level design was completed and the region engaged Emergency Operations Centers in this regional partnership. Regional partners have developed a list of deal points and a draft Memorandum of Understanding agreement to accomplish this interagency communication goal through a cooperative review process.

NCTCOG has been working with regional partners and most recently with TxDOT to develop an ITS Field Device Data Quality Plan to ensure devices continue to work to their full potential. This plan will monitor various maintenance issues, assess impacts on mobility, identify the problem and respond to reduce congestion and environmental impacts of malfunctioning equipment, incidents or system outages. The data from these devices used for planning purposes will also be of better quality and reduce the need for additional field data collection. This will reduce the mobility interruptions due to field data collection and save money to be used for other transportation needs.



Economic Competitiveness

North Central Texas is a major economic, social, and political center of both Texas and the United States. The Dallas-Fort Worth area represents 34 percent of the state's economy and is the twelfth largest metropolitan economy in the world and sixth largest in United States. The region supports a diverse economy and is home to 24 Fortune 500 companies. By 2040, the region is expected to experience a 48 percent increase in population and a 46 percent increase in employment. The transportation system is critical to regional and national viability because it allows for the efficient movement of people and goods. The IH-35 NAFTA Corridor traverses the region, with important freight facilities including the Fort Worth Alliance Airport, the Dallas Intermodal Terminal rail facility, the Union Pacific Mesquite Terminal rail facility and the Tower 55 rail facility. Without adequate transportation operations and integration to ensure a high level of mobility, the region will be challenged to sustain economic growth. This is an important reality for the continued prosperity of the region.

Quality of Life

The quality, safety, effectiveness and efficiency of a region's transportation system directly affects both the quality of life and the standard of living of its residents and visitors, the businesses operating within the region and all those people and goods which move through it. Advance information about unavoidable delays can provide travelers the opportunity to allow adequate travel time to reach a destination, to make essential arrangements such as purchasing fuel, and supplies, make comfort stops, and advise others in advance of potential delays. Implementation of fiber optic cable and V2I is essential to providing this information.

The delays associated with congestion cause stress and frustration, late arrival of drivers, passengers and freight, directly leading to a reduction in quality of life. Recurrent congestion leads travelers to the need to plan travel at suboptimal times and use routes that are less than ideal. Concerns about congestion can lead travelers to forgo desired activities, such as participating in special events. Delays often have a cascading effect on travelers' activities. The negative effects of congestion are compounded when they threaten essential activities, such as fire and emergency assistance response, medical personnel arrival at hospitals, flight crew arrival at airports, and Just in Time freight deliveries, to name a few. Congestion reduces the availability and usability of the regional roadway facilities and impacts most aspects of everyday life. Completing the fiber optic communications which deliver the regional ITS data will reduce congestion, connect communities and improve the quality of life in the North Central Texas region.



Estimating the true cost of congestion requires consideration of all its impacts on society. The Texas A&M Transportation Institute (TTI) estimates that, in 2011, congestion in 498



metropolitan areas caused urban Americans to travel 5.5 billion hours more and to purchase an extra 2.9 billion gallons of fuel for a congestion cost of \$121 billion³. The volume of freight movement alone is forecast to nearly double by 2020.

Congestion has the additional impact of increasing the likelihood of crashes. Crashes contribute to an increased cost of living, reducing expendable income for the region's travelers and residents. The results of crashes can be directly linked to increased costs of insurance and health care, the environmental impacts of producing otherwise unnecessary vehicles and parts, lost productivity and wasted time.

All of these negative factors result in a reduced quality of life for the region's population and visitors. ITS and connected vehicle technologies, such as V2I, can increase crash avoidance by providing immediate information and warning to drivers. Vehicles with built in crash avoidance systems from manufacturers will have an additive function to the safety and other messages that will be provided through V2I. Avoiding crashes will provide an improvement to the quality of life in the North Central Texas region.

Environmental Sustainability

Clean air, water, and the availability of open space for recreation and wildlife habitat is a central quality of life consideration for the residents of North Central Texas. It is important to consider the impacts the transportation system has on environmental resources such as air quality. Supporting a broad approach to assessing conservation goals and opportunities to improve the decision-making process through data exchanges and partnerships is an essential step in advancing the efficient delivery of transportation projects. The RCTSI project will offer the opportunity to provide these data sharing methods and enhance the environment in the North Central Texas region.



It is important to consider the impacts that the transportation system has on environmental resources such as air quality. The North Central Texas region is a non-attainment area for ozone and a maintenance area for carbon monoxide. This project supports a broad approach to assessing conservation goals and opportunities to improve the decision-making process through data exchanges and partnerships as an essential step in advancing the efficient delivery of transportation projects.

In addition to air quality, other environmental conditions are subject to being improved through the use of ITS and connected vehicle technologies. These include improved water quality, reduced soil contamination and less pollution based impacts to wildlife.

³ (Source: [2012 Urban Mobility Report](#), TTI).



Safety

The project enhances safety issues on the regional network by improving more interagency real-time traffic information data sharing and vehicle interaction with the road infrastructure. The project will strongly increase capabilities of processing and sharing information that can prevent potential primary and secondary crashes, keep traffic moving, and decrease the negative environmental impacts of the transportation sector on society.



Transportation and emergency responders from various agencies will quickly identify and respond to incidents using real-time data. First responders will be able to clear primary incidents more efficiently and in turn it will help reduce secondary crashes. Furthermore, it will reduce exposure of first responders to hazards related to traffic. According to the U.S. DOT, ITS can reduce response and clearance times by up to 20 percent and reduce secondary crashes by a similar amount (USDOT, Intelligent Transportation Systems for Traffic Incidents Management, January 2007).

Traveler Information Systems will reduce incident related driver stress as users will be able to make informed decisions regarding trip departures, routes, and mode of travel through applications using a variety of technologies such as Internet websites, traveler information systems including 511DFW, Dynamic Message Signs and television and radio. According to the U.S. DOT ITS Joint Program Office's Developing Traveler Information Systems Using the National ITS Architecture, effective Traveler Information Systems help users to avoid a dangerous situation, or to feel protected in the event of a severe accident or other emergency.

NCTCOG has partnered with universities in the region to enable the Collaborative Adaptive Sensing of the Atmosphere (CASA) program, providing early detection of tornadoes and tornadic activity. This and other weather information will employ the benefits of RCTSI to allow travelers and others to avoid the hazards of severe weather, including flooding and high winds. Recently, TxDOT in partnership with the National Weather Service has incorporated weather information and severe weather messages as part of the LoneStar TMC software.



The vision of the Connected Vehicle (CV) is to test connected vehicle safety applications in real-world driving scenarios in order to determine their effectiveness at reducing crashes and to ensure that the devices are harmless and do not unnecessarily distract motorists or cause unintended consequences. In addition, the critical safety data exchange between vehicles and infrastructure through V2I technologies can increase crash avoidance by providing immediate information and warning to drivers. Vehicles with built in crash avoidance systems from manufacturers will have an additive function to the messages that will be provided through V2I.



The exchange of information between vehicles and an intelligent infrastructure will provide experience and capability leading to more autonomous functions. The ultimate benefits of a transportation system that is fully connected and information rich is to be able to address safety, mobility, and environmental impacts. This will be experienced by every commuter in the region delivering extensive benefits to our communities and visitors.

Secondary Selection Criteria

The RCTSI project addresses the secondary criteria in the areas of innovation and partnership. If this project is funded, the region will benefit from an integrated system that will provide improved operations for a multi-agency, multi-modal and multi-functional transportation system.

Innovation

This project seeks a solution to a growing region with growing traffic problems by targeting resources to operational management and travel demand reduction strategies. Filling in gaps, sharing resources and connecting operational agencies allows the transportation system to appear seamless to the users of the system. This project will leverage existing communications to get the most out of the existing transportation system through providing traveler information, improved operations of traffic control devices and balancing the load across the entire corridor capacity.

Partnership

NCTCOG has been working with regional partners to bridge the communication gap between TxDOT, local government, transit agencies, tollway authority, private- sector partners and emergency responders regarding the exchange of data and video through a regional fiber network. This regional fiber network is envisioned to utilize TxDOT dark fiber in addition to fiber provided by other regional partners including, but not limited to, the North Texas Tollway Authority, Dallas Area Rapid Transit, Fort Worth Transportation Authority, and local governments.



The types of information that would be exchanged include closed circuit television (CCTV), traffic signals, speed sensors, roadway incidents, and video teleconference capabilities during regionally significant catastrophic events and other large special events. NCTCOG feels all these data types affect transportation directly and the information should be freely exchangeable on the regional fiber network between regional partner agencies.

This is the primary emphasis of the national/regional ITS architecture in terms of duplication of services and integration of systems. If one fiber network can be shared between regional partners, we can save taxpayer dollars, use pooled resources to expand our network area, remove the silos of governmental agencies, and build partnerships. We feel this is the primary emphasis for establishment of the



national/regional ITS architecture by the Federal Highway Administration.

Benefit Cost Analysis

A Benefit Cost Analysis for a period of 20 years, the life span of the project, was performed in order to determine the financial and economic feasibility of the project. The total benefits were divided into Baseline benefits and benefits for the 2016 TIGER Discretionary Grant portion of the project. This used a simple proportional method, based on project components available without and with TIGER grant funding. The following sections summarize the costs and benefits of the baseline system and the proposed project.



Infrastructure Baseline without TIGER Grant Funds

To leverage the existing communication infrastructure, communication switches will need to be purchased and installed to separate the network from the individual agencies' networks. Regional partners have committed to reserving and sharing at least two strands of each fiber optic link for the regional communication network. This project will create a regional network utilizing the existing 423 miles of fiber optic cable and 75 miles of funded fiber optic cable. If funds are granted for this project, an additional 134 miles of fiber optic cable will be added. To support this network, 16 switches will need to be installed. In addition, 10 agencies within the region are currently connected. This project plans to connect an additional 13 agencies. By connecting and integrating these agencies' systems through a shared communication network, eliminating gaps and making critical connections, the region will leverage the existing regional infrastructure as well as new infrastructure as it comes online. This includes 589 CCTV, 147 DMS, 684 vehicle detection sites, over 5,000 traffic signals, transit vehicle locators, transit priority and traffic signal preemption.

The region has been working toward a regional network for many years with a lack of funding to fully support the effort. In order to determine the benefits of the baseline and proposed project separately, it was assumed that the baseline infrastructure provide benefits proportional to the total fiber optic coverage and total existing connections. In other words, the baseline system is assumed to provide 88% of the total benefits and the proposed TIGER Grant funds project 12% of the total benefit. More detail providing these calculations are provided in Appendix A.

Baseline System and Proposed Project Benefit-Cost Ratio

In order to determine the benefits of the baseline infrastructure and proposed project separately, it was assumed that the baseline infrastructure will provide 88% of the total benefits and the proposed 2016 TIGER Discretionary Grant funded project will provide 12% of the total benefits. Project benefits and costs were computed for a 20 year life span of the Baseline and Proposed project starting in 2020 and continuing through 2041.



Table 1 presents a summary of the benefit-cost analysis for the Proposed Project System.

Table 1. Summary of Benefits Cost Analysis for Proposed Project

Discount Rate	Total Cost	Total Benefits	Benefit-Cost Ratio
0%	\$46,500,000	\$2,419,769,290	52.0
3%	\$33,875,261	\$1,548,051,245	45.7
7%	\$23,860,454	\$951,383,419	39.9

Mobility

Based on the calculation of the benefits for this project, the total reduction in recurrent and non-recurrent congestion is estimated to be 378,900 and 677,900 hours per day. Assuming an average hourly value of time of \$19.52 per hour or (\$19.52/60) per minute, the Mobility Benefit is calculated for the annual savings of recurrent and non-recurrent congestion to be \$539.8 million (discounted at 7%) and \$313.1 million (discounted at 3%).

Air Quality

NCTCOG and regional agencies are already implementing air quality improvements through the use of traffic signal retiming and adaptive signal deployment. This project will further reduce vehicle emissions and fuel consumption throughout the region for both recurring and non-recurring conditions. By reducing vehicle delay, the project will reduce idling emissions such as Volatile Organic Compounds (VOCs), Nitrogen Oxides (NOx), Carbon Monoxide (CO) and greenhouse gases such as Carbon Dioxide (CO2). The project is estimated to reduce 370 tons of VOC, 1,815 tons of NOx and 1,148 tons of CO2 annually.

Safety

The dollar benefit of reductions in injury and fatal crashes was estimated using 2016 DOT’s guidance on treatment of the economic value of a statistical life. The distribution of motor vehicle injuries by injury severity from National Highway Transportation Safety Administration 2014 Report on the Economic Cost of Crashes were employed to properly weight the injury data. The value of a statistical life in 2015 dollars by injury classification is detailed in the table below. In total, the safety benefit is calculated at \$528 million (discounted at 7%) and \$874 million (discounted at 3%).

Costs

Construction Costs

Proposed construction costs of \$15 million were obtained in coordination with Texas Department of Transportation and City governments and annual construction costs were estimated based on the proposed construction schedule for each facility.

Operation and Maintenance Costs

The operation and maintenance costs of ITS are estimated at about 10% of the total capital cost, or \$1.5 million per year.



Other Impacts or Indirect Benefits

The following impacts of the proposed projects or indirect benefits were quantified and monetized values were calculated, but these variables were not included in the Benefit Cost Analysis because these benefits can be long term and other external factors such as private investment can impact these benefits.

Short Term Jobs

Per BCA Guidance, the proposed transportation investment per quarter was divided by \$76,900 to calculate the short term job years and short term jobs generated by quarter. Median Income (2014) was converted using Consumer Price Index (CPI) to 2015 and was multiplied to the number of jobs to calculate Short Term Payroll by Quarter. This number was multiplied by 0.5 to estimate Spending Benefit, and Spending Benefit was provided during design and construction of each project between 2019 and 2021.

Long Term Jobs



Economic Benefit was divided by \$76,900 and 20 years to calculate long-term job years, and long-term jobs. Median Income (2014) was converted using CPI to 2015 and was multiplied by the number of jobs to calculate Annual Long Term Job benefit at \$9.5 million.

Fuel Savings

Intelligent Transportation System deployment helps reduce congestion causes and duration of incidents. Commuters will save fuel expense from the shorter commute times, spend less idle time in grid lock, and have access to better information for trip planning. Travel times are also improved, although fuel savings impacts were not calculated.

Project Readiness

Project Schedule

If awarded the 2016 TIGER Discretionary Grant program funding, the North Central Texas Council of Governments (NCTCOG) will move quickly to finalize and design the RCTSI project and begin procurement to fill in gaps in the fiber optic cable and wireless connections. The RCTSI project is expected to take 2.5 years. It will begin in January 2018 and be completed in May 2020. Funds will be obligated before the 2022 deadline.

Legislative Approvals

The RCTSI project is widely supported by transportation agencies and elected officials. The project submission of the 2016 TIGER Discretionary Grant proposal was approved by the Regional Transportation Council (RTC) on April 14, 2016. NCTCOG's Executive Board passed a resolution on April 28, 2016. The Resolution is provided in Appendix C. No other legislative action is required to move forward with the project.



State and Local Planning

NCTCOG and its regional partner agencies completed an update of the Regional ITS Architecture (RIA) in 2014. The updated architecture incorporates the project being proposed as part of this grant application.

The update can be accessed on NCTCOG's website at <http://www.nctcog.org/trans/its/regitsArch/>. NCTCOG and its regional partners are working on the North Central Texas Intelligent Transportation System (ITS) Strategic Deployment Plan that is expected to be completed in May 2016. In March 2016, the Regional Transportation Council approved the long –range transportation plan. The Mobility 2040 builds on previous plans and allows critical projects to move towards implementation. The project being proposed as part of this grant application is outlined in the plan that is available at the following website <http://www.nctcog.org/trans/mtp/2035/documents/2013Update-OperationalEfficiency.pdf>



Technical Feasibility

NCTCOG and its partner agencies have proven and successful experience in implementing such projects. The project will include off-the-shelf components to develop the system. This project will extend the system and fill in gaps for the existing fiber optic network system in the region, provide additional connections and develop a V2I system. The project will employ most of the same components, but on the scale of the entire network. NCTCOG and its partner agencies have experience in planning, negotiating and executing the necessary agreements and facilitating the physical implementation of agency connections.

Financial Feasibility

NCTCOG currently manages federal, as well as state-administered, grants that are in various stages of development, implementation, and closeout. In Fiscal Year (FY) 2015, NCTCOG facilitated expenditures of \$13.4 million from various multi-year federal grants including awards from the Environmental Protection Agency, Federal Transit Administration, Federal Emergency Management Agency, and the Department of Labor. Also in FY 2015, NCTCOG facilitated expenditures of \$103.4 million from various state-administered grants including awards from the Commission of State Emergency Communications, Department of Aging and Disability Services, Texas Department of Transportation, Texas Commission on Environmental Quality, Texas Workforce Commission, and the Texas Department of Public Safety. The NCTCOG Transportation Department employs 19 fiscal and grant professionals who provide financial, legal, and compliance support for projects funded from various grants.

No adverse audit findings from standards used by states, local governments, and non-profit organizations expending federal awards (Circular A-133) have been determined at this time. NCTCOG has not been required to comply with special “high risk” terms and conditions under agency regulations in the implementation of consistency and uniformity in the management of grants and cooperative agreements with state, local, and federally-recognized Indian tribal governments (OMB Circular A-102).



As indicated above, NCTCOG has extensive experience in administering federal and state funds. NCTCOG has experience in administering TIGER grants. NCTCOG has committed \$5,000,000 to fund various components of the RCTSI project. This funding along with \$10,000,000 requested from the TIGER FY 2016 program will fully capitalize the project up front. In addition, the region has committed significant resources in the ITS operations and maintenance which will provide long term success of the project.

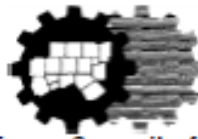
Environmental Approvals

This project would not have any significant environmental effects. The project does not require the acquisition of right-of-way, affect any Section 4(f) properties, require individual permits from the US Army Corps of Engineers or US Coast Guard, or impact any federal or state threatened/endangered species. The project meets the conditions to be classified as Categorical Exclusions (CE) under the National Environmental Policy Act (NEPA).

The majority of the project would be considered C-list project under 23 CFR 771.117 (e.g., utility installations, traffic signals). In 2014, TxDOT assumed FHWA responsibility for approving NEPA documents in Texas. See <http://ftp.dot.state.tx.us/pub/txdot-info/env/txdot-fhwa-ce-mou-121113.pdf> and <http://ftp.dot.state.tx.us/pub/txdot-info/env/txdot-fhwa-nepa-assignment-mou.pdf> for the agreements between TxDOT and FHWA). This delegation allows for quicker review and approval of all NEPA documents. Additionally, TxDOT has developed a checklist format for CEs, which will help streamline the NEPA review and approval process.



Federal Certification



North Central Texas Council of Governments

DATE: April 13, 2016

SUBJECT: Federal Wage Rate Requirement

The North Central Texas Council of Governments (NCTCOG), as an applicant for Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grant funds, certifies that for TIGER funds awarded to NCTCOG it will comply with the requirements of Subchapter M of Chapter 31 of Title 40 (40 U.S.C. 3141, *et. seq.*) (federal wage rate requirements) as required by the Fiscal Year 2016 Continuing Appropriations Act.

Furthermore, NCTCOG annually certifies compliance with the Davis-Bacon Act as amended, 40 U.S.C. 3141 *et. seq.*, the Copeland "Anti-Kickback" Act, as amended, 18 U.S.C. 874, and the Contract Work Hours and Safety Standards Act, as amended, 40 U.S.C. 3701 *et. seq.*, regarding labor standards for federally assisted projects. NCTCOG certifies to this provision within its annual Certifications and Assurances to the Federal Transit Administration.

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