NCTCOG AUTOMATED TRANSPORTATION SYSTEM DEVELOPMENT

(EXECUTIVE SUMMARY)

North Central Texas Council of Governments

LEA ELLIOTT

vai architects

VRX

BURNS McDONNELL

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EXECUTIVE SUMMARY

The North Central Texas Council of Governments (NCTCOG) is highly focused on integrating more technology in transportation as it performs transportation planning for a twelve-county region. As our region grows, the need to identify innovative means of transporting people and goods while managing congestion and reducing emissions is even more pronounced. Transportation continues to evolve, and the demands and expectations of transportation users evolve with it. Bus riders used to check timetables; now they look at live tracking for the location of the next bus. Dispatchers connected riders and taxicab drivers; today various apps serve as virtual dispatchers. Even uncrewed aircraft vehicles (UAV or sometimes colloquially known as drones) and sidewalk-bound robots are beginning to deliver small packages in campus and neighborhood settings. A successful transportation network of the future must provide its users with the mobility options they need, and rapidly evolving technology will be a part of it.

Previous solutions to the need for district-wide transportation in campus or dense urbanized areas, serving as circulators or regional connectors, have typically been capital-intensive infrastructure projects which end up locked into a specific technology or mode of transportation. While these projects may succeed at first, they prove to be difficult or expensive to maintain as components for the transportation system become more difficult to source, let alone attempt to expand.

With this in mind, NCTCOG's efforts to evaluate emerging technology innovations have focused on achieving economies of scale through modular infrastructure that is paved for use by any independent-running vehicle, "future-proofing" the infrastructure and providing users with demand-responsive transportation. This approach, the core vision of NCTCOG's Automated Transportation System (ATS) Initiative, reduces long-term risks of obsolescence of the infrastructure while providing maximum opportunity to use any current and future vehicle technology depending on the changing transportation needs. In other words, the "smart technology" is removed from the infrastructure and secured wholly within the vehicle. This type of system – smart vehicle and paved guideway infrastructure – allows for leveraging of technology advances in ATS vehicles without simultaneously sacrificing the infrastructure investment.

Previous work in this initiative has included the development of the Last Mile Transit Connections Concept Study (2015/2016): a regional exploratory analysis of people movers and other local-scale transit options, the development of Geographic Information Systems (GIS) mapping and data algorithms to determine feasible locations within the region that might benefit from an ATS deployment. Building on this exploratory effort, the study of the Dallas International District (previously Midtown) advanced the initiative through the Dallas Midtown Autonomous Transportation System and Shared Parking Feasibility Study (2019): a planning study integrating the ATS route planning with parking management and land use considerations, including a separate technology survey of available ATS vehicles. These previous efforts serve as a foundation for this study, ATS Development, to focus on the three main components of an ATS: vehicles, charging systems for the vehicles, and guideways.

The ATS Development Study explores independently operating ATS vehicle technologies for transporting both passengers and cargo/goods; reviews cutting-edge options for wireless Electric Vehicle (EV) charging technologies, with a focus on dynamic charging; and develops modular guideway infrastructure design guidelines using the latest advances in technologies. To future-proof infrastructure investment for grade-separated (elevated) guideways, these structures must not preclude utilization by various types of ATS vehicles. In kind, the ATS vehicles themselves must be able to traverse a simple, paved guideway without relying on guideway-mounted rails for propulsion or guideway-mounted equipment for vehicle guidance

that would be technology-specific to each vehicle. As such, the modular guideway is envisioned to provide a) a signature appearance, b) a means for efficient assembly with standardized components readily available, and c) economies of scale to potentially reduce construction costs, process, and time.

Additionally, this ATS development study will use pilot projects and case studies within the region to inform the analysis of vehicles and charging systems and the development of guideway design guidelines. Retrofit opportunities for existing people mover systems within the region will also be explored to determine if these structures can be reused for the ATS concept.

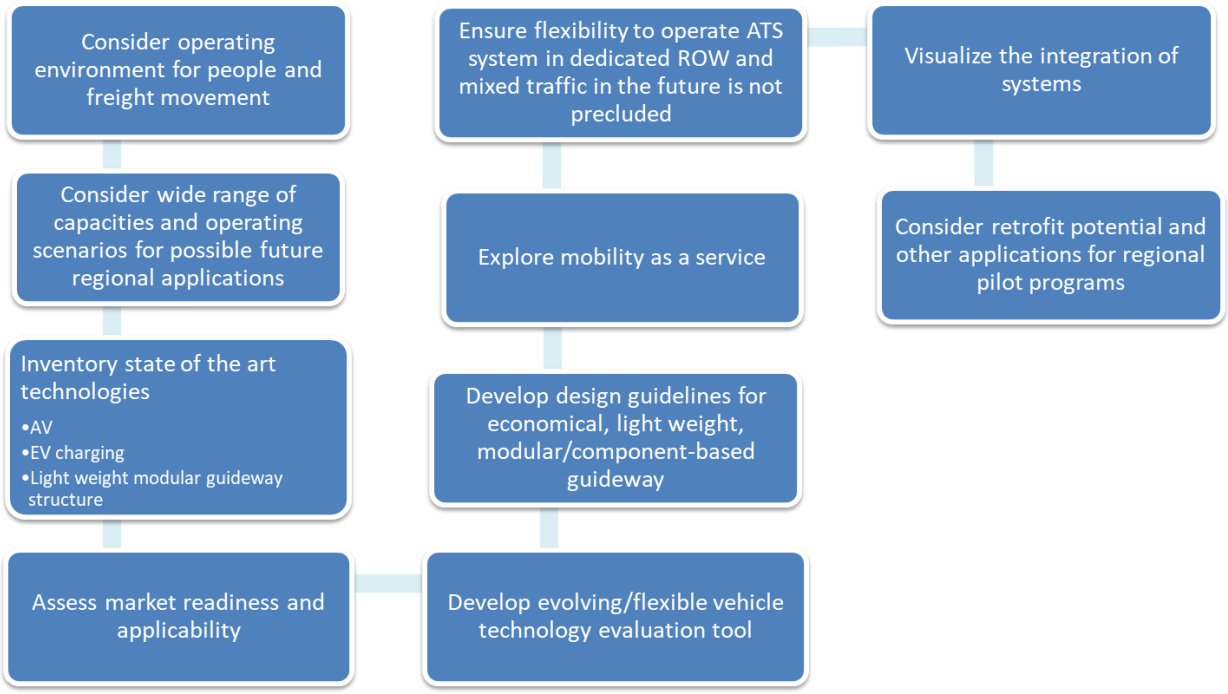
The results of this study are intended to provide a flexible guideline that can be updated as technologies evolve and can be used as a guide to plan and design future ATS systems. The guidelines will assist public agencies in laying the groundwork for future mobility-as-a-service transportation system for the region.

Background and Study Approach

Two operating environments were identified as example applications and were used in developing the basis of this study. Operating Environment A (OE-A) is a manufacturing environment involving the transportation of cargo/goods within a manufacturing complex. Operating Environment B (OE-B) is focused on transporting passengers in a dense urban environment. To support the development of the ATS system guidelines for applicability in any future passenger or cargo/goods movement within the parameters of OE-A and OE-B, the study considered two specific potential pilot systems and two retrofit applications of existing people mover systems within the region. The pilot locations used for the study were the Dallas International District and the General Motors (GM) manufacturing facility located in Arlington. The retrofit projects considered were the Las Colinas Urban Center Area Personal Transit (APT) and Dallas-Fort Worth (DFW) International Airport Skylink Automated People Mover (APM). It was important to review the applicability of the concepts with both new systems and retrofit of existing systems to assess the viability of both approaches.

Early in the study, NCTCOG facilitated a series of outreach activities that included meetings with stakeholders and research and development professionals, as well as tours of various pertinent sites to ensure the study included relevant assumptions and criteria in the development of the concept. In addition, this industry outreach was helpful in establishing the study approach and understanding the current state of development of some technologies.

The study approach shown below was established as a general guideline for the work.



Technology Identification and Representative Technology Suppliers

Assessment of ATS Vehicle Technologies

An inventory of state-of-the-art ATS vehicle technologies that allow for a wide range of capacities and operating scenarios for potential future regional applications for passenger and cargo/goods movement was developed. The technologies considered in the study were selected based on their applicability for either OE-A (cargo/goods movement in manufacturing environment) or OE-B (passenger movement in dense urban environment).

A Request for Information (RFI) was issued by NCTCOG to get additional information from emerging ATS technology suppliers to augment the database of ATS vehicle technologies and current information available regarding the specific vehicles. NCTCOG received responses from three ATS vehicle technology suppliers.

To accommodate the fast-paced evolution of the Autonomous Vehicle (AV) technologies, it was necessary to develop tools that could be used by NCTCOG to continue to evaluate the readiness of these technologies for future implementation projects. A technology evaluation plan was created to assist the user in assessing market readiness and applicability of technologies within the available inventory that provide the required parameters for each specific use.

Based upon the study's technology goals described above, the AV technology categories that could meet the requirements of OE-A and OE-B are:

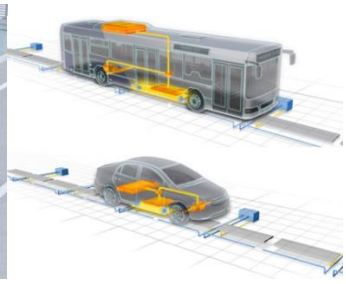
- Group Rapid Transit (GRT)
- Automated Vehicle Shuttle / Autonomous Vehicle (AV)
- Next Generation Automated People Mover (APM)
- Autonomous Bus
- Other Autonomous Technologies

Assessment of Wireless Electric Vehicle Charging Technologies

The study also involves reviewing the feasibility of using wireless dynamic Electrical Vehicle (EV) charging (charging on-the-fly) systems to help optimize the ATS operations. Ideally, the ATS technologies identified for this study will be capable of using a state-of-the-art wireless EV charging technology, immediately or in the near future.

There are three EV technology options currently available or under development:

- Stationary plug-in EV charging
- Stationary opportunity EV charging (wireless)
- Dynamic EV charging (wireless)



Stationary plug-in charging is currently the most common EV technology and is widely available on the market. Stationary opportunity EV charging can be either contact charging or inductive charging. It consists of a charging plate in the surface of the guideway/pavement that the vehicle parks over and the charging occurs while parked. This type of charging has been used as a means of supplemental charging during operations when a vehicle is stopped for a short time (such as in a station). The dynamic EV technology is embedded along the guideway such that the vehicle's batteries can be charged while the vehicle is in motion. This technology is currently under development or being tested in various pilot programs.

Currently, dynamic EV charging technologies are not yet ready for commercial use, though the pilot projects underway aim to make these technologies more commercially available in the near future. Static/opportunity wireless charging is commercially deployed and could be a good option for near-term ATS projects.

An RFI was issued by NCTCOG to access additional information from emerging EV charging technology suppliers. Two suppliers responded to the RFI.

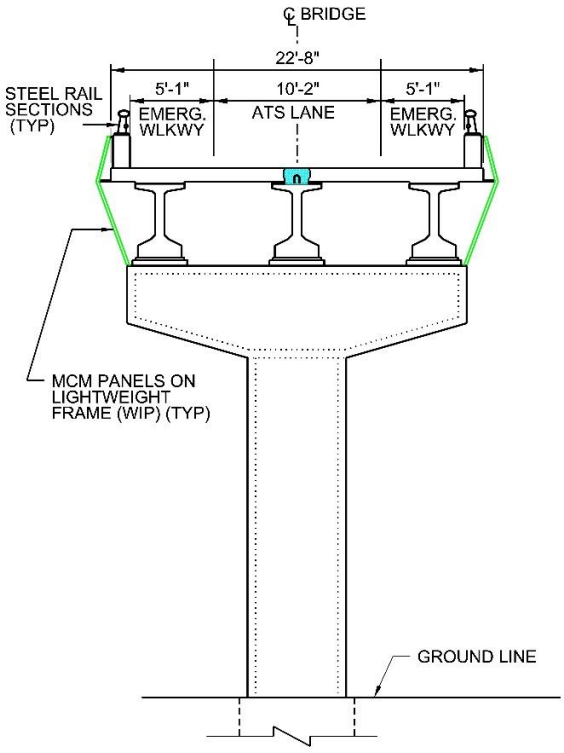
Guideway Design Guidelines

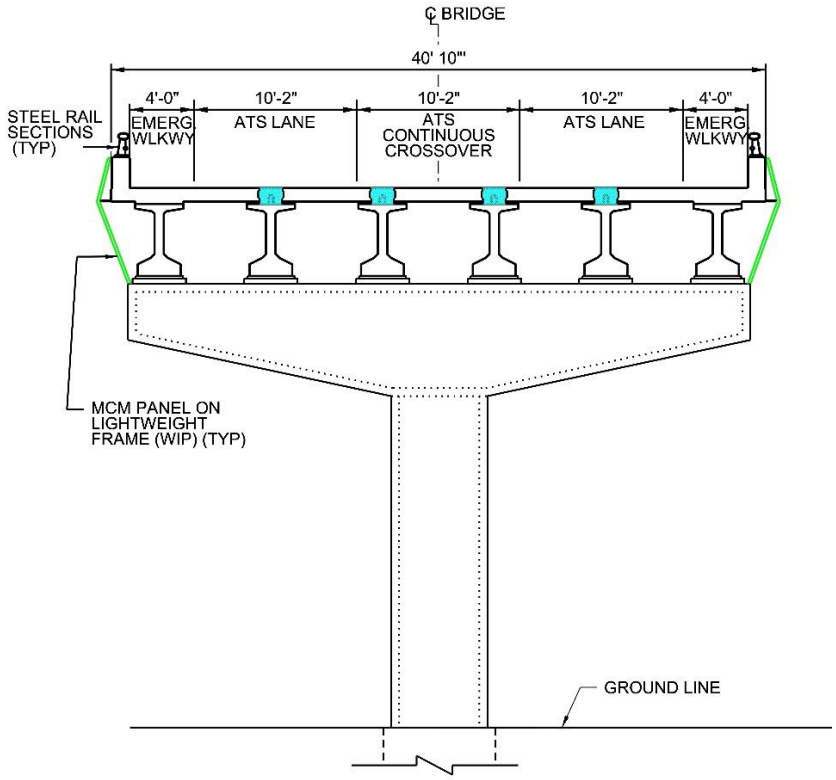
The task was to develop guidelines for a simple, paved guideway with streamlined lightweight appearance, modular construction, and innovative design materials and methods. Other practical considerations included environmental sustainability, capital cost, lifecycle/maintenance costs, consideration of business risk, availability of materials, and geometric compatibility. For the guideway system to be modular, streamlined, and low cost, weight was a major consideration. Complementing the streamlined visuals of an ATS vehicle, the guideway structure was designed to have a signature look; the structural components were designed to be modular (so they can be prefabricated to the extent possible), understanding that there are situations that preclude any bridge element preconstruction.

The substructure and superstructure components were designed so that each component can be precast in multiple pre-designed sections that can be stockpiled if desired. Then the sections can be assembled on site to create the finished guideway component and ultimately, the finished guideway.

Recommendations from an extensive evaluation, based on the criteria identified above, resulted in the selection of lightweight concrete I-Beam/ Girder or U-beam if the concrete mix meets all design strength requirements. The beams recommendations are TxDOT I-Girders with girder depths determined by span length, with TX54 preferred. For decking, the top-rated materials are Fiber Reinforced Polymer (FRP) panels or lightweight precast concrete panels depending on the application. For the columns recommendations are lightweight precast concrete columns, provided that the concrete mix meets all design strength requirements.

The final guideway structural configuration is shown below. Aesthetic considerations and accommodations for wireless EV charging equipment were also considered in the guideway design guidelines. Specific configurations should be coordinated during detailed design considering any operational and failure management requirements.


℄ BRIDGE
22'-8"
5'-1"
10'-2"
5'-1"
STEEL RAIL SECTIONS (TYP)
EMERG. WLKWY
ATS LANE
EMERG. WLKWY
MCM PANELS ON LIGHTWEIGHT FRAME (WIP) (TYP)
GROUND LINE


℄ BRIDGE
40' 10"'
4'-0"
10'-2"
10'-2"
10'-2"
4'-0"
STEEL RAIL SECTIONS (TYP)
EMERG WLKWY
ATS LANE
ATS CONTINUOUS CROSSOVER
ATS LANE
EMERG WLKWY
MCM PANEL ON LIGHTWEIGHT FRAME (WIP) (TYP)
GROUND LINE

Conclusion/Next Steps

The tools, considerations and guidelines provided in this study are intended to be used as a roadmap for future first and last mile connectivity projects in the region, including the retrofit and future pilot projects identified below. This framework provides a tool to monitor and evaluate emerging technology innovations for their applicability related to advancing the efficiency and effectiveness of passenger and supply chain transportation systems and services in north Texas, with the goal of meeting the changing mobility demands. Further, the guideway infrastructure design guidelines provide a modular approach to create a signature look to these projects and a streamlined and cost-effective approach to guideway construction.

Retrofit Projects:

Las Colinas APT Results: high-level retrofit assessment determined the APT guideway infrastructure could be modernized to allow most ATS vehicles inventoried in this study to operate; follow-on engineering designs would be required prior to implementation.

DFW Skylink International Airport APM Results: high-level retrofit assessment also determined the DFW International Airport Skylink APM could be modernized; however, further consideration should be given to the “air-side” transportation passenger movements between terminals to determine if the fixed-route circulator currently in place should continue or if on-demand type movements with smaller passenger movements are needed. This will determine operational needs and movements which will, in turn, affect the scope of any future retrofit of the existing guideway infrastructure.

Future Projects:

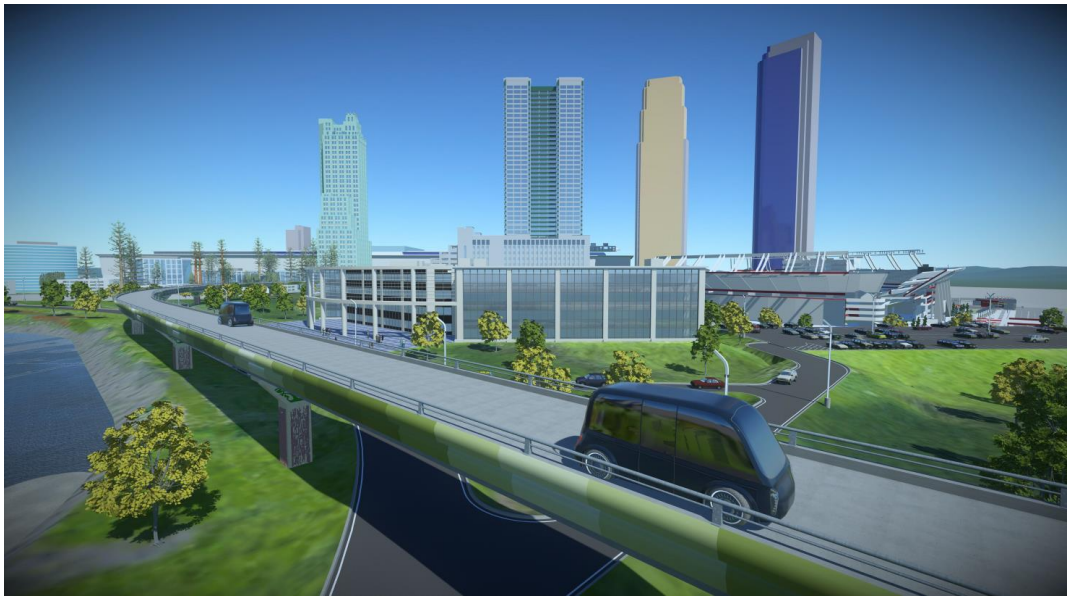
OE-A (cargo/goods movement)

For the pilot project addressing OE-A (cargo/goods movement) at the General Motors manufacturing facility and for other future projects where repeated movements can be supplanted by ATS technology, project development can utilize the findings of this study to determine compatibility of ATS vehicle technology with their particular objective as well as the appropriate operating structure to govern the ATS fleet. Implementation details must be coordinated among private and public entities on alignments which cross or utilize public right-of-way. The results of this study will support those discussions and enable opportunities for cohesive ATS implementations throughout the region.

Conceptual Image of ATS Manufacturing Operating Environment (OE-A)

OE-B (passenger movement)

The early-stage of development of the Dallas International District leaves several next steps to be considered before an ATS focused on OE-B can be deployed. Not only must a plan be laid for covering the necessary capital and operations costs, but a governance structure must be identified that will take the lead in implementing the system. In addition, further study is needed to identify the parking management and land use strategies that will directly affect the ATS and International District's overall success. While NCTCOG has developed in-house tools to identify locations where an ATS might be beneficial to implement, the development of processes to answer the outstanding questions on the International District ATS would provide a framework for the future development of ATS in other locations.



Conceptual image of ATS Passenger Operating Environment (OE-B)