



North Central Texas
Council of Governments



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AV2.1 EXISTING CONDITIONS REPORT

AV2.1: Conduct a Planning Process to help the North Texas Region
Prepare for Automated Vehicles and Related Technologies



September 13, 2021

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AV2.1: Conduct a Planning Process to Help the North Texas Region Prepare for Automated Vehicles and Related Technologies

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EXECUTIVE SUMMARY

The North Central Texas Council of Governments (NCTCOG) is preparing for emerging transportation technologies through a three-phase Automated Vehicle 2.0 (AV2.0) program. The first phase of the AV2.0 program is AV2.1: *Conduct a Planning Process to Help the North Texas Region Prepare for Automated Transportation & Related Technologies*. This Existing Conditions report represents the first in a series of deliverables completed as part of AV2.1.

The purpose of this Existing Conditions report is to detail the current state of transportation in North Central Texas and to expand the understanding of the anticipated effects from automated transportation and related technologies across North Central Texas communities.

Existing Conditions

The state of existing conditions in North Central Texas is documented in five categories: (1) personal mobility, (2) freight movement, (3) equity, (4) safety, and (5) infrastructure readiness/resilience. For each category, we present the existing needs, outline how agencies are already planning for relevant impacts of emerging technologies, identify region goals and objectives for the category, and discuss current emerging technology efforts planned or implemented by local agencies in the North Central Texas region.



Personal mobility is captured in terms of congestion, travel time and travel time reliability. Many roadways in the region are already operating near capacity resulting in high congestion levels and unreliable travel times. By 2045, the region's cost of congestion is estimated to be \$27.2 billion under the planned transportation system improvements. Efforts to address personal mobility have centered around roadway improvements, public transit, and active transportation. Local emerging technology efforts include a series of transportation technologies including high-speed rail, demand-responsive services, first-mile/last-mile connections via micromobility¹, mobile ticketing and scheduling applications, and people movers.



Freight movement is the backbone of the North Central Texas economy. Increasing traffic congestion in the region will have a negative impact on freight movement. Emerging technologies in freight movement include automated trucking, platooning, and unmanned aerial system (or drone) delivery. These freight-specific technologies, as well as enhanced traffic and congestion management strategies, can provide opportunities to improve freight movement reliability.

¹ Micromobility refers to a range of small, lightweight personal mobility vehicles operating at speeds typically below 15 mph, such as bicycles, e-bikes, e-scooters, electric skateboards, shared bicycles, and electric pedal assisted (pedelec) bicycles. Source: Wikipedia, "Micromobility" <https://en.wikipedia.org/wiki/Micromobility>



Equity in transportation is affected by how the benefits and impacts of the transportation system are distributed. Transportation system changes, whether due to traditional transportation planning needs (such as capacity) or due to emerging transportation technologies, will impact different people and communities in different ways. The North Texas region is committed to providing the same level of access to essential destinations to all residents, irrespective of their residence location, race, age, gender, income, and/or abilities. Agencies need guidance on how to develop equity-focused policies and programs related to emerging technologies.



In terms of **safety**, the North Central Texas region is committed to the goals of the Towards Zero Deaths vision. NCTCOG, Texas Department of Transportation (TxDOT), and local agencies strive to provide safe transportation options to all travelers in the region. However, there were 820 crash-related fatalities in North Central Texas in 2019. Emerging Technologies may provide new opportunities to improve transportation safety in the region.



Approaching transportation technologies through a lens of **infrastructure readiness and resiliency** offers a framework for understanding how capital investments can prepare for future conditions and build more resilient systems. Public infrastructure (such as roadways, traffic management systems, sensors, and the electric grid) enables or supports emerging technologies. Infrastructure readiness and resilience can be measured through three primary categories: assets, data, and integration. Supporting projects have been deployed across North Central Texas by cities in collaboration with private industry and university partners, such as Intelligent Transportation System (ITS) installations, automated vehicle deployments, and expanded internet services for residential areas.

Planning for Emerging Transportation Technologies

Anticipated Impacts from transportation technologies are also documented across the five categories: personal mobility, equity, freight movement, infrastructure readiness and resilience, and safety. Key state and regional planning and programming documents that address emerging transportation technologies were reviewed, including the Texas Long Range Transportation Plan: *Texas Transportation Plan 2050*; Texas Transportation Improvement Program (TIP); NCTCOG Long Range Transportation Plan: *Mobility 2045*; NCTCOG Transportation Improvement Program 2019 – 2022; and TxDOT Texas Freight Mobility Plan 2018. TIP projects at the regional level include enhanced communications for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) applications, infrastructure maintenance, and digital installations in the right of way. Long-range plan improvements include both infrastructure installations and projects to modify driver behavior.

Regional Transportation Technology Goals & Objectives

Local agencies have common high-level goals and objectives including:

- Connecting people with their destinations through a multi-modal system,
- Improving system performance through congestion mitigation, and
- Attracting technology investments to create desirable places to live and work.

Local initiatives include Dallas County's effort to install smart intersections designed to reduce traffic congestion and collisions, as well as the City of Fort Worth's efforts to attract technology talent to the DFW workforce. Project-level goals are reflected in those objectives, as outlined in the state and local TIP, and are translated in terms of projects funded as part of the AV2.0 program and other local and regional opportunities.

Current Technology Efforts

NCTCOG launched a bold, multiphase funding opportunity for AV deployment under the AV2.0 program: AV2.2 (AV deployment support) and AV2.3 (Strategic investments in AV services). NCTCOG selected eight projects from the submitted AV2.2 and AV2.3 proposals. Project objectives range from delivering food to needy communities, moving students around campus, creating first-mile/last-mile connections for hospital patients, and expanding infrastructure in support of automated freight. Other technologies currently implemented include cloud computing and crowdsourced data, open road tolling, connected vehicles, automated vehicles, low speed automated shuttles, automated freight, urban air mobility, and parking and curbside management.

Regional Needs and Opportunities

North Central Texas is a leader in automated vehicle deployments and technology testing. As a result, technology impacts will happen sooner in North Texas than in other parts of the country who are not supporting emerging technologies. Agencies need to monitor the transportation system to learn how these technologies impact mobility, safety, quality of life, and the environment in the region. Not all local agencies are piloting new technologies, and some will need more guidance on how to start. NCTCOG can help local agencies form partnerships with industry, lead dialogues on emerging technologies, share information, and help write grant applications to implement new solutions.

Local agencies will need guidance on how to adapt to achieve the greatest benefits from emerging technologies. Over the next year, this AV2.1 project will develop guidance for NCTCOG and its partner agencies on future technology scenarios for long-range planning, best practices for hosting AV deployments, and funding opportunities for local and regional projects.

How to use this document?

The region has made progress advancing and adopting new technologies across modes, yet many opportunities remain. This report provides a snapshot of Existing Conditions across the North Texas region that might be impacted by emerging transportation technology implementation.

CONTENTS

Introduction 1

Personal Mobility 5

Freight Movement 11

Equity..... 17

Safety 23

Infrastructure Readiness & Resiliency..... 27

 Project Prioritization Process 31

Regional Emerging Technology Efforts 34

 NCTCOG AV2.2 & AV2.3 Grant Program 34

 Transportation Data Sharing Program 35

 Cloud Computing & Crowdsourced Data 35

 Open-Road Tolling 36

 Connected Vehicles..... 36

 Automated Vehicles..... 37

 Common Payment Systems 37

 Parking and Curb Management..... 37

 Urban Air Mobility..... 38

 High-Speed Rail 38

 Electric Vehicles..... 38

Conclusions 40

 What can agencies do today? 40

 What's next in AV2.1? 41



Section 1

Introduction

INTRODUCTION

Transportation technologies are emerging and evolving. The transportation planning process must adapt to incorporate new applications.

Why is NCTCOG completing this study?

Automated transportation solutions are part of the long-term transportation strategy for North Central Texas Council of Governments (NCTCOG). NCTCOG is preparing for emerging transportation technologies through a three-phase Automated Vehicle 2.0 (AV2.0) program. AV2.0 will advance the North Texas region through **planning**, **partnerships**, and **investment** into new transportation technologies like automated vehicles (AVs).

The first phase of the AV2.0 program is **AV2.1: Conduct a Planning Process to Help the North Texas Region Prepare for Automated Transportation & Related Technologies**. This project will develop guidance for local agencies to proactively plan for the effects of emerging transportation technologies. This understanding and readiness will help the region apply for federal, state, or local deployment funding to deploy or support new technologies.

All North Central Texas communities should have the resources to plan for emerging technology, such as automated vehicles (AVs), and to build effective partnerships with the AV industry.

What information does this report provide?

This report details the current state of transportation in North Central Texas related to personal mobility, freight movement, equity, safety, and infrastructure readiness & resilience. The following chapters focus on each category individually. In each chapter, we present the existing needs, outline how agencies are already planning for relevant impacts of emerging technologies, identify regional goals and objectives, and discuss opportunities for emerging technologies in North Central Texas.



Personal mobility is shifting as new modes of travel are introduced and as technology reduces or replaces the need to travel. These changes impact mode choice, trip length, and trip generation. For example, teleworking replaced the need to commute to work for many Texans during the COVID-19 pandemic. Other applications, such as shared e-scooters or e-bikes create new options for last-mile connections to transit or other destinations.



Freight movement throughout the country, and specifically across Texas, will continue to be an important economic driver. The freight industry's aim to move goods in a more efficient, less carbon-intensive, and safer manner will spur the application of emerging technologies, which may change transportation system capacity, design, and regulations. There are many freight technology applications developing, such as launchpads for automated drone deliveries, mobility lanes for sidewalk robot deliveries, dynamic curbside management for freight loading zones, AV-only lanes for truck platooning, urban consolidation centers, and protected bicycle infrastructure for cargo e-bikes.



Equity in transportation is affected by how the benefits and impacts of the transportation system are distributed. Transportation system changes, whether due to traditional transportation planning needs (such as capacity) or due to emerging transportation technologies, will impact different people and communities in different ways. Baseline equity conditions are measured using both accessibility (i.e., access to job and services within a given radius or travel time) and mobility (i.e., congestion and travel time) performance measures.



Safety is a primary goal of all transportation agencies in the region. Emerging vehicle and infrastructure technologies might help agencies achieve their safety targets by reducing the frequency and severity of crashes.



Infrastructure readiness and resiliency is critical to realize the potential benefits of new transportation technologies. Public infrastructure (such as roadways, traffic signals, utility poles, and the electric grid) must be equipped to operate as part of the Internet of Things (IoT). These 'smart' devices equipped with sensors and internet connectivity can continuously monitor and analyze the operations of the equipment and its surrounding area. This infrastructure must also be equipped to handle increasingly extreme climatic conditions, with built-in system redundancy. Approaching transportation technologies through a lens of infrastructure readiness & resiliency offers a framework for understanding how capital investments can prepare for future conditions and build more resilient systems.

What is the state of transportation in North Central Texas?

We reviewed key planning and programming documents in the North Central Texas region to understand how they address emerging transportation technologies. The documents reviewed include:

- TxDOT Texas Long Range Transportation Plan: Texas Transportation Plan 2050
- TxDOT Texas Transportation Improvement Program
- NCTCOG Long Range Transportation Plan: Mobility 2045
- NCTCOG Transportation Improvement Program 2019 – 2022
- TxDOT Texas Freight Mobility Plan 2018
- Local comprehensive plans, strategic plans, and parking management plans

North Central Texas is a large metropolitan area with diverse mobility needs for its residents and businesses. The region is also one of the fastest growing metropolitan areas in the U.S.

Population. The North Central Texas region has added approximately one million people per decade since 1970. The region is expected to experience about 51% increase in population and 47% increase in employment between 2018 and 2045.

Safety. In 2020, there were 108,948 crashes in the North Central Texas region, of which 2,942 resulted in serious injuries and 820 resulted in a fatality.

Congestion. Many roadways in the region are already operating near capacity as indicated by their high congestion levels and inadequate travel time reliability. In 2018, the region's cost of congestion was estimated at \$12.1 billion associated with 1,680,685 total vehicle hours spent in delay daily. These numbers are estimated to jump to \$27.2 billion and 3,788,105 hours,

respectively, in 2045 under the planned transportation system improvements. Recent forecasts indicate that by 2045, trips in congested conditions will take nearly 59% longer to complete than in uncongested conditions, compared to 41% in 2018.

Even with the planned transportation improvement projects, congestion is expected to increase across the region.

Environmental. Greenhouse gas (GHG) emissions from transportation account for about 29 percent of total U.S. greenhouse gas emissions, making it the largest contributor of U.S. GHG emissions. Per capita transportation emissions in the DFW region are higher than most metro areas.

In 2010, the Dallas metro area ranked third out of the top 20 most rapidly growing urban heat islands. Increased daytime temperatures can negatively affect human health, contribute to respiratory difficulties, and increase heat-related mortality. High temps also contribute to ground-level ozone. In 2012, 10 North Texas counties were designated as non-attainment for 8-hour ozone. Automated technologies offer the opportunity for more efficient use of the existing right-of-way, reducing the need for future roadway expansions.

Opportunity. Emerging technologies, like automated vehicles (AVs), could support the region's mobility, quality of life, system sustainability, environmental, and project implementation goals. These technologies are not a one-size-fits-all solution. Local agencies will need guidance on how to *adopt* and *adapt* to achieve the greatest benefits from emerging technologies.

Over the next year, this AV2.1 project will develop guidance for NCTCOG and its partner agencies on future technology scenarios for long-range planning, best practices for hosting AV deployments, and funding opportunities for local and regional projects.



Section 2

PERSONAL MOBILITY

PERSONAL MOBILITY

Personal mobility relates to the movement of people. Current and emerging modes of personal mobility include passenger cars, transit, active transportation.

Passenger cars. Travelers use passenger cars to move through personal use, carpooling, ride-hailing (e.g., Uber, Lyft, Via), or car sharing (e.g., Car2Go, Turo).

Public transit. The main transit providers in the region include Dallas Area Region Transit (DART), Denton County Transit Authority (DCTA), and Trinity Metro, which provide a variety of services including fixed-route, demand-responsive routes, commuter rail, and passenger rail, as well as paratransit. The private sector also partners with public agencies to enhance public transit services, through the provision of paratransit or mobility-on-demand services.

Research to define and identify transit deserts, has identified areas where transit demand exceeds transit supply, specifically amongst the transportation dependent. Approximately 11% of the census tracts within the City of Dallas have transit demand that exceeds supply. This difference between available service and need impacts approximately 20% of the total population.

Active Transportation. Active transportation provides healthy, affordable, and environmentally friendly mobility options, such as walking, bicycling, or using micromobility (shared, lightweight vehicles like e-bikes and e-scooters). These trips are typically shorter than car or transit trips and are supported by the network of sidewalks, shared-use paths, bike lanes, cycle tracks, and marked shared lanes. In 2018, approximately 0.1% of the Dallas Area Region commuted via bike and 1.3% walked to commute compared to 0.5% and 2.6% of the U.S. population respectively.

Regional Needs & Challenges

Barriers to personal mobility include the cost of travel, the inability to drive, lack of transit service access, lack of ADA-accessible vehicles or sidewalk connections, and personal comfort using active transportation on the existing sidewalk/path/bike lane network.

Congestion, travel time, and travel time reliability impact personal mobility and quality of life. The financial cost of transportation and the time costs of transportation can be a burden to residents. Congestion increases the time cost of a trip. Unreliable travel times make it hard for commuters to know how much time to plan for a trip—so they may have to leave earlier or risk being late. In 2020, the DFW-Arlington area ranked 5th for overall congestion, and 8th for delay experience per commuter out of 101 urban areas surveyed by the Texas Transportation Institute. Each commuter in Dallas wasted 40 hours sitting in traffic.

From an agency and user perspective, two of the biggest challenges facing automation goals are public acceptance of AV technologies and acceptance in the growth of automated shared-mobility services that would require drivers to abandon their personally operated vehicles to use a shared service.

Regional Goals and Objectives

Local agencies have common high-level personal mobility goals and objectives including:

- Connecting people with their destinations through a multi-modal system,²
- Improving system performance through congestion mitigation to accommodate growth with limited resources,³ and
- Attracting technology investments to create desirable places to live and work.⁴

Current Plans and Policies

In 2017, Texas state legislature passed a law that allows self-driving cars on the state's roads and driveways if they follow traffic laws and have video recording devices and insurance.⁵ The City of Arlington approved a resolution to allow private companies to test and deploy robotic delivery devices in a real-world setting.

NCTCOG promoted 10 transportation technology policies to advance vehicle automation in the *Mobility 2045* long-range transportation plan. These policies focus on:

- Providing more travel options and safe travel options for the public.
- Making transportation system data accessible to third party technology developers through two-way data sharing agreements and cost/benefit analyses compared to installing/operating/maintaining hardware.
- Preserving transportation corridors and using them more efficiently (e.g., increasing average vehicle occupancy or using demand management tools) to offer the same level of service instead of building new roads.
- Supporting the safe testing and deployment of AVs and conducting cost/benefit analyses of using AV technology and demand management tools as an alternative to widening roads.
- Installing and operating reliable and robust wireless communications for transportation facilities.

Several local agencies have developed plans or policies for emerging personal mobility technologies.

- **Automated Parking Systems.** The Dallas Midtown Automated Transportation System Study aims to "Connect the Midtown district with the larger DFW region using an automated transportation system and share parking system".⁶
- **Transportation Demand Management.** The City of Plano plans to use Transportation Demand Management strategies to address traffic congestion, safety, and system efficiency during periods of high travel demand, such as morning and afternoon rush hour".⁷
- **Micromobility.** The City of Dallas and the City of Plano (LegacyConnect) are evaluating best practices to implement and manage dockless scooters, rideshare, mobility as a service (MaaS) and automated vehicles to "enhance and maintain a micromobility"⁸

² NCTCOG North Texas Vision 2050, NCTCOG Mobility 2045, City of Dallas, City of Plano

³ North Texas Vision 2050, TxDOT Texas Freight Network Technology and Operations Plan, Dallas County, City of Plano, City of Fort Worth

⁴ City of Fort Worth, City of Dallas

⁵ Texas [S.B. No. 2205](#)

⁶ NCTCOG (2019), [Dallas Midtown Autonomous Transportation System and Shared Parking Feasibility Study](#)

⁷ City of Plano, [Comprehensive Plan 2021](#)

⁸ Micromobility refers to a range of small, lightweight personal mobility vehicles operating at speeds typically below 15 mph, such as bicycles, e-bikes, e-scooters, electric skateboards, shared bicycles, and electric pedal assisted (pedelec) bicycles. Source Wikipedia, "Micromobility" <https://en.wikipedia.org/wiki/Micromobility>

system" to provide safe and accessible travel to all destinations, especially to "facilitate collaboration between area businesses and transportation services to give people options other than driving alone".^{9,10,11}

Local Personal Mobility Technology Programs

North Central Texas is a leader in automated vehicle pilot programs. Local agencies have already conducted many successful personal mobility technology programs.

- **Frisco Drive.ai Automated Vehicle Pilot.** In 2018, Frisco became the first place in Texas to host an automated vehicle service on public roads.¹² Drive.ai provided on-demand, automated microtransit service between an office park and nearby commercial facilities over the 8-month pilot hosted by Frisco's Transportation Management Association (TMA). The greatest concern reported by Frisco residents was that the technology is new, and respondents desire more pilot deployments to further vet the technologies.
- **Arlington milo Low-Speed Automated Shuttle Pilot.** Arlington's *milo* program deployed two EasyMile EZ10 autonomous shuttles in an off-street environment in the Entertainment District for one year, ending in August 2018.¹³ *milo* rides were free of charge and available along select off-street trails during stadium and ballpark events, as well as public demonstration events. *milo* operated on a preprogrammed route and did not encounter vehicular traffic.
- **Arlington Drive.ai Automated Vehicle Pilot.** This on-demand, automated microtransit pilot connected users within Arlington's Entertainment District in 2019. During the 8-month pilot, 760 trips were completed in mixed traffic serving over 1,400 passengers on 440 miles of automated driving trips.¹⁴
- **Arlington RAPID Automated Microtransit Pilot with Via.** In March 2021, five self-driving vehicles (including one wheelchair-accessible vehicle) joined the Via Arlington fleet. Riders in Downtown Arlington or on UT Arlington's campus can request a seat in an AV for their trip between 7 a.m. and 7 p.m. The pilot combines Via's on-demand ridehail service and platform with May Mobility's automated driving technology and UT Arlington's research team.¹⁵
- **Skylink - DFW Airport Automated People Mover.** Skylink is an automated people mover train system that has been moving passengers around DFW Airport at speeds up to 35-37 mph since 2005.¹⁶
- **Smart Intersections.** Dallas County has installed smart intersections designed to reduce traffic congestion and collisions.¹⁷
- **Micromobility.** Dallas piloted shared e-bike (2017-present) and e-scooter (2018-2020) programs and will consider allowing e-scooters to return later this year.
- **GoPass.** Travelers can use the GoPass® mobile app to plan trips, purchase tickets, and check the balance of their reloadable farecard for transit trips on DART, Trinity Metro,

⁹ City of Dallas (2021), [Connect Dallas: Strategic Mobility Plan Final Report](#)

¹⁰ City of Plano, [Comprehensive Plan 2021](#)

¹¹ LegacyConnect, <https://www.legacyconnect.solutions/>

¹² Repko, Melissa (25 March 2019). "Why are Frisco's autonomous vans moving to another North Texas suburb", *The Dallas Morning News*. Accessed 25 June 2021.

¹³ City of Arlington, [milo Pilot Program Closeout Report](#)

¹⁴ MyArlingtonTx (23 May 2019), ["Arlington Concludes Successful Pilot Program with Drive.ai"](#). Accessed 25 June 2021.

¹⁵ City of Arlington, ["RAPID"](#). Accessed 3 August 2021.

¹⁶ Wikipedia, ["DFW Skylink"](#). Accessed 3 August 2021.

¹⁷ Dallas County (2020), [Dallas County Mobility Plan](#)

Trinity Rail Express, Denton County Transit Authority, Tulsa Transit, STAR Transit, and the Dallas Streetcar System.

Opportunities for Emerging Technologies

Emerging transportation technologies could help to reduce the monetary cost of travel and the time cost of travel. But there isn't a single solution to solve all mobility needs or a one-size-fits-all solution.

Scenario Planning. To prepare for impacts of emerging technologies, regional planners are developing future technology scenarios. The TxDOT 2021-2024 Statewide Transportation Improvement Program focused on AV's, people movers, 5G connectivity, DSRC, and signal upgrades. Proposed personal mobility technologies considered by NCTCOG in the *Mobility 2045* long-range transportation plan include: demand response services, first-mile/last mile connections via micromobility, mobile ticketing and scheduling applications, and people movers.

Electric Vehicles (EVs) might help to reduce the costs of travel. EVs cost less to maintain than internal combustion engines and they don't require the cost of gas. However, widespread EV adoption will require a significant investment to build an EV charging infrastructure network.

Automated vehicles (AVs) can perform driving tasks with limited to no input from a human driver. Potential personal mobility impacts of AV technology include increased roadway capacity, vehicle throughput, and travel time reliability; and increased access to travel for people unable to drive; and reduced level of stress especially compared to driving in congested traffic. AVs may also impact land use by reduced parking requirements, especially in urban areas. However, public acceptance is needed. Texans have expressed mixed opinions about the use of AVs on Texas roadways—many cannot wait for the convenience, whereas others are skeptical that the current technology is sufficiently safe, secure, and reliable.¹⁸

Micromobility are shared, lightweight vehicles like e-bikes and e-scooters (e.g., Spin, Lime, Bird) that can be rented and ridden within a community. Micromobility provides first-/last-mile access and may open active transportation options to travelers who would not normally walk or ride a traditional bike. Local agencies could sponsor micromobility programs to provide shared active transportation options to travelers.

Transit service providers in the North Central Texas region are uniquely positioned to test and implement a variety of emerging transportation technologies to connect more people with more destinations, faster and more efficiently. As the North Central Texas region grows, transit expansion and improvements will focus on the following service enhancements, which each have different potential technology applications:

- **High-Speed regional connections** such as commuter rail, light rail, and bus rapid transit can support commuting and special event trips.
- **Community access transit** provides a demand-responsive service that links people to essential destinations and can be improved with mobile ticketing and scheduling applications.
- **Last-mile connections** between regional transit and a passenger's destination can seamlessly integrate multiple modes through partnerships with micromobility providers.

¹⁸ TxDOT, [Texas Transportation Plan 2050](#) – Texas Long Range Transportation Plan

- **'People Movers'** circulate travelers across a small geographic area such as an airport, art district, campus, or medical plaza, and can employ automated, electric vehicles.
- **Common Payment Systems** like GoPass® make transit trips easier because riders can upload transit fares in one app or on one reloadable fare card. This makes transfers easier and reduces the need to purchase multiple tickets or carry balances on multiple accounts. Through partnerships with micromobility providers and ridehail services, transit agencies could further connect common payment systems to other last-mile connection services.

Electric Vertical Takeoff and Landing (EVTOL) Aircraft integrates unmanned aerial systems (UAS, or more commonly referred to as drones) for passenger movement, goods movement, and system management. Testing is underway to learn how EVTOL could support passenger movement. Today, this service could come from human-driven systems, like helicopters. Tomorrow, it is possible for automated UAS systems to transport vehicles. Vertiports will support this EVTOL aircraft.

As emerging technologies are increasingly integrated into the North Central Texas region's transportation system, *safe* and possibly *separate* facilities will be crucial to prevent conflicts between people walking, rolling, and biking with automated vehicles, delivery robots, and other technology applications sharing the rights of way. This includes expanding and enhancing the sidewalk, bike lane, and trail network.

Unknowns

Technologies that reduce the monetary cost of travel or the time cost of travel usually end up increasing the demand for travel. People are willing to travel more often or longer distances. AVs should make the driving experience less stressful for travelers. Reducing the cost and level of stress of travel might increase the demand for travel. If these vehicles are shared, the VMT might increase even more due to vehicles circulating between rides. The impacts of automation, electrification, and shared mobility on currently unknown—because we don't yet know the sustainable price point of these technologies or because there isn't enough data on these systems being used by the public in real-world applications.

This project will explore these potential impacts further in the Future Technology Scenario Development and Evaluation Task.



Section 3

Freight Movement

FREIGHT MOVEMENT

Freight movement is the backbone of the North Central Texas economy. Freight-related jobs constitute about 20% of the total employment in the region. The region provides widespread trade opportunities for more than 600 motor carriers and almost 100 freight forwarders. The region is a national railroad crossroads and a domestic and international air/land cargo hub.

Four major interstate highways serve freight movement in the region: I-20, I-30, I-35, and I-45 (including I-35E and I-35W business routes). Critical Urban Freight Corridors connect the region's freight network to the FHWA National Highway Freight Network (NHFN). Trucks can reach 98% of the US population within 48 hours from the North Central Texas logistics hub.¹⁹

Regional Needs & Challenges

Key regional freight issues include²⁰:

- Growing congestion on major regional transportation facilities
- First- and last-mile connections
- Inadequate infrastructure
- Inadequate truck parking supply
- Safety

Reducing congestion and **balancing commodity flows** are critical needs to support the regional freight economy. The travel model data show that nearly 1.02 million truck trips are made daily on the region's roadway network. This number is expected to increase to almost 1.10 million in year 2045.²¹ Additionally, commodities moved through the Texas Multimodal Freight Network are expected to double by 2045. Increasing traffic congestion in the region will have a negative impact on freight movements. Currently congestion and associated unreliable travel times, require logistics planners to plan for as much as 75% longer travel times to ensure that a trip arrives on time.

First- and last-mile connections need to be safe and efficient. The connections on local streets between highways and warehouses or between distribution centers and delivery locations can lead to delays and present more potential conflicts between freight vehicles and other road users. Sidewalk delivery robots create new first- and last-mile connection challenges for freight movement, such as sidewalk and ramp access or potential conflicts with pedestrians on the sidewalk.

Infrastructure improvements are needed to support increasing vehicle size and weight, increasing freight traffic, and changing freight fleets. Global e-commerce sales have increased from \$1.5B in 2015 to \$4.3B in 2020, which is increasing the demand for local goods movement and delivery.²² Many delivery fleets are using smaller, sometimes electric vehicles to make deliveries, but much is currently unknown about the logistics, such as whether these vehicles are fully loaded.

¹⁹ Texas Freight Mobility Plan (2017), www.movetexasfreight.com

²⁰ Ibid.

²¹ NCTCOG, [Mobility 2045](#)

²² Statista, "Retail e-commerce sales worldwide from 2014 to 2024."
<https://www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales/>

Cities should also consider curb management policies for the orchestration of first-mile/last-mile delivery and other mobility services that might impact access to the curb.

Across the country, agencies are focusing on truck parking needs due to changes in federal requirements for driver hours of service and trip logging. Truck parking is needed not only for mandatory rest breaks but also for truck staging around warehouses, distribution centers, airports, and railroad facilities.

Additionally, as regional rail grows, agencies will need to plan for safe and efficient interactions between passenger and freight trains.

Regional Goals and Objectives

The regional freight movement goals of NCTCOG member agencies are to:

- Develop a multi-level planning framework to enhance the integration and connectivity of the freight transportation system
- Support innovation and technology implementation through research, testing, and capital improvements
- Integrate safety and operations of the rail in freight improvement program and expanding rail network

Current Plans and Policies

The nature of freight movement often requires more than participation from local and state governments and involves multi-state coalition. The Departments of Transportation from Texas, California, Arizona, and New Mexico formed the **I-10 Corridor Coalition**. The Coalition is planning for the operations and technology needs to create a streamlined experience for connected vehicles traveling along the corridor. In 2023, they will launch a **Truck Parking Availability System (TPAS)** to inform drivers about public rest area capacity.²³

Some agencies in the NCTCOG region are developing **freight master plans** to support efficient freight movement and address freight-related issues. For instance, the City of Dallas started developing a freight master plan including sidewalk to avoid conflict of freight movement with other modal priorities (e.g., parking, walking, bicycling, etc.). The freight master plan will be developed in coordination with the City's Curb Management Strategy to set policy on the design of truck routes, placement of delivery loading zones, and identifying future improvement of freight network.²⁴

The City of Arlington also has approved a resolution to allow private companies to test and deploy **robotic delivery devices** in a real-world setting.

Investing in safe, efficient, and reliable freight movement supports the regional economy. The *Texas Freight Mobility Plan* (2017)²⁵ **encourages the freight industry (trucking and rail) to participate** in freight system planning at the regional and local levels to improve safety, air quality, delivery time reliability, and integrated operations with local commuter rail agencies. The

²³ I-10 Corridor Coalition, <https://i10connects.com/>

²⁴ https://dallascityhall.com/departments/transportation/Documents/DSMP_FinalReport_041921.pdf

²⁵ Texas Freight Mobility Plan (2017), www.movetexasfreight.com

plan also requires local governments to create a **dedicated and recurring funding source** for projects that enhance freight mobility.

NCTCOG leads several freight-focused programs critical to the planning and implementation of the freight goals and policies:²⁶

- The **data collection program** collects and monitors freight traffic data in the region including vehicle classification counts and vehicle movements, freight transportation facility inventory and freight economic impact. This data is essential for determining where potential issues may arise in the freight system and will help to create projects addressing these issues.
- **Freight System/Network Planning** involves studies for safe, freight routes and hazardous material routing. The freight routes planning effort is responsible for maintaining Critical Urban Freight Corridors up-to-date, bottleneck removal projects, **new technologies** (e.g., automated vehicles), improve truck parking availability, infrastructure improvements on primary and secondary freight networks and local truck routes, first/last mile access improvements, operations improvement on key freight routes, implement projects to enhance network connectivity.
- **Freight Outreach Activities** are required to engage participants from within and outside the freight sector in the freight planning to promote understanding of freight's importance to the region and of long-term freight planning for the public, industry professionals, and decision makers.
- The **Land-Use Planning program** will create safer and more efficient freight centers by ensuring compatible land uses near freight developments such as railroad tracks, intermodal facilities, truck parking facilities, freight-orientated developments, and truck routes and other major freight carry roadways.
- NCTCOG is pursuing a **freight signal priority pilot deployment**. This pilot program aims to identify main freight routes in the region and to optimize the signal timing plans along these routes to provide priority to trucks. The goal is to increase the efficiency and reliability of freight movement in the region.

²⁶ NCTCOG, [Mobility 2045](#)

Opportunities for Emerging Technologies

The **Texas Triangle** is a prime testing ground for freight technologies. The mega region connects Dallas, Houston, and San Antonio. As one of the largest freight hubs in the US, Dallas is an important testing ground for many of the AV industry leaders.

Automated freight testing, including automated driving, platooning, and electric vertical take-off and landing (EVTOL), has begun in the Texas Triangle. The AV-friendly legislative environment in Texas and the large freight hubs attract AV developers to test their automated fleets in Texas.²⁷

The Texas Triangle is one of the regions with the highest potential for electric truck success due to the large number of fleets running regional-haul routes of 230 miles or less per day, according to the North American Council for Freight Efficiency (NACFE).²⁸

Several regional agencies already have already implemented automation and technological improvements such as truck platooning, autonomous trucks, freight terminal automation, a connected and automated fleet, and unmanned aerial system (UAS) package delivery.

- The **TxDOT Texas Connected Freight Corridors** project is deploying connected vehicle technology on I-35, I-45, and I-10 and in more than 1,000 commercial vehicles to reduce truck-related crashes and reduce time trucks spend in congestion.²⁹
- **Kodiak Robotics**, **TuSimple**, and **Aurora** are developing and testing automated trucking and platooning in the Texas Triangle.
- **Starship Robotics** sidewalk delivery bots are being tested by UT-Dallas to deliver in Frisco, Plano, and Richardson.³⁰
- NCTCOG's **511DFW** serves as the single source for real-time, comprehensive regional traveler information. 511DFW provides information to freight companies and to drivers on traffic conditions on freeways and major arterials.³¹
- **AllianceTexas' Mobility Innovation Zone (MIZ)** provides a facility for testing and innovation of many new technologies, including automated trucking and unmanned aerial system (UAS) testing.³²
- NCTCOG is studying **truck-only lanes** as a freight congestion mitigation strategy.

Automated last-mile delivery is another new opportunity for freight automation. For example, UPS is testing package delivery drones. Last-mile delivery robots are being tested by Amazon

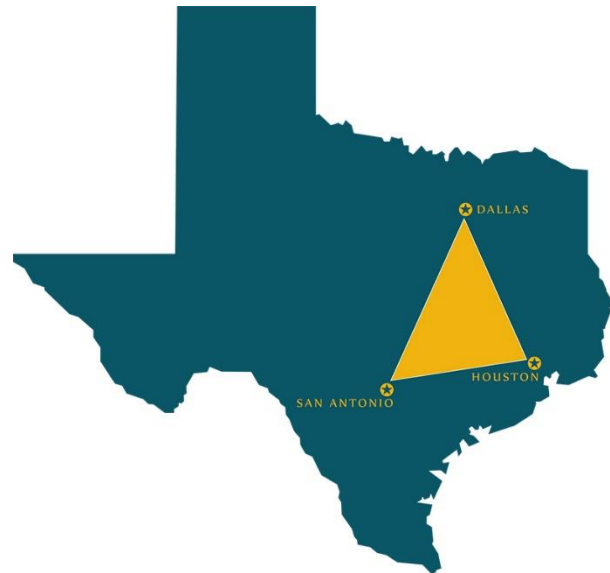


Figure 1. Texas Triangle (Image Source: tti.tamu.edu)

²⁷ Fleet Owner (27 May 2021), "[Autonomous truck testing heats up under the Texas sun](https://www.fleetowner.com/autonomous-truck-testing-heats-up-under-the-texas-sun/)". www.fleetowner.com

²⁸ North American Council for Freight Efficiency (NACFE) (2020), [High-Potential Regions for Electric Truck Deployments](https://www.nacfe.org/publications/high-potential-regions-for-electric-truck-deployments/)

²⁹ TxDOT, [Texas Connected Freight Corridors](https://www.txdot.gov/projects/freight/texas-connected-freight-corridors/), www.txdot.gov

³⁰ NCTCOG, (2020). [Progress North Texas 2020: Connecting the Dots of Regional Transportation](https://www.nctcog.org/progress-north-texas-2020-connecting-the-dots-of-regional-transportation/).

³¹ www.511dfw.org

³² <https://www.alliancetexasmiz.com/>

Scout, Starship Robotics (DoorDash), Postmates Serve, FedEx Roxo (Walmart, Pizza Hut), Nuro (Walmart, CVS), Refraction AI, and more.

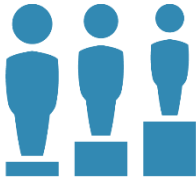
The private industry is leading freight automation and logistics innovation. Local agencies need to be part of the conversations to learn what is coming, what the impacts could be, and how the transportation system can support this innovation to meet regional goals and needs. NCTCOG and its partners can ensure a seat at the table by inviting the freight industry to participate in the planning process.



Section 4

Equity

EQUITY



An equitable transportation system should provide the same level of access to essential destinations to all residents, irrespective of their residence location, race, age, gender, income, and/or abilities. The North Central Texas region is committed to providing an equitable transportation system for all residents.

Regional Needs & Challenges

Changing Population. From 1970 to today, the region's total population more than tripled (from 2.5 million to over 7.8 million as of January 1, 2021). And the population is expected to continue to grow. NCTCOG estimates that by 2045, the region's population will be over 11.5 million people. **Figure 2** shows the annual population increase in the region. During the same period, the region's minority population has increased significantly. Thoughtful planning is needed to support the increasing population, changing demographics, and continually increasing stress on the region's transportation system.

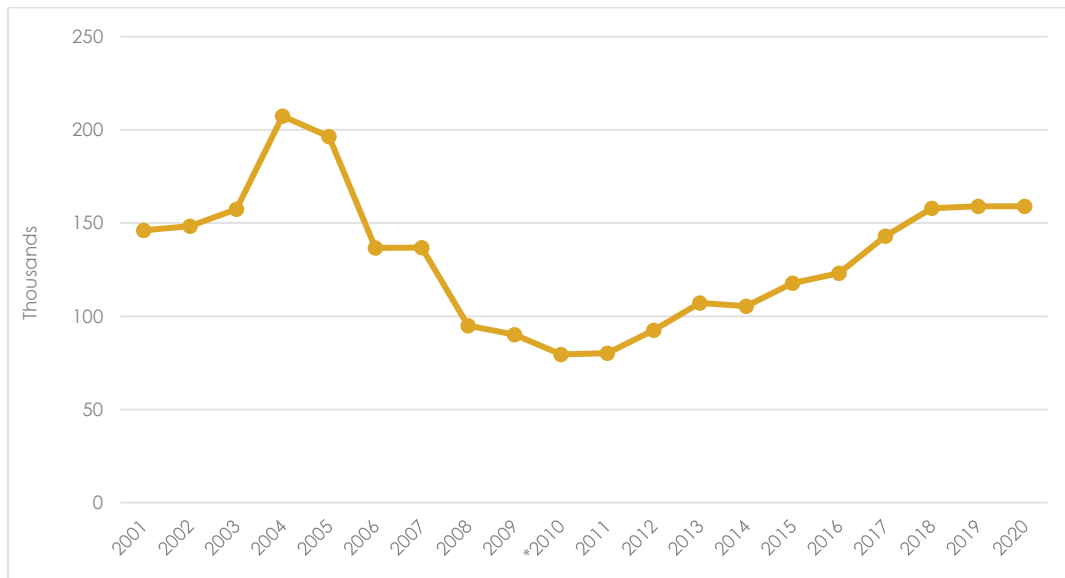


Figure 2. Annual Regional Population Change

(Source: NCTCOG. Note: *Partial Year Growth shown for 2010.)

History has shown that an increasing population and the desire to create efficiencies in the movement of people throughout the region has often led to the displacement of minoritized populations. In the 1940s, the desire to save a marginal amount of time on people's commutes was enough to justify the construction of the Central Expressway, which cut through the heart of Dallas' Black neighborhoods.³³ The continued growth of the region creates opportunities for the implementation of emerging technologies that support equity goals and the needs of diverse peoples.

³³ Yarbrough, C. (2021), *Paved A Way: Infrastructure, Policy and Racism in an American City*. New Degree Press.

Aging Population. Like many communities across the U.S., the population of 65 and older adults is increasing faster than it has in the past. Aging adults need transportation solutions to allow them to age in place.

Driving Challenges. Aging adults, children, and persons unable to drive need transportation alternatives to driving. They need options that give them safe and reliable access to the places they need to go—like school, work, grocery stores, health care, and social services.

Missing connections. One of the region's challenges to increasing personal mobility mode shift away from passenger cars to transit or active transportation are the missing connections in each system. Transit deserts, or areas where transit demand amongst the transportation disadvantaged exceeds supply, have been identified, with impacts to 19% of the total population in Dallas. Dallas has also identified gaps in their sidewalk network but does not have the funding to build out the network.

Communication Challenges. NCTCOG estimates approximately 13% of the region's population has limited English proficiency—the ability to read, write, speak, or understand English. Signs, audible messages, websites, and apps can be difficult for some people to understand.

Financial Challenges. Monetary costs of transportation include vehicle expenses for ownership, registration, and maintenance; fuel costs; and tolls. The time cost of travel is another transportation burden. NCTCOG's environmental justice analysis indicates that the increasing congestion in the region is expected to have a significant impact on the equity of the transportation system.³⁴ **Figure 3** illustrates the costs of transportation compared to household income. Additionally, in 2018, the single-family affordability index was down 9.6%.³⁵

Financial challenges to transportation also include barriers to emerging technologies for people who are un- or under-banked and people who don't have a smartphone or can't afford a wireless data plan.

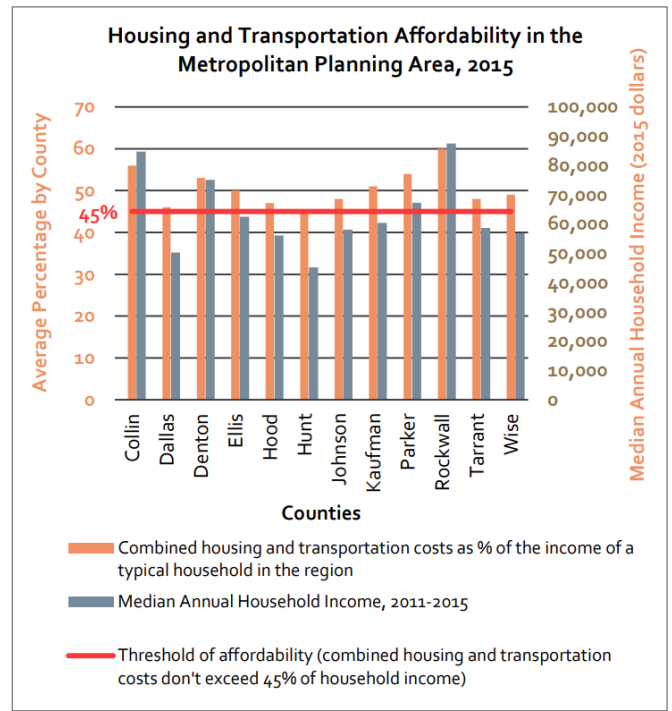


Figure 3. The True Costs of Transportation

(Graphic Source: Mobility 2045)

³⁴ NCTCOG, *Environmental Justice & Title VI*, www.nctcog.org

³⁵ National Association of Realtors (2019), *Affordability Index of Existing Single-Family Homes for Metropolitan Areas*.

Internet Access. The digital divide is growing for people without high-speed internet access. Barriers to the internet include limited internet service provider coverage of all communities, cost of service limiting access to available services, and limited digital literacy and training.

One challenge is to expand the high-speed internet network to provide service to more communities. The second challenge is then to increase the number of residents who can or choose to access the available internet service providers.

Figure 4 shows the percentage of each county's population who are accessing the internet at 25 Mbps or faster.

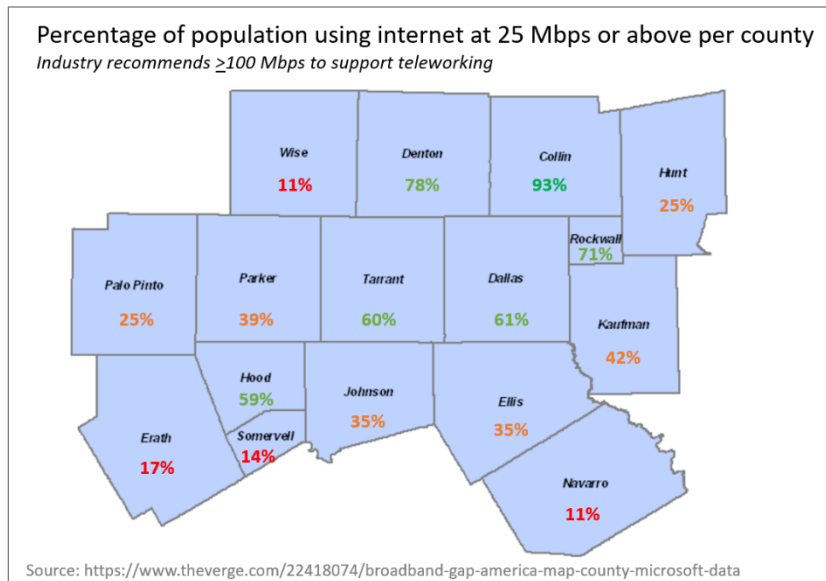


Figure 4. Regional Population Accessing Internet

The *Broadband and Digital Equity Strategic Plan* for the City of Dallas and Dallas Independent School District (2021) provides an in-depth analysis of the digital equity challenges and broadband gaps. The Plan outlines strategies local agencies can take to provide affordable high-speed broadband service for student's households.

The *South Dallas Employment Project* is a large equity project in the region, which includes a focus on digital access, inclusion, and literacy.³⁶

Teleworking or telecommuting was slowly increasing before the COVID-19 pandemic. In 2020, many employers made a shift to full-time teleworking, and some will continue to support at least a hybrid work environment. Slow internet speeds create barriers to teleworking. Teleworking is not possible in some jobs, such as the food, hospitality, manufacturing, and warehousing industries.

Regional Goals and Objectives

NCTCOG member agencies focused their equity goals on the accessibility and connectivity of the transportation system, specifically for walking and using transit. Walking and riding transit are two of the most accessible modes of transportation for many people, including those of lower incomes, with disabilities, and in historically excluded communities. Many equity goals overlap with personal mobility goals. Focusing investments on improvements that benefit the greatest number of people is crucial in creating a more equitable transportation system.

The local agency equity-related goals are:

³⁶ www.southdallasemploymentproject.org/digital-inclusion

- Promote investments in infrastructure improvements to maximize success of systems, such as sidewalks and other infrastructure improvements that will increase use of service (City of Arlington).³⁷
- Create a universally accessible and well-connected pedestrian system that enhances walkability, improves navigation of major thoroughfares, and provides connections to nearby destinations desired by the community (City of Plano).³⁸
- Advocate for increasing safe spaces for slower moving transportation modes like scooters, bikes, and walking (LegacyConnect, the transportation management association in Plano).³⁹
- Provide connections to nearby destinations desired by the community; access to a convenient transit network focused on increasing and improving travel options and direct connections to major local destinations (City of Dallas; City of Plano).⁴⁰

NCTCOG utilizes mobility measures and accessibility measures to measure equity.

MOBILITY Equity Measures

- Average level of congestion
- Average travel time (e.g., minutes to travel 20 miles)

ACCESSIBILITY Equity Measures

- Number of jobs accessible within 30 minutes by automobile
- Number of jobs accessible within 60 minutes by transit
- Population within 30 minutes to university and regional shopping center special generators
- Population within 15 minutes to hospitals

Current Plans and Policies

NCTCOG's planning process is guided by several key nondiscrimination and public involvement policies focused on equity⁴¹:

- Evaluate the benefits and burdens of transportation policies, programs, and plans to prevent disparate impacts and improve the decision-making process, resulting in a more equitable system.
- Balance transportation investment across the region to provide equitable improvements.
- Meet federal and state requirements to ensure all individuals have full and fair access to provide input on the transportation decision-making process.
- Demonstrate explicit consideration and response to the public input received.
- Use strategic outreach and communication efforts to seek out and consider the needs of those traditionally underserved by the transportation planning process.
- Enhance visualization of transportation policies, programs, and projects.
- Provide education to the public and encourage input and engagement from all residents on the transportation system and the transportation decision-making process.

The *Broadband and Digital Equity Strategic Plan* for the City of Dallas and Dallas Independent School District (2021) makes four recommendations:

³⁷ City of Arlington (2017), *Connect Arlington: A Transportation Vision Connecting People and Places*

³⁸ City of Plano, *Comprehensive Plan 2021*

³⁹ LegacyConnect, <https://www.legacyconnect.solutions/>

⁴⁰ City of Plano, *Comprehensive Plan 2021*; City of Dallas (2021), *Connect Dallas: Strategic Mobility Plan Final Report*

⁴¹ NCTCOG, *Mobility 2045*

- Proceed with the City's plan to construct a 100-mile City fiber backbone, which could indirectly promote digital equity
- Consider expanding targeted fixed wireless infrastructure using school rooftops to supplement existing broadband offerings to serve both DISD families and other residents
- Increase staffing for digital equity programs, such as by establishing a call center to help qualified low-income residents enroll in subsidy programs
- Expand programmatic efforts aimed at helping residents access computers and develop digital skills

Opportunities for Emerging Technologies

Equitable transportation is accessible and affordable for everyone in a community. Emerging technologies (like automated vehicles, ridehail, and micromobility) may provide unprecedented mobility solutions to all members of our communities, such as children, the elderly, low-income households, disadvantaged communities, and traveler with physical or visual impairments.

Technology and mobility services may not be available to all residents, especially those without smartphones or those who are un- or underbanked. Agencies and private-sector partners/providers will need to find solutions to overcome those barriers and provide multiple safe and reliable mobility options to all travelers.

The City of Baltimore established performance requirements based on **Equity Zones** for their dockless vehicle program to ensure that shared bikes and scooters were available in underserved neighborhoods.⁴²

Common Payment Systems like GoPass® make transit trips easier because riders can upload transit fares in one app or on one reloadable fare card. This makes transfers easier and reduces the need to purchase multiple tickets or carry balances on multiple accounts.

GoGo Grandparent lets people use Lyft, Uber, DoorDash, and Instacart without using a smartphone. GoGo users dial a phone number and select a menu option to request a ride or place a delivery order. The GoGo Guardian service notifies selected family members of the riders' trips and provides real-time updates.⁴³

Equity solutions don't have to be high-tech. Creating a more accessible transportation system will provide more equitable service to people in wheelchairs, visually or hearing impaired, and travelers with limited English proficiency.

⁴² Kittelson & Associates, Inc., "[What Baltimore can teach us about e-scooters and equity during COVID-19](#)" Kittelson.com

⁴³ <https://gogograndparent.com/>



Section 5

Safety

SAFETY

NCTCOG, TxDOT, and local agencies strive to provide safe transportation options to all travelers in the region. Emerging technologies may provide new opportunities to improve transportation safety in North Texas.

Regional Needs & Challenges

NCTCOG adopted the national “Toward Zero Deaths” vision, which focuses on eliminating fatalities and serious injuries across all modes of travel.^{44, 45} In 2020, there were 108,948 crashes in the North Central Texas region, of which 2,942 resulted in serious injuries and 820 resulted in a fatality.⁴⁶ In 2019, Texas experienced 1.25 deaths per 100 million miles traveled, which is greater than the national U.S. rate of 1.11 deaths per 100 million miles traveled. NCTCOG tracks five key **safety performance measures**, based on federal reporting requirements. Safety needs extend to all road users, including vulnerable road users. Safety strategies are needed for the region’s roadways, multimodal systems, and rural roads.

Table 1. Transportation Safety Needs

Safety Performance Measure	2019 5-Year Rolling Average
Number of fatalities	557.2
Rate of fatalities per 100 million vehicle miles traveled	0.781
Number of serious injuries	3,692
Rate of serious injuries per 100 million vehicle miles traveled	5.200
Number of non-motorized fatalities and non-motorized serious injuries	559

Source: Safety Performance Measures 2019.⁴⁷

Regional Goals and Objectives

NCTCOG’s stance on safety is that even one death on the transportation system is unacceptable. The region’s transportation system safety program focuses on four core concepts to create a safer transportation system:

1. Data analysis and information system development,
2. Safety planning and implementation efforts,
3. Safety education and training efforts, and
4. Performance reporting.

Regional safety goals include:

⁴⁴ NCTCOG, [Mobility 2045](#)

⁴⁵ FHWA, [Zero-Deaths – Saving Lives through a Safety Culture and a Safe System](#). Accessed 12 July 2021. [safety.fhwa.dot.gov](#)

⁴⁶ NCTCOG (2021), [Predictive Crash Analysis Software Request for Proposals](#)

⁴⁷ NCTCOG, [Safety Performance Targets Update](#), Regional Transportation Council presentation 11 February 2021.

- Reduce fatalities and serious injuries 2% by 2022 across the region through road safety improvements and first responder incident clearance times (TxDOT's Texas Transportation Plan 2050).⁴⁸
- Enhance and maintain a micromobility system to provide recreation and feasible options for travel to destinations, which is safe and accessible to all users (City of Plano).⁴⁹
- Improve safety on thoroughfares or multimodal facilities and for bicycles and pedestrians (Dallas County).⁵⁰
- Safely accommodate all users and modes by addressing existing safety hazards, revising dangerous cross-sections to provide adequate facilities for multi-modal transportation, and incorporating the changing uses of roadway space into safety modifications (City of Fort Worth).⁵¹

TxDOT summarizes the region's technology scenario planning with the following time-constrained options⁵²:

- **Quickly Attainable:** Improve safety and optimize the efficiency of existing infrastructure through rapid deployment of technology.
- **On-The-Horizon:** Safety for all systems users, with separation between freight, CAVs, and other travelers as needed.
- **Ultimate Dream:** No transportation fatalities – the Road to Zero Initiative has been successful in cutting fatal crashes in half by 2035 and achieving zero deaths by 2050.

Current Plans and Policies

In *Mobility 2045*, NCTCOG outlined several policies to guide the safety planning effort for the region.⁵³ The region's programs, projects, and policies should **reduce serious injuries and fatalities** across all modes of travel, such as:

- **Work zone safety** strategies.
- **Safety data sharing partnerships** with TxDOT, local governments, local police departments, and equipment vendors (including, but not limited to, crash data, red light camera data, and incident response and clearance time data).
- **Wrong way driving** prevention, warning, or detection systems.
- **Low-cost intersection safety countermeasures** consistent with the *Intersection Safety Implementation Plan for North Central Texas* and other similar studies.

Many of these policies have the potential to incorporate emerging technology to enhance safety through applications such as data collection, advanced warning systems, and collision avoidance systems.

⁴⁸ NCTCOG, (2020). *Progress North Texas 2020: Connecting the Dots of Regional Transportation*.

⁴⁹ City of Plano, *Comprehensive Plan 2021*

⁵⁰ Dallas County (2020), *Dallas County Mobility Plan*

⁵¹ City of Fort Worth (2020), *Master Thoroughfare Plan*

⁵² TxDOT, *Texas Transportation Plan 2050 – Texas Long Range Transportation Plan*

⁵³ NCTCOG, *Mobility 2045*

Opportunities for Emerging Technologies

Emerging transportation technologies offer opportunities for improving safety for vehicle occupants and vulnerable road users.

Open road tolling eliminates the safety risks at the bottlenecks created by toll plazas.

Connected vehicles (CVs) can share travel and safety information to drivers through in-vehicle messaging. There are potential safety applications when CVs can communicate with other vehicles, for example, they can help a driver to “see” around blind spots, activate emergency braking sooner, detect vulnerable road users who can communicate with the CV. CVs can share data to infrastructure or traffic management centers about traffic, pavement, or weather conditions to inform maintenance and operations. Additionally, CV manufacturers can provide aggregated, anonymized data on crash incidents as well as near-miss events such as harsh braking, harsh acceleration, lane departure warnings, etc. Insights from this data can proactively point to hotspots within the traffic system that may pose safety concerns.

Some advanced safety technologies are available today. **Advanced driver assistance systems** are standard or optional features on many new passenger, transit, and freight vehicles. Technologies such as lane keeping assist, blind spot warning, forward collision warning, and automatic emergency braking help drivers avoid crashes or slow down to reduce the severity of a crash.

Automated vehicles might offer additional safety benefits by always remaining attentive, by being able to process and respond to situations faster than a human driver, and by being able to communicate with other vehicles or equipment to get safety-related traffic information that isn't available to a human driver. Approximately 94% of crashes are human error related. Automated vehicles have been estimated to reduce crashes by 40%. TxDOT hopes emerging vehicle technology could reduce fatalities in 2050 on all public roads by as much as 51% (expected) to 85% (optimistic).

Unmanned Aerial Systems (UAS or drones) can support traffic safety through accident reconstruction, quick clear, and congestion mitigation.

Emerging technologies are creating **new data sources**. Many of these data can share safety information faster than traditional crash reporting, which takes years to process. Local agencies will need guidance to understand how best to use emerging technology data to monitor safety impacts so they can make policy or program changes if safety goals are not being met.



Section 6

Infrastructure Readiness & Resiliency

INFRASTRUCTURE READINESS & RESILIENCY

Infrastructure readiness is focused on what needs to be done to prepare our roadways and other transportation infrastructure for automation and related technologies.

Regional Needs & Challenges

Over the next 25 years, NCTCOG expects to see changes in vehicle automation, shared mobility, and electrification. As a result, infrastructure readiness extends beyond traditional transit and transportation system operations to electric vehicle charging infrastructure, active transportation networks, connected and automated vehicle support, data sharing and management, and resiliency.

Automated vehicle developers recommend roadway owners and transportation system operators support AV development by maintaining lane striping on roads and sharing accurate data and information about lane and road conditions, such as construction work.

As the fleet transitions to automation, dedicated lanes might be needed for special use, such as AV-only lanes, truck-only lanes for platooning, or separated and protected bike/e-scooter lanes.

Investment is needed in communications infrastructure, such as fiber optic cable and small cells that support 5G wireless communications. Policymakers describe a growing *digital divide* between rural and urban regions that could put geographic limits on technological, social, and economic opportunities in the future without the right investments in rural digital connectivity.⁵⁴ Infrastructure readiness and resilience improvements need to focus on the *digital divide*.

Advanced traffic signal systems could require upgrades to signal controllers, controller cabinets, detectors, and communication equipment along arterial corridors.

Data sharing between public agencies and private entities is needed to enable logistics applications and technologies that will help to use the existing transportation system more efficiently.

Technology adoption leads to cybersecurity risks. Agencies need to follow best practices for developing and enforcing cybersecurity plans and protocols to keep their networks and data secure.

“Resilient communities can efficiently absorb economic, social, and environmental shocks, including disasters such as pandemics.”

– Todd Litman,
*Pandemic-Resilient
Community Planning*

Regional Goals and Objectives

The infrastructure readiness & resiliency goals of NCTCOG member agencies are to:

- Encourage sustainable development and minimize carbon emissions
- Ensure adequate infrastructure maintenance and protect against natural disasters

⁵⁴ TxDOT, [Texas Transportation Plan 2050](#) – Texas Long Range Transportation Plan

- Maintain a robust interstate system that can pioneer automated transportation technologies

The NCTCOG approach to infrastructure readiness is focused broadly on four categories: (1) assets, (2) data, (3) integration, and (4) resiliency.

Assets. Use emerging technologies to increase the efficiency and capacity of the existing transportation system without widening roads, building new roads, or otherwise adding capacity to the network. Asset management includes roadway maintenance. NCTCOG is focusing on maintaining roads with good quality lane striping to benefit human drivers and automated driving systems.

Data. Share crucial decision-making data in real-time so roadway operators can help improve the operation of automated vehicles. For example, share accurate information about changes to roadway conditions because of events, such as lane closures for construction work.

Integration. Local agencies share the common infrastructure goal: to prepare the transportation system for connected and automated vehicles. North Central Texas is integrating emerging technologies into the existing transportation system through pilot deployment programs and planned roadway improvements.

Resiliency. Create a resilient transportation system that can avoid, minimize, and recover from unforeseen events. A resilient transportation system offers travelers multiple options. North Central Texas has already invested in transportation through transit, rail, trail, and roadways projects to connect communities. Hurricanes, winter storms, power outages, cyber threats, and pandemics are real-world challenges that the resilient transportation system must be able to overcome to continue to provide safe, affordable, and accessible transportation options to travelers and shippers.

Current Plans, Policies, and Programs

Planned Roadway Improvements. Planned roadway improvements included in NCTCOG's *Mobility 2045* long-range transportation plan include improvements to the controlled-access roadway, the arterial network, and roadway design.

- Controlled-access roadway improvements include a mix of adding new capacity to existing freeways and toll roads, constructing new managed lanes, performing asset optimization to existing facilities, and dedicated lanes for AVs.
- Arterial street improvements will provide additional capacity mainly along the region's peripheral zones to accommodate the expected developments and to ensure their connectivity with the regional transportation system.
- Roadway design enhancements to support AV operation include in-vehicle safety warnings to support safety goals, improved maintenance standards and lane markings, updated roadway design (i.e., narrower lanes) for AVs, cellular infrastructure updates, and modified signage and messaging signs (due to a reduced need to influence human driver behavior).

Planned Technology-Supporting Projects. Regional infrastructure technology actions include open data and data sharing projects (including the 511DFW/Waze data sharing collaboration and the traffic signal data sharing project), connected vehicle deployments in the Cities of Arlington and Frisco, smart transportation websites developed through university partners, and

technology corridor developments. TxDOT plans to develop, test, and implement technology to deduct and verify auto occupancy on regional managed lane systems. NCTCOG's Transportation Improvement Program (TIP) includes projects focused on technology infrastructure related to:

- Digital or enhanced access to the digital world within the right of way
- Cellular or low-latency communication for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) applications
- Vehicles as sensors or cars as advanced road sensors via smart phones and vehicle telematics
- Big data and artificial intelligence or the process of wrangling with data
- Digitizing condition of roads, sidewalk, signs, curbs, etc. for use in V2V and V2I communication
- Maintenance of striping, consistent signage, and fewer potholes

Parking and Curb Management. The demands for curb space are changing. NCTCOG developed a regional planning guide that recommends actions communities can take to ensure varying modes can access the curb and different or competing activities can occur at the curb in a safe and orderly manner:⁵⁵

- *Use policies to institute a price or time limit on spaces and encourage use of often-abundant, off-street spaces to reduce parking issues and ensure equitable sharing of the curb spaces.*
- *Set-up policies to provide pickup and drop-off zones, vehicle storage, and abandonment ordinances for freight delivery.*
- *Implement Advanced Parking Guidance Signs (APGS), parking sensors, and mobile applications to assist parking alongside curb.*
- *Establish a curb usage fee for TNC services and monitoring TNC pick-up and drop-off activities through third-party camera technology.*
- *Designate pick-up and drop-off areas for TNC services by implementing computer-generated geofencing applications.*
- *Establish policies related to mobility options along the curb, such as protected bike lanes, bus bulbs, queue jumps etc.*
- *Create regulations governing the use of micro-mobility options and physically organizing portions of the curb itself.*
- *Establish policies to ensure 'equity' among all the competing modes to accommodate the relatively increased demand of non-auto modes.*

The **City of Arlington** conducted a **parking needs analysis**, which included a high-level parking needs assessment and shared parking model based on new uses.⁵⁶ The memo recommends several parking policies including:

- *Encourage a "park once" policy intended to limit internal vehicular circulation within downtown Arlington.*
- *Develop efficiency of existing and new parking facilities through shared-use parking strategies and strategic locations that maximize the ability of parking structures to conveniently serve as many user groups as possible.*

⁵⁵ NCTCOG, [Parking Management](#)

⁵⁶ NCTCOG, [Arlington Parking Needs Analysis Technical Memorandum](#), 26 June 2019. nctcog.org

- Develop parking structures that act as multimodal hubs integrated with existing and future active transportation, microtransit⁵⁷, and shared mobility options.

Opportunities for Emerging Technologies

Connected and automated vehicle technologies represent an array of innovative approaches to transportation and infrastructure design and operations.

Connected vehicles. NCTCOG's Transportation Improvement Program (TIP) identifies projects to enhance communications for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) applications, infrastructure maintenance, and digital installations in the right of way. Long-range plan improvements include both infrastructure installations and projects to modify driver behavior.

Automated vehicles. AV developers recommend roadway owners and transportation system operators support AV development by:

- Maintaining lane striping on roads
- Sharing accurate data and information about lane and road conditions, such as construction work

HOW CAN TRANSPORTATION AGENCIES SUPPORT AUTOMATED VEHICLE DEVELOPMENT?

- Maintain roadway lane striping
- Share accurate data and information about lane and road conditions, such as construction work

Weather Sensors. NCTCOG could update existing micro weather radars in the Collaborative Adaptive Sensing of the Atmosphere (CASA) program to collect more detailed weather data for use in ground and air vehicle industries.⁵⁸

Data Sharing. NCTCOG is focused on active system management, which requires data collection and sharing. NCTCOG encourages local partners to share transportation data to support connected and automated vehicles, such as traffic signal data (such as signal phase and timing information) and traffic data (through the 511DFW/Waze data sharing project).

High-Speed regional connections such as commuter rail, light rail, and bus rapid transit for commuting and special event trips can be enhanced with transit signal priority for congested corridors and railroad crossings. This could also include the use of IH 30 between Dallas and Fort Worth for testing high-speed automated vehicles.

Internet access is a critical component for readiness consideration. The transportation system uses the Internet of Things to support transportation systems management and operations (TSMO) strategies such as advanced traffic signals, variable message signs, dynamic tolling, incident management, transit operations, and traveler information sharing. Expanding internet access beyond the transportation system to provide home- or work-based internet access can expand mobility options for residents by enabling access to the Internet of Things.

⁵⁷ Microtransit is shared, demand-responsive transit with flexible routing or flexible scheduling. Source: Wikipedia, "[Microtransit](#)"

⁵⁸ <https://www.nctcog.org/ep/casawx>

Project Prioritization Process

Selecting projects for the Metropolitan Transportation Plan requires NCTCOG to score projects based on system selection (part of a larger/regional network), technical selection (project need), and prioritization (planning status, implementation timeline, and local support). This process focuses on identify strategic infrastructure investments that maximize the existing system (Figure 5).



Figure 5. Prioritization of Improvements

Source: NCTCOG Mobility 2045, Exhibit 6.5-1

Emerging technologies are new and evolving. Unlike more traditional transportation improvement projects, there isn't a lot of historic data available on emerging technologies to support data-driven decision making. Impacts of automated vehicles on capacity are based on simulation models, rather than real-world traffic data monitoring, because there simply aren't enough automated vehicles in the fleet yet. Long-lasting parking demand changes due to ridehail and shared mobility services are not yet known.

Agency decision makers at NCTCOG and TxDOT will need to get comfortable comparing and scoring projects that have historical impact data and strong community understanding with new technology projects that lack real-world data and are new concepts not widely understood by the public or decision makers.

Project selection should also consider equity and barriers to technology access to ensure projects provide safe, affordable, equitable, and accessible travel options for all communities.

Agencies should start monitoring their transportation system utilization and demand today to be able to identify trends to support project prioritization and decision making.

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Section 7

Current Emerging Technology Efforts

REGIONAL EMERGING TECHNOLOGY EFFORTS

The region is evaluating several innovative transportation technologies that could reduce traffic congestion, enhance safety, and increase economic productivity. This section highlights examples of emerging technologies in the region that are currently undergoing evaluation or have recently been tested including connected vehicles, automated vehicles, open-road tolling, cloud computing, and crowdsourcing data.

NCTCOG AV2.2 & AV2.3 Grant Program

In 2021, NCTCOG received eight proposals for funding from the AV2.2 and AV2.3 programs submitted by three cities, two institutes of higher education, one transit agency, one private sector company, and one non-profit. Project objectives ranged from delivering food to needy communities, moving students around campus, creating first-mile/last-mile connections for hospital patients, and expanding infrastructure in support of e autonomous freight. Details of the six awarded AV2.2 and AV2.3 projects are provided in **Table 2** below.

Table 2. NCTCOG AV2.2 and AV2.3 Selected Proposals

Proposer	Title	Project Purpose	Funding Request	Partners
DART	Transit Bus Automated Vehicle Purchase and Deployment	The purpose of this project is to purchase and deploy in transit service four 40-foot SAE Level 4 automated transit buses. These buses will be placed into service on Route 524 (DART's Love Link route), which operates between the Inwood Road/Love Field Station and Love Field airport.	\$2,250,000	NCTCOG, City Dallas, Love Field Airport
City of Richardson	Infrastructure Upgrades and Senior AV Ride Services	The AV2.2 project will include infrastructure upgrades at 10 locations to supplement AVs with crucial information, including vulnerable road user (VRU) location information and traffic signal status. Communications from the traffic infrastructure will use Cellular Vehicle-to-Everything (CV2X)/LTE2X communication. The AV2.3 project will provide AV ride services for seniors and the underserved to/from various points-of-interest in the city, including Network of Communities Ministries, Richardson Public Library, City Hall/Civic Center, YMCA, First United Methodist Church, USPS, and Arapaho Center Station.	AV2.2: \$1,521,595 AV2.3: \$3,048,00	University of Texas at Dallas and private entities
Paul Quinn College	Automated Delivery of Produce in the South Dallas Food Desert	Paul Quinn College (PQC) proposes to use automated and/or remote-control vehicles (bots) to deliver fresh produce from PQC's WE Over Me Farm to 250 pre-determined single-family homes and key locations in a defined service area.	\$1,000,000	City of Dallas and technology partners

Dallas College	Dallas College Autonomous Vehicle Initiative	Deployment of autonomous shuttles on and around campus will provide practical learning and internships opportunities for students engaged in the program. Further, Dallas College wishes to provide better mobility options for its students and visitors and is undertaking a project explore how AV technology can achieve that goal.	AV2.2: \$1,150,000	1. Beep, Inc – envisions the deployment and operations of a local circulator at the Cedar Valley campus.
			AV2.3: \$2,840,000	
			AV2.2: \$1,150,000	2. May Mobility – proposes the deployment of approximately 5 autonomous, electric vehicles to cover approximately 10 miles of road in the Eastfield campus and surrounding community.
			AV2.3: \$3,560,000	
City of Fort Worth	Open-Access Autonomous Truckport	The Truckport project will help increase the efficiency of Interstate 35W, which serves as one of the Metroplex's key lifelines and faces high levels of traffic congestion. The Truckport will leverage the existing supply chain ecosystem within Alliance Texas to improve transportation efficiencies focused on drayage and long-haul movements.	AV2.2: \$1,124,088 AV2.3: \$4,963,625 Matching Funds: \$2,019,680	Alliance Texas, Pilot Travel Centers LLC, and leading autonomous trucking developers spearheaded by Kodiak Robotics

Transportation Data Sharing Program

NCTCOG encourages local partners to share transportation data to support connected and automated vehicles. In 2018, NCTCOG provided local grants for public agencies who were willing to make their **traffic signal data** accessible to developers, universities, NCTCOG, and other public entities, and for public agencies willing to participate in the **511DFW/Waze data sharing project**.⁵⁹ Traffic Signal Data Sharing Project agencies include Arlington, Flower Mound, Frisco, Garland, Grapevine, Grand Prairie, Plano, and TxDOT. 511DFW/Waze data sharing project agencies include Arlington, Crowley, Frisco, Garland, Grand Prairie, and Plano.

Cloud Computing & Crowdsourced Data

Cloud computing and crowdsourcing are two emerging technologies that are usually combined to enhance data services for transportation applications. *Cloud computing* makes data, infrastructure, and software available on the Internet and allows end users to remotely access high-powered computing resources through Internet connections. *Crowdsourcing* enables rapid and inexpensive automatic collection of data/information from the users of the system. A layer of advanced data analytics is built on top of these platforms for improved system management, organizational efficiency, and public communication. The **City of Dallas** recently

⁵⁹ NCTCOG, "Traffic Signal Data Sharing Grant Program and 511DFW/Waze Grant Program Awards", Surface Transportation Technical Committee Presentation, 28 July 2017. Accessed 3 August 2021. nctcog.org

completed a project that leveraged these technologies through tapping into the smartphone application Waze's real-time road closure data to speed 911 response times.⁶⁰

Open-Road Tolling

Open-Road Tolling allows a toll operator to collect tolls without using booths or stopping vehicles. Instead, vehicles are equipped with transponders or other readable devices connected to a credit card or payment account. Open-road systems also can use license plate recognition technology to invoice those without readable devices. By eliminating the need to stop to pay tolls, open-road tolling leads to better traffic flow, improved safety, faster travel times, reduced congestion, and lower emissions. Vehicle owners in the region can obtain **TollTag®** which allows them to drive along North Texas Toll Authority (NTTA) toll roads and any toll road in Texas without stopping for paying the tolls. TollTag® can also be used to pay for pass-through and parking costs at DFW International Airport, and to pay for parking costs at Love Field Airport.⁶¹

Connected Vehicles

Connected Vehicle (CV) technologies use wireless communication to connect vehicles with each other and the surrounding infrastructure (e.g., cell towers or roadside communication equipment). There exist three types of connectivity:

- Vehicle-to-vehicle (V2V)
- Vehicle-to-infrastructure (V2I)
- Vehicle-to-everything (V2X) – such as pedestrians, cell phones, buildings, etc.

CV technologies create an intelligent transportation environment that could enable safety, mobility, and environmental solutions to prevent collisions and reduce traffic congestion (which also reduces fuel consumption and decreases greenhouse gas emissions). Several projects that implement CV technologies in the region are underway.

The **TxDOT Texas Connected Freight Corridors** project is deploying connected vehicle technology on more than 1,000 commercial vehicles to improve traveler information, asset condition management, and system performance. The technology could also increase the safety of the traveling public and reduce both truck-related crashes and the time trucks spend in congestion.⁶²

The **City of Arlington** is testing multiple CV technology applications, including:

- Red-light violation warning application.⁶³
- Driver information alerts, such as pedestrian proximity, upcoming school zones, and approaching fire trucks. (Partner: Applied Information)
- *Enlighten* advance traveler information system providing drivers with real-time signal data, anticipated wait time, and suggested travel speed. (Partner: Connected Signals, Inc.)

⁶⁰ Dallas Innovates, "[How North Texas Dispatchers Tapped Waze Data to Speed 9-1-1 Response Times](#)". Accessed 7 July 2021.

⁶¹ NCTCOG, [TollTags® at NCTCOG](#), www.nctcog.org

⁶² TxDOT, [Texas Connected Freight Corridors](#), www.txdot.gov

⁶³ CAMP LLC (2021), Vehicle-to-Infrastructure (V2I-4) Consortium, [Red Light Violation Warning \(RLVW\) Application Vehicle System Concept of Operations](#), www.campllc.org

NCTCOG is pursuing a **freight signal priority pilot deployment**. This pilot program aims to identify main freight routes in the region and to optimize the signal timing plans along these routes to provide priority to trucks. The goal is to increase the efficiency and reliability of freight movement in the region.

Automated Vehicles

Automated vehicles (AVs) use sensors and computer systems to perform driving tasks with limited to no input from a human driver. Applications of AV technology could increase roadway capacity, vehicle throughput, and travel time reliability; reduce crashes; reduce emissions; reduce urban parking land use requirements; and increase access to travel for people unable to drive. North Central Texas is a leading region in AV pilot deployments. These pilots were discussed in more detail in the Personal Mobility and Freight Movement sections.

- Frisco Drive.ai Automated Vehicle Pilot
- Arlington milo Low-Speed Automated Shuttle Pilot
- Arlington Drive.ai Automated Vehicle Pilot
- Arlington RAPID Automated On-Demand Ridehail with Via
- TuSimple, Kodiak Robotics, and Aurora automated freight testing in the 'Texas Triangle'
- DFW Skylink Automated People Mover
- Frisco Starship Technologies Personal Delivery Device pilot
- Arlington Marble robotic delivery device testing

Common Payment Systems

Travelers can use the **GoPass®** mobile app to plan trips, purchase tickets, and check the balance of their reloadable farecard for transit trips on DART, Trinity Metro, Trinity Rail Express, Denton County Transit Authority, Tulsa Transit, STAR Transit, and the Dallas Streetcar System. Through partnerships with micromobility providers and ridehail services, transit agencies could further connect common payment systems to other last-mile connection services. The private industry is doing this by combining ridehail services and micromobility services in the same app (like the Uber/Lime partnership⁶⁴).

Parking and Curb Management

The demands for curb space are changing. Parking and curb management plans and policies are needed to ensure competing activities can occur at the curb in a safe and orderly manner. Airports like DFW and Dallas Love Field were forced to be leaders in curb management due to the unexpected impacts that ridehail services had on passenger pick-up/drop-off traffic. NCTCOG developed a regional planning guide⁶⁵ and the City of Arlington conducted a **parking needs analysis**.⁶⁶ NCTCOG provides regional training to help more communities learn the best practices for parking management and curb planning.⁶⁷

⁶⁴ Uber Help, "[Uber's Lime scooter partnership](#)". Accessed 11 August 2021. [help.uber.com](#)

⁶⁵ NCTCOG, [Parking Management](#)

⁶⁶ NCTCOG, [Arlington Parking Needs Analysis Technical Memorandum](#), 26 June 2019. [nctcog.org](#)

⁶⁷ NCTCOG, ["Parking Events and Symposiums"](#) [nctcog.org](#)

Urban Air Mobility

Urban Air Mobility (UAM) relates to new areas of policy recommended by the Federal Aviation Administration to ensure safe operations of highly automated aircraft for passengers or cargo within urban and suburban areas. NCTCOG formed an **Unmanned Aircraft System (UAS) program**.⁶⁸ This program has produced the *Regional General Aviation and Heliport System Plan*⁶⁹ and *Unmanned Aircraft Systems Report* (2012). NCTCOG also formed the North Texas Unmanned Aircraft Systems (UAS) Safety and Integration Task Force, which is reviewing national policies and best practices to develop local guidance to promote safe UAS operation and integration into the DFW regional airspace. More information is available on the UAS program website www.northtexasuas.com. NCTCOG is also a partner in the NASA Community Planning and Integration Partnership.⁷⁰

High-Speed Rail

NCTCOG is working to bring high-speed transportation options to, from, and within the region through its **High-Speed North Texas program**.⁷¹ *Mobility 2045* outlines the regional plan for high-speed rail corridors. The high-speed modes considered include conventional rail, higher-speed rail, high-speed rail, maglev (magnetic levitation rail), and hyperloop (next-generation maglev).

Electric Vehicles

Electric Vehicles North Texas (EVNT) is the Electric Fuel Subcommittee of Dallas-Fort Worth Clean Cities (DFWCC). The EVNT program encourages and supports the transition to electric vehicles by educating the region through resources, data, and networking opportunities.⁷²

⁶⁸ NCTCOG, "[UAS](http://www.nctcog.org)". [nctcog.org](http://www.nctcog.org)

⁶⁹ <https://www.nctaviationplan.com/>

⁷⁰ Dallas News, "[Air Taxis and Drones: Why North Texas is Teaming up with NASA to Study Transportation](#)", 4 June 2021.

⁷¹ NCTCOG, "[High-Speed Rail](http://www.nctcog.org)". [nctcog.org](http://www.nctcog.org)

⁷² <https://www.dfwcleancities.org/evnt>



Section 8

Conclusions

CONCLUSIONS

Emerging technologies, like automated vehicles (AVs), could support the region's mobility, quality of life, system sustainability, and project implementation goals.

Personal Mobility. Travelers need safe, affordable, accessible, and reliable transportation options. Resilient systems offer multiple options to give travelers flexibility. Emerging transportation technologies could improve personal mobility by reducing the monetary cost of travel and the time cost of travel. From an agency and user perspective, two of the biggest challenges facing automation goals are public acceptance of AV technologies and acceptance in the growth of automated shared-mobility services that would require drivers to abandon their personally operated vehicles to use a shared service.

Freight Movement. Freight movement is the backbone of the North Central Texas economy. Reducing congestion and balancing commodity flows are critical needs to support the regional freight economy. Automation presents opportunities for highway applications (like platooning) and for last-mile delivery solutions (like urban air mobility, sidewalk delivery robots, and other automated delivery vehicles). Real-time traffic data sharing supports logistics applications.

Equity. Emerging technologies (like automated vehicles, ridehail, and micromobility) may provide unprecedented mobility solutions to all members of our communities, such as children, the elderly, low-income households, disadvantaged communities, and traveler with physical or visual impairments. However, technology and mobility services may not be available to all residents, especially those without smartphones or those who are un- or underbanked. Resilient planning will need to find solutions to overcome those barriers and provide multiple safe and reliable mobility options to all communities.

Safety. NCTCOG is striving to eliminate all transportation-related fatalities. Emerging transportation technologies could improve safety for vehicle occupants and vulnerable road users through regional applications in data sharing, connected and automated vehicles, and open road tolling. As emerging technologies are increasingly integrated into the North Central Texas region's transportation system, *safe* (and possibly *separate*) facilities will be crucial for preventing conflicts between people walking, rolling, and biking with automated vehicles, delivery robots, and other technology applications sharing the rights of way.

Infrastructure Readiness and Resiliency. Emerging technologies could increase efficiency and capacity of the existing transportation system without widening roads, building new roads, or otherwise adding capacity to the network. Infrastructure readiness extends beyond traditional traffic signal, transit, and transportation system maintenance and operations to electric vehicle charging infrastructure, connected and automated vehicle support, data sharing and management, and resiliency.

What can agencies do today?

Self-Assess. Agencies can support automated vehicle development by maintaining roadway lane striping and sharing accurate data and information about lane and road conditions, such as construction work.

Get Data. Agencies should start monitoring their transportation system utilization and demand today to be able to identify impacts and trends. For example, monitor parking utilization today

to learn if AVs or shared mobility reduce parking demand, which could allow an agency to change parking requirements or repurpose parking facilities.

Get Smart. The private industry is driving automation and logistics innovation. Local agencies need to be part of the conversations to learn what is coming, what the impacts could be, and how the transportation system can support this innovation to meet regional goals and needs. NCTCOG and its partners can ensure a seat at the table by inviting the freight industry to participate in the planning process.

NCTCOG's AV 2.0 program supports pilot deployments. Pilots help the public and the public agencies learn how to use and work with the next generation of transportation. They give municipalities the opportunity to learn directly about the effects that new technologies will have on local communities and to learn what unique solutions are needed to fit the existing infrastructure and travel demands. Identifying challenges early on enables an agency to make changes in response to lessons learned.

Agencies interested in more guidance on how to plan for the effects of emerging technologies on land use and transportation should reference *NCHRP Report 924* to learn how to self-assess, get data, and get smart to develop nimble policies and programs.⁷³

What's next in AV2.1?

Emerging technologies, like automated vehicles (AVs), could support the region's goals for mobility, quality of life, system sustainability, and project implementation. These technologies are not a one-size-fits-all solution. Local agencies will need guidance on how to *adopt* and *adapt* to achieve the greatest benefits from emerging technologies.

Over the next year, the AV2.1 program will deliver a regional vision with tailored planning tools, and suggested policies that NCTCOG and its partners agencies should employ to ensure AVs address the region's mobility, safety, accessibility, and reliability needs. This guidance will help the region be proactive (rather than reactive) in its planning for new technologies and in how it pursues technologies as tools to advance community goals.

⁷³ National Cooperative Highway Research Program (NCHRP). 2019. Report 924: *Foreseeing the Impact of Transformational Technologies on Land Use and Transportation*. <https://doi.org/10.17226/25580>.