01 Introduction

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Project overview

This document represents a vision for how the City of Lincoln, Nebraska will establish itself as a nationwide leader in the implementation of autonomous vehicle technology, and how that technology will be used in a real-world deployment to support Lincoln's existing transit service. Upon implementation, this will be one of the largest mixed-traffic deployment of autonomous microshuttles in the United States, solidifying Lincoln's reputation as a community that is forward thinking and helping to lead the country into an exciting future.

This Vision is intended to lay the groundwork and outline how the initial deployment should be conducted. While it can't answer every question, it will provide a benchmark for how the system should operate, where it will be deployed, and how it is intended to serve the Lincoln community.

A call to act

The City of Lincoln is on the move. The City is home to a growing and thriving community; recognized nationally as a premier American city of businesses, entrepreneurs, young people, retirees, and families. Lincoln has added 140,287 new residents since 1958 and in that same amount of time, the City has grown from 25.54 square miles to 92.74 square miles; a 265% increase. To successfully support Lincoln's continued growth and prosperity, the City must establish a strategic mindset that is aimed at continual improvement of vital infrastructure and services coupled with a sustainable and responsible approach to the management of public resources. As growth continues, so too does its impact on the community. Continued growth will result in more pressure on the existing system, and an increasing need for infrastructure that will bring additional maintenance and operational costs.

The City wants to offer additional mobility options for the community by leading an early expansion and adoption of a downtown transit system that will facilitate the movement of people between major destinations such as the State Capital, the University of Nebraska, and the Haymarket District. Recognizing that technology will have the ability to improve upon traditional transit systems, the City is proposing to create the largest, full-service autonomous microtransit deployment in the United States. This transit service will provide on-demand service on a fixed route, and may one day lessen the need for personal vehicles within Downtown Lincoln.

Project goals and outcomes

As this project is developed and is eventually kicked off, it is critical to keep focus on the goals of the project. In short, a goal is a desired outcome expressed in simple terms. The overall goals of the project include:

- Safely and efficiently move people between major destinations and landmarks within Downtown Lincoln
- Test an on-demand autonomous service along a fixed route
- Highlight innovative transportation in Lincoln

Transit ridership increases

In April of 2016, StarTran released the final report of its Transit Development Plan that outlined the state of Lincoln's existing transit service, areas likely to see an increase in ridership, and a number of short and long term recommendations to improve system service and usability.

As outlined in the study, transit ridership has experienced a steady increase in annual ridership of 26% from 1.7 million to 2.2 million from 2010 to 2014. As the City continues to grow, likely so too will ridership. The City and StarTran are looking to improve service while planning for the future, and this pilot deployment is the first step.

The rise of autonomous and connected vehicles

Autonomous vehicles (AV) utilize technology to monitor the driving environment and perform driving functions independent of human interaction. There are several technologies that support these functions (see figure 1.1):

- Radar sensors monitor the position of nearby vehicles.
- Light Detection and Ranging (LIDAR) sensors detect lane markings and road edges.
- Video cameras interpret traffic signals and road signs and detect pedestrians, nearby vehicles, and other objects.
- A global positioning system (GPS) places the vehicle accurately within a map.
- An on-board computer analyzes the above inputs and controls steering, acceleration, and braking.

Autonomous vehicle technology exists on a spectrum, with Level 0 representing vehicles lacking any autonomous functions and Level 5 including fully autonomous vehicles capable of driving in any scenario. Many vehicles currently available for sale have autonomous functions ranging from radar cruise control and automated emergency breaking (Level 1) to more advanced self-driving capabilities like Tesla's AutoPilot system (Level 3). Autonomous microtransit shuttles represent Level 4 autonomy because they do not require driver fall-back capabilities, yet they cannot operate in all conditions. Level 5 autonomy adds this full operating range and is in the research and development phase.

Connected vehicles (CV) consists of point-to-point dedicated short-range communication (DSRC) message exchanges including vehicle-to-vehicle communication that allows enabled vehicles to communicate with each other; vehicle-to-infrastructure communication that allows vehicles to communicate with surrounding infrastructure; and, vehicle-to-all communication that enables the interaction of vehicles and any capable communication device in the immediate vicinity. The potential applications allowed by connected vehicle technology are considerable in number and include safety, environmental, mobility, road weather, and smart roadside families of applications.

Dynamic transit/mobility-on-demand is a hybrid model combining the benefits of both ride-sharing and traditional transit. Rather than using traditional fixed routes, these services links riders to transit service on an on-demand basis. Often dynamic transit will utilize a central dispatching software that optimizes service while minimizing the distance each traveler has to traverse to reach a "pop-up" transit stop.

Figure 1.1 Navya sensor platform

Image source: curbsideclassic.com