



THE CITY OF LINCOLN, NEBRASKA BEYOND TRAFFIC

The Smart City Challenge



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MAYOR CHRIS BEUTLER
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February 1, 2016

U.S. Department of Transportation (USDOT)
Federal Highway Administration (FHWA)
Office of Acquisition and Grants Management
1200 New Jersey Avenue, SE
Washington DC 20590

RE: “*Beyond Traffic: The Smart City Challenge*”

Dear Ms. Tarpgaard and Selection Committee Members:

Never has there been a more amazing time in our history to implement emerging technologies that will forever change how we move about communities. The Smart City Challenge is a pivotal step in this change and the City of Lincoln is eager to share with you our vision. Our project will provide increased connectivity to underserved populations, provide transportation education opportunities, and spark new trends in our many high tech private sector startup companies.

Lincoln is poised to accept the Smart City challenge and is in a perfect position to leverage two of our technology projects already underway. Our recently announced fiber-to-the-home public/private partnership will bring high speed broadband to every citizen, and Gigabit connections to every traffic signal and public building facility. Our “Green Light Lincoln” project will modernize our entire traffic system, implementing the newest software, hardware, and management center in America this year. These two projects provide a foundation on which we plan to build our Smart City project, and will allow us to start work immediately.

The City of Lincoln has a bold and innovative management team and we are fully committed to the successful, on time completion of this project. And, we take this challenge very seriously as we understand that this is more than a demonstration project – it is opportunity for our city to change thinking, improve our climate, and enhance quality of life.

Thank you again for this unique funding opportunity. We look forward to sharing more of our ideas with you during the next round of solicitation.

Sincerely,

A handwritten signature in blue ink, appearing to read "Chris Beutler".

Chris Beutler
Mayor of Lincoln

LINCOLN'S VISION

1

Imagine a city offering the greatest quality of life. A capital city with a strong economy, a vibrant downtown, and top notch schools at all levels. Imagine a city full of people with optimism, and a spirit of innovation and discovery. People of multiple ethnic and economic backgrounds – caring, volunteering, and fostering a sense of community pride.

Imagine a city in the middle of the U.S., with growing mobility challenges, yet a clear directive on urban growth policy. A city with a renewed focus on transportation and technology that is facing the challenges of growth head on. A city with a large student population, feeding the technology startups that are expanding the "silicon prairie" to help address this growth.

Imagine a city on the cusp of beltway construction around its perimeter, bringing additional commerce to the **largest freight corridor in America**. A city that has so far dodged the need for such freeways bisecting its community center and displacing people. A community where neighborhoods tie to other neighborhoods that tie to mixed use development. This is Lincoln. This is a great City.

We know that a strong transportation network integrated across all modes that serves **everyone** is a vital key to maintaining our desirable community. Through the years, we maintain our roads and bridges, and we've built new roads and bridges. We are now at a point where we must prioritize technology to improve mobility. We must implement and operate the next generation of our system to be consistent with the reality of funding and the desires of the end user. We have work to do. We are ready.

To address the continued transportation challenges of the future and better manage existing mobility, the City of Lincoln has proposed bold yet attainable components of a demonstration project. We will leverage our current and on-going transportation technology assets to accomplish the following vision elements ahead of schedule:

- Implement a fully **autonomous, electric** vehicle transit enhancement to our current system that will result in a **20% reduction** of vehicle trips city wide.
- Deploy additional city wide non-intrusive sensors and communications hardware to facilitate **connected vehicle applications** and proactive traffic management.



Secretary Foxx & Mayor Beutler

-
- Collection, analysis, and documentation of **data** across the traffic management system to allow for **performance measurement** and application development by the private sector in coordination with our many partners and stakeholders.
 - Robust public education regarding these smart transportation initiatives, including a primary focus within our after school programs **serving under-represented populations** and transportation technology programs at our career academies.

These items will be rolled into the delivery of an unprecedented demonstration project that can be documented and later applied to other mid-sized cities across the United States. Our current environment in Lincoln (as described in later sections) will make this a reality. The results of this effort will be more than just a demonstration project for the City of Lincoln. This initiative will produce citizen and industry buy-in, and will change the transportation landscape in Lincoln, and elsewhere, forever. This project will address **ALL** three of the high-level anticipated outcomes as identified in the solicitation:

VISION CHALLENGES

The challenges are real. Whether nationally or locally in Lincoln, these primary outcomes must be addressed as we build and manage our future city.



1. Improve Safety



2. Enhance Mobility



3. Address Climate Change



The City of Lincoln transportation network is impacted by approximately 7,500 crashes annually, resulting in a socioeconomic loss to the community of nearly \$300,000,000 each year. In addition, the amount of bicycle related crashes has been on a steep increase in recent history, indicating the improved mode share of bicycle activity has outpaced our implementation of safe improvements.



The current City of Lincoln transit system struggles to provide "off hour" operations including abbreviated Saturday service and no Sunday service. In addition, the fixed route nature of the system can leave those with limited mobility at a disadvantage to reach certain stops. Lincoln has increasing poverty levels within neighborhoods adjacent to the Central Business District, furthering the need for enhanced transportation services that are affordable and efficient.



Continued greenhouse gas emissions due to idling and inefficient vehicle travel continues to result in a real monetary loss and also impacts the climate in aggregate. Achieving low-carbon cities will require giving people incentives to make different choices about how they live, work and travel. There is a need to partner with key stakeholders to reinvent how services are delivered, save energy, and build the next generation of sustainable transit and traffic management systems.



Improving the transportation network to produce solutions that mitigate these challenges and provide the desired outcomes **can be** achieved. It **can be** demonstrated to the public. It **will result** in a game changer for the citizens of Lincoln and the USDOT.

VISION APPROACH

The City of Lincoln vision for the Smart City Challenge will be focused into attainable project components that leverage our current and continued focus on the use of technology for major transformation of our system. It will educate and build consensus, boost transportation research and development, and level the playing field amongst all citizens in regards to transportation accessibility. The project vision elements are illustrated in **Figure 1**, and are further described on the following pages.

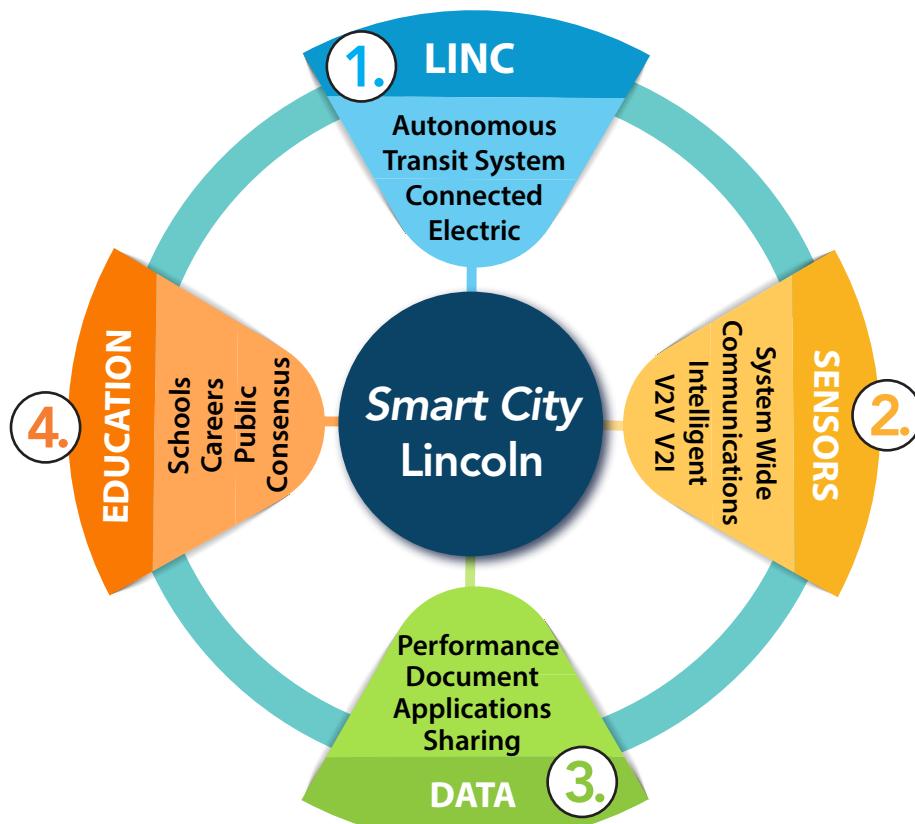


Figure 1 - Vision Components

1. LINC

Our Smart City Lincoln vision will implement a robust enhancement to our existing transit system. In fact – it will become the majority carrier of our ridership. We will deploy and integrate LINC (Lincoln Independent Navigational Carriers) in a phased implementation city wide with a bold but reachable goal of reducing 20% of existing vehicle trips and parking needs.

The LINC system will include two vehicle types – 1) a shuttle seating 8 passengers that will provide service to the immediate Central Business District, and 2) standard passenger cars for city wide service. These vehicles will have the following characteristics:

- **Autonomous (driver-less)**
- **Electrically Powered (battery)**
- **Connected (to each other, and the traffic signal system)**

The LINC system will work based upon user requested information via typical smart



Figure 2 – LINC Transit system

device applications. Efficiencies in route designation will be provided based upon fastest path data, and nearby user requests (ride-sharing).

The LINC system will provide for exponential growth in ridership amongst all citizens. As more users become comfortable with the ease of use and economic value of the system, in addition to wide ranging education and marketing of its benefits, the results will be dramatic and far reaching. This demonstration project and its documented value in enhancing safety, mobility, and climate change will lead to an even larger scale deployment. More detailed project initiatives for the LINC system include:

- Allowing existing transit service to focus solely on fixed route, high ridership corridors between major trip generators, and additional special use service.
- Connectivity of the vehicles to one another, and the traffic signal system, will allow for incredible efficiencies, safety, and vehicle management.



- Transit signal priority will be deployed city wide on both LINC and the thirty (30) compressed natural gas (CNG) buses that remain on the existing system fleet.
- **Mail and package delivery demonstration** will be included for a number of test vehicles at defined private carrier parcel stops and the downtown U.S. Postal Service facility.
- In vehicle, looping video and interactive education materials will be presented and displayed so that the riders are able to learn even more about the LINC system, their personal contributions to benefits of the program, and other USDOT transportation technology initiatives.
- Major safety enhancements for moving downtown pedestrians during special events such as at the Pinnacle Bank Arena, and during UNL home football game days which bring over **100,000 spectators interacting with traffic** crossing two major arterials in a 6-block area.



Husker football gameday pedestrian traffic
at 9th and Q Streets

In addition to just this sample list of obvious and impactful components of the LINC system, a major focus will be on the change in vehicle power. Implementation of additional electric vehicle charging stations will be completed throughout Lincoln at multiple, strategic locations that are public property operated by City of Lincoln. In partnership with our own Lincoln Electric System (LES), dozens of these aggregated sites will be constructed to provide ample bandwidth for the **600-plus autonomous, connected vehicles**.



Charging Bay



Current LES Charging Stations in Lincoln



With a current focus already on alternative fuels and clean energy through our existing CNG powered bus fleet, this will be yet another community enhancement that can be documented with stakeholders. These sites will be used to recharge the new fleet of vehicles during **non-peak electric usage** periods. In addition, adjacent use recharging infrastructure will be completed by the City to allow for private citizen charging access at relevant locations.

2. SENSORS

To complement the LINC project component, and deliver additional Smart City capabilities, a major deployment of non-intrusive sensors and dynamic short range communications (DSRC) equipment will be made at every signalized intersection. For this component of our project vision, the City of Lincoln will leverage its already robust network of camera detection and Bluetooth/Wi-Fi sensors to obtain additional vehicle data and travel characteristics. The sensors will be tied to existing signal infrastructure and routed to the cabinet equipment. Data will be brought back to the Operations Center over the expansive Gigabit fiber connections at field cabinet locations.



Non-Intrusive Vehicle Sensors

Supplemental data collection systems via sensors will gather not only traffic data, but also other system data impacting mobility. An example of one major ancillary system is the many at-grade railroad crossings that impact the City of Lincoln transportation network. The **busiest railway corridor in the world** makes its way through the state of Nebraska. Both the BNSF and Union Pacific Railroads have facilities that traverse through Lincoln. Thus, the need for smart railroad crossings and sensors that can provide valuable information for impending train delays and alternate routing are critical.



Train Delays in Lincoln



DSRC Units Installed at Intersections

A robust system of DSRC units will also be installed at signal locations to provide valuable Vehicle-to-Infrastructure (V2I) communications capabilities. The V2I setup will allow the signal system to communicate with all LINC system vehicles and other private vehicles with capable on board equipment. The infrastructure will inform riders and drivers of traffic conditions, work zones, weather, and potholes. Enhanced signal timing and operational efficiencies can also be better managed.

In addition to vehicle applications, Lincoln will also implement test equipment for new bicycle facilities. The "N Street Cycle Track" has just opened and was recently awarded a **#4 ranking of America's 10 Best New Bike Lanes 2015!** In addition to the existing wireless magnetic bicycle sensors along the track, what a great time to implement new bicycle-to-vehicle communications for the LINC vehicles (among others) to gather more data and improve safety.



Secretary Foxx - Biking in Lincoln



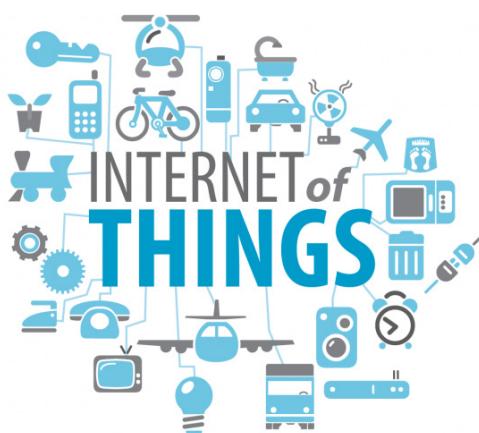
The New "N" Street Cycle Track - #4 in America

3. DATA

So what to do with all this data? The third project component will be focused on massive data aggregation, **data sharing, analytics**, reporting, and detailed performance measurement. There will no doubt be a wealth of data. And with all this data and connectivity comes possibility. Raw data sets will be summarized and funneled through the cities new advanced traffic management software (ATMS), further enriching the capability to improve and automate signal coordination plans, transit signal priority for the LINC system, and active traffic management of problem areas on the network.

FACT!

“20 Billion connected devices are expected by the year 2020.”



Open source data for the **sharing economy** can only help to spur entrepreneurial solutions and new applications for further improving mobility for all users. Creating an environment of safe, open data sharing will provide additional educational and economic opportunities. Next generation transportation industry startups will focus additional energy to develop applications for mobility on demand. A connection to real-time data from the traffic management system will allow our partner stakeholders, private industry, and the public at large to benefit from improved research and development capabilities. In addition, as part

of the large scale data gathering and analyses, relevant reporting and performance measurement will be documented for the LINC system impacts, and many other traffic operational, safety, and environmental benefits.

Through the course of the Lincoln demonstration project this compelling data can be utilized to further market the improved quality of life benefits realized through better mobility for all users and the reduction of inefficient vehicle trips.

4. EDUCATION

The final project component identified for the Lincoln Vision is what really helps the future happen today. It is the focused and widespread education of these Smart City transportation technologies and concepts to the end users. ***It is vital to educate users of all ages and backgrounds on the importance of getting beyond traffic***, and getting there soon. If we are to make fundamental changes in living habits and how we use transportation, ***education and consensus amongst our coworkers, neighbors, friends, and children is key***. Without motivation, there is no change.

It has been identified that much of the future employment opportunities in the transportation field will be “operations focused.” The transportation industry needs talented operators and individuals who are excited to take smart transportation technologies to the next level. Proper training and career path development in many of the transportation sector employment opportunities will be crucial to advance modern mobility.



Mentoring program at Lincoln Public Schools

Through our partnerships with local education leaders and research faculty, a swift, yet formal program will be rolled out into our local schools – with initial focus on those schools serving under-represented populations. In addition, the University of Nebraska-Lincoln Nebraska Transportation

Center will support the Smart City Challenge through continued education in the “After School Program.” This program is for age K-12 students and is uniquely geared towards ***building a diverse base of transportation professionals*** to ensure sustainable transportation infrastructure for future generations. And finally, the Career Academy - a joint venture between Lincoln Public



*Lincoln Public Schools/Southeast Community College
Career Academy*

Schools and Southeast Community College (SCC) - will be utilized to further the knowledge base of transportation technologies amongst those wishing to pursue a career in the industry.

WHY

LINCOLN?

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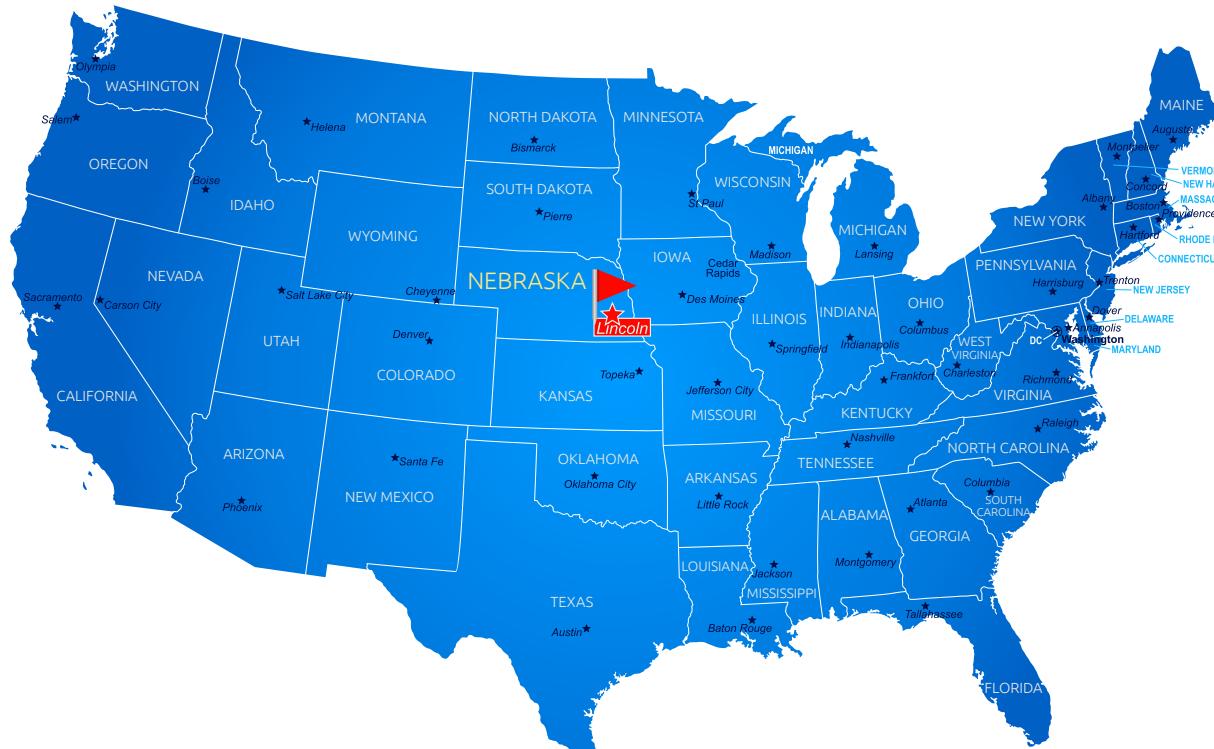
The City of Lincoln is an ideal match for the Smart City Challenge. Our population demographics and other characteristics as defined in the USDOT solicitation favor Lincoln as great testbed in the middle of America. See **Table 1** below for a description of how we compare:

TABLE 1: CHARACTERISTICS OF A SMART CITY - LINCOLN, NEBRASKA

ITEM	COMPARISON	CHARACTERISTIC	FULFILLS
1	IDEAL CITY	Population between 200,000 and 850,000 people within city limits	
	LINCOLN	Lincoln's population is 257,924	✓
2	IDEAL CITY	Dense urban population typical for mid-sized American city	
	LINCOLN	Lincoln has larger than average density amongst peer cities of 2,899 people per square mile	✓
3	IDEAL CITY	Represents a significant portion (more than 15%) of the overall population of its urbanized area	
	LINCOLN	Lincoln represents 100% of the overall population of our urbanized area	✓
4	IDEAL CITY	An existing public transportation system	
	LINCOLN	Lincoln has a progressive public transportation system (StarTran) with CNG Fuel Sources	✓
5	IDEAL CITY	Environment conducive to demonstrating proposed strategies	
	LINCOLN	Lincoln has a public sector management structure geared towards new innovative strategies and private sector partnerships that continue to push cutting edge project components	✓
6	IDEAL CITY	Continuity of committed leadership and capacity to carry out the demonstration through period of performance	
	LINCOLN	Lincoln has a newly re-elected third term mayor and a wealth of innovative department leaders and staff with proven "big project" experience and technology expertise	✓
7	IDEAL CITY	Commitment to integrating with the sharing economy	
	LINCOLN	Lincoln is already integrating data with partner agencies, and startups, with plans to do more as part of the Traffic Management Master Plan implementation and Fiber to the Home build out	✓
8	IDEAL CITY	Commitment to making open, machine-readable data accessible, discoverable, and usable by the public to fuel entrepreneurship and innovation	
	LINCOLN	Lincoln has existing open GIS, ITS, and traffic data sources for consumption by the public, other agency stakeholders, and research partners	✓

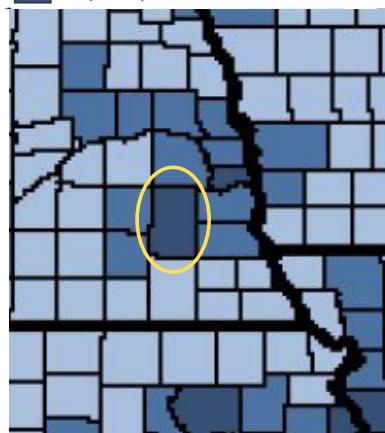


As illustrated on the previous page, Lincoln satisfies ALL criteria. In addition, our **environment in the Midwest** makes us a perfect demonstration location. Lincoln has weather patterns ranging from some of the hottest to some of the coldest in the nation. If a project can work here, it can work anywhere! This is a key factor when testing new technologies such as electrical charging stations, roadway sensors, and communications equipment. Whether or not products are properly outdoor rated (NEMA TS2 etc.) we can put them through the paces by simply letting Mother Nature work.



1980 to 2010 Population Change

- Population Decline
- Population Growth
- Rapid Population Growth



Lincoln Growth

Lincoln also has similar and possibly more unique characteristics than our peer cities when evaluating information provided in the USDOT report *Beyond Traffic 2045, Trends and Choices*. As illustrated in the growth map that was included in the report, Lincoln and Lancaster County Nebraska is one of the highest growth areas in the entire Midwest.

Lincoln is “One Community.” This moniker is the main aspect of the long term vision for the community in its Comprehensive Plan as both a current reality and as a future aspiration. Over 90% of Lancaster County’s population and growth occurs within the city limits of Lincoln, and consistent goals and policies are shared throughout the community. There are **no competing suburbs** to divide the benefits of this growing city.

Instead, Lincoln prospers by having single, top performing public school district that serves all the residents of the city. Longstanding policies of phasing urban growth and appropriately timed public infrastructure improvements help Lincoln provide urban services and utilities efficiently. This not only allows Lincoln to prosper, but it also helps maintain an “edge” between urban and rural land uses in Lancaster County. ***Lincoln is committed to remain a unified community*** through these policies and thus is positioned to move forward as a leading 21st Century city.



City of Lincoln skyline at night

As One Community, the City of Lincoln has grown in a more compact and contiguous manner than peer cities in the region. Lincoln's population density of 2,899 persons per square mile benefits from an increase in infill development in the Downtown area over the past several years. ***Over a quarter of all new residential development has occurred in the Downtown area during the past six years.*** Such recent trends lead to expectations that population density in the older core areas of Lincoln will increase steadily. Similarly, employment densities are also trending upwards with major expansions and increased concentrations in the Downtown area. All of this points to a more efficient and productive future for Lincoln. Continued emphasis on policies that support a more efficient city are in place to achieve such a future.

The City of Lincoln is also somewhat unique in the transportation challenges we face due to being in the confluence of the large-scale and impactful freight corridors that travel through our community. With Interstate 80 (I-80) traversing the north side of our community, U.S. Hwy 77 on the west, a new South Beltway being readied for construction, and NE Hwy 2 providing connectivity to I-29 and Kansas City to the south, we lie along one of the largest trucking corridors in America. In addition, due to the presence of a major confluence of BNSF and Union Pacific Railroad lines in this end of our state, we also fight mobility issues with the ***busiest rail lines in the world.***

A map on the following page depicts the freight flows in America for 2010.





Freight Flows in America - 2010

Lincoln faces unique transportation challenges due to large-scale trucking and rail corridors that move through our city and the state.

These factors, along with the following list of “Quick Facts” for Lincoln, uniquely qualify our city for the Smart City Challenge.

Quick Facts:

- Lincoln’s total population grew more than 15% over the last decade. By 2045 our population will jump to over **415,000** bringing with it larger metro mobility issues.
- We control our own destiny – ideas and technologies implemented are not influenced by any suburbs or jurisdictional lines – just Lincoln!
- When compared to other peer cities, we fall right in the middle for all three categories of: population, land size, and density (**one of only 6 cities** able to make this claim)
- Our population, land area, and lack of other jurisdictions makes us able to more easily stretch and utilize dollars for city-wide logistics.
- For the average Lincoln citizen, transportation is the second largest expense in regards to our cost of living.
- By this coming Fall, we will have the nation’s **newest** traffic management center, newest system software, and newest signal controllers – offering state of the art flexibility for integration of new technology.



- We are presently constructing Fiber-to-the-Home on a city-wide basis and leveraging **over \$120M** in the project that will bring high speed (Gigabit) connection to every signal cabinet and every public building in the city. Communication to all city facilities will be provided by this Gigabit network, and therefore no grant funding will be spent on communications - only on advanced technologies.
- Lincoln has recently completed our first "Cycle Track" in downtown Lincoln, complete with wireless sensors.
- We are already moving forward with a brand new 15 station **Bike Share program**.
- Our community is full of Millennials and new technology startup companies.
- **Google** named Lincoln the top eCity in Nebraska for 2015.
- Our current Public Transit system, StarTran, has been awarded the National Community Transit Award.

FACT!

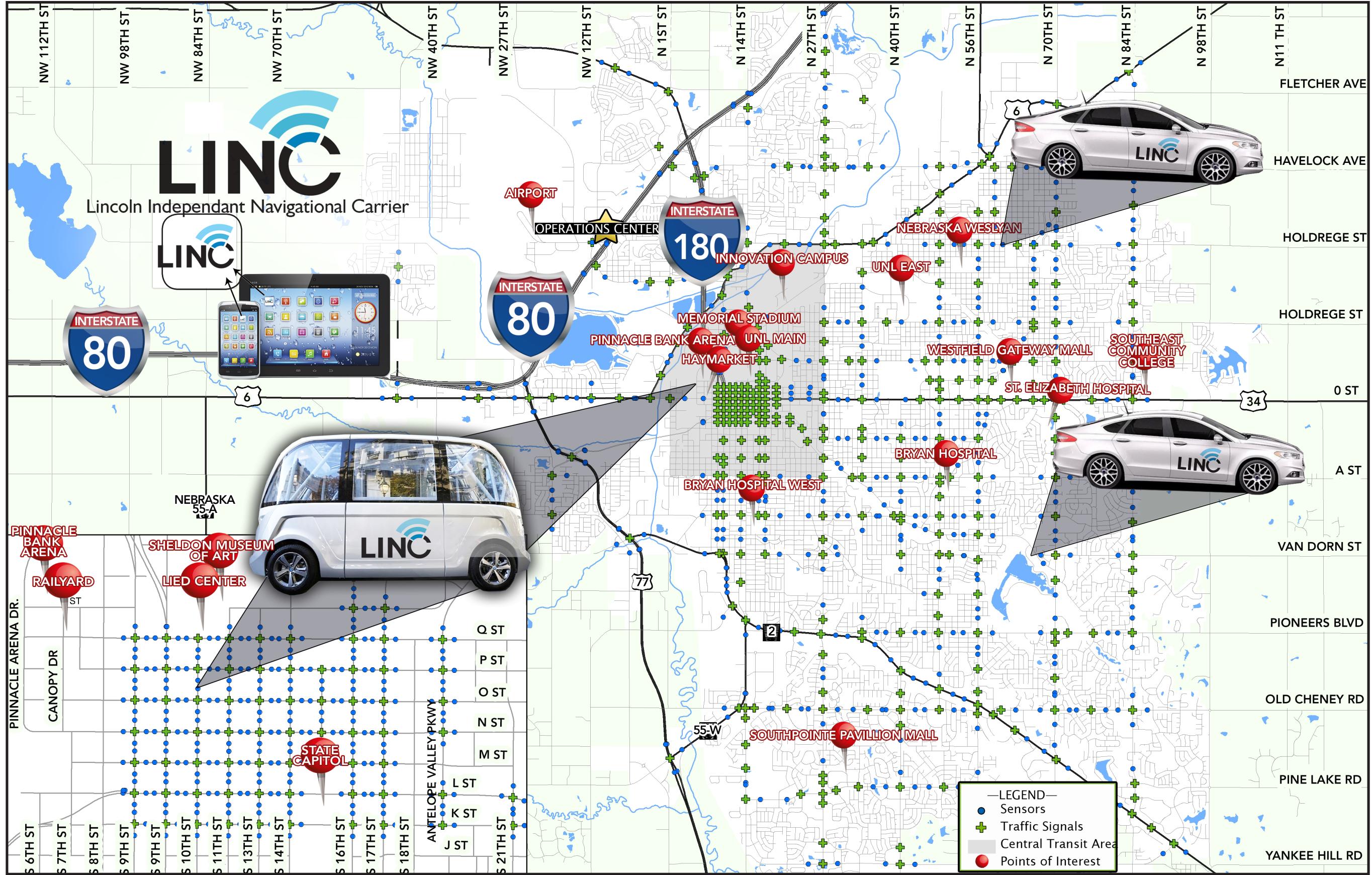
Forbes Magazine says:

"City of Lincoln is the #3 city for young entrepreneurs."

These are just a few of the factors that make the City of Lincoln a great candidate for the Smart City Challenge. **We share the vision of the USDOT** in prioritizing the next generation of transportation technology to improve safety, enhance mobility, and address climate change. We have a successful track record on deploying technology projects, and know we need to stay ahead of the transportation growth curve. We are excited to implement a demonstration project that will result in achieving these goals, and one that can be duplicated many other cities across the U.S. A preliminary project site map of Lincoln is illustrated on the following page.



LINCOLN, NE VISION SITE MAP



THE USDOT

VISION ELEMENTS 3

The Lincoln Vision Project components fulfill the USDOT Vision Elements. **Table 2** below provides additional detail.

TABLE 2: USDOT VISION ELEMENTS - LINCOLN, NEBRASKA

ELEMENT	DESCRIPTION	FULFILLS
1	 Urban Automation Urban automation will be realized through the Lincoln Independent Navigation Carriers (LINC) project components. Full autonomous, electric, connected shuttle and small car transit service will be operated through user friendly application interface and enhance/replace current transit offerings.	✓
2	 Connected Vehicles The LINC transit system project component will provide 600-plus connected vehicles, also integrated with sensors and DSRC units at traffic signal locations. This network is connected with existing robust communications systems. Private vehicles (if equipped) will be able to communicate with the infrastructure as well.	✓
3	 Intelligent, Sensor-Based Infrastructure System-wide non-intrusive sensors will be deployed at traffic signal locations to collect additional data beyond existing camera detector and Wi-Fi systems. A wealth of vehicle count, class, speed, and arrival data will be aggregated at the state of the art traffic management center.	✓
4	 Urban Analytics Data analysis and open data sharing will be provided via the City of Lincoln ATMS software system and open portal concept at the traffic management center. Research facilities, companion agencies, private sector, and public will have access to relevant data streams for use in product and application development/support.	✓
5	 User-Focused Mobility The combination of the LINC system and open source data will provide for immediate user choice of mobility options, and also future application enhancements (example - additional rideshare capabilities or delivery options) as further applications are evaluated and developed, LINC will level the playing field.	✓
6	 Urban Delivery & Logistics Package delivery and defined parcel stops will be included on a set number of demonstration project vehicles. Lincoln will work with local parcel service logistics personnel and the U.S. postal service to define synergies that can be demonstrated as part of the LINC system. Partnerships with private logistics planning consultants could provide additional modeling of reduction in business to retail trips.	✓

7		Strategic Business Models & Partnership	City of Lincoln has partner stakeholders in both the public sector and private sector including local legislative representatives, State Dept. of Roads, universities and Educational centers, and private entities that are already providing and sharing data - both traffic data and GIS/asset management data. Education programs are defined and will benefit greatly from these partnerships.	
8		Smart Grid, Roadway Electrification, & EVs	As part of the LINC system deployment, multiple sites around the City will be constructed with charging bays and additional stations for charging of the fleet during off-peak electrical loads. In addition, excess units will be provided for private vehicles that begin to convert over, and the City Fleet Vehicles.	
9		Connected, Involved Citizens	Broad access of data will be provided as described in project components 2 and 3. However, a large need in this portion as well is a focused training and education plan that will guide the desire and interest of citizens to stay involved throughout the pilot, offering useful feedback.	
10		Architecture & Standards	National ITS Architecture standards will be followed for implementation of the demonstration project. City of Lincoln is currently updating the Regional ITS Architecture to latest web-based format. In addition, all appropriate systems engineering deliverables will be submitted to local FHWA and JPO for review.	
11		Low-Cost, Efficient, Secure, and Resilient Information & Communications Technology	As part of the project elements for DSRC implementation, it is envisioned the City will work with USDOT to formalize any recommendations based upon the prior RDE open source application development portal and the operational data exchange.	
12		Smart Land Use	The analysis of massive data sets under previous tasks could be used to improve "model" development that has been conducted by teaming partner Quetica. Preliminary descriptions of this modeling effort suggest land use could be more advantageously laid out to result in fewer overall trips for commercial activities.	

Through implementation of the four major project components included in the Lincoln vision: – LINC System, Sensors/DSRC deployment, Data Analytics and Performance Measurement, and broad based Public Education, there are cross cutting activities that fulfill **all of the 12 USDOT Vision Elements**. This indeed creates synergy amongst the four components – providing demonstration and research opportunities for a large portion of the overall vision, while more easily implementing these projects with a single, unified Smart City Challenge applicant. In addition, Lincoln is also leveraging our own investment in the following items:



-
- High speed broadband network city wide at all signals, all ITS devices, and up to 150 public building facilities.
 - 15 virtual local area network (VLAN's) at each location for use by the City.
 - Newest ATMS software, controllers, and Traffic Management Center in the nation at project kickoff.

The Smart City grant dollars will be fully put to work on the mission at hand – implementing and testing a full array of technology to improve mobility for all.

THE RISKS 4

As with any major project of this scale there are risks involved. The City of Lincoln is prepared however, to make this demonstration a success for the USDOT. We take the responsibility seriously, and have full commitment of leadership to be successful.

TYPICAL TECHNICAL RISKS: <ul style="list-style-type: none">• New technologies• Size and experience of immediate project team• Availability of components	MITIGATION STRATEGIES ARE: <ul style="list-style-type: none">• Use as much field-tested equipment as possible• Ensure primary point of contact, and technical expertise is available• Check reality of project component inventories before finalizing scope
TYPICAL POLICY RISKS: <ul style="list-style-type: none">• Potential for municipal code conflicts• IT Governance• Legislation / Legal	MITIGATION STRATEGIES ARE: <ul style="list-style-type: none">• Review any conflicts with City/State Code• Include IT staff early and often• Coordinate with legislators early in the process
TYPICAL INSTITUTIONAL RISKS: <ul style="list-style-type: none">• Lack of agreed upon final project objectives• Lack of agreement on final criteria for project success• Inadequate project scope detail• Changes to project priorities	MITIGATION STRATEGIES ARE: <ul style="list-style-type: none">• Appoint a project champion• Plan very detailed project criteria and scope with stakeholders• Ensure single organization is responsible for program management

Through all of the activities, communications and strong project management is the key to successful final project delivery to USDOT.

STAKEHOLDERS AND PARTNERSHIPS

5

The Smart City Challenge has created unprecedented inquiry and widespread information sharing not only in Lincoln, but across the nation. Locally, it has led to numerous discussions with partner stakeholders and community and industry leaders. Lincoln is in an advantageous position – we are a Capital city, and our state Legislature meets 4 blocks away from our own City Hall and Public Works Department. The Nebraska Department of Roads is headquartered a short drive away. When and if discussions need to be had and decisions made, we are here in close proximity and can coordinate easily.

In addition, many of our ***"Silicon Prairie" tech startups*** continue to grow here in Lincoln. With support from our own University of Nebraska partners, Innovation Campus, Lincoln Electric System, and key private entities, the time is ripe for Lincoln. An initial listing of those partner stakeholders is included below, and their letters of commitment and support are attached to the end of this submittal.

Deb Fischer
United States Senator
State of Nebraska

Paul Illich
President
Southeast Community College

Kyle Schneweis, PE
Director
Nebraska Department of Roads

Wendy Birdsall, CCE
President
Lincoln Chamber of Commerce

Marc J. Shkolnick
Manager, Energy Services
Lincoln Electric System

Mike Boyle
Vice President/Plant Manager
Kawasaki Motors Manufacturing Corp., U.S.A.

Val Lefler
President and CEO
Integrated Global Dimensions LLC

Doug Durham
Principal and CTO
Nebraska Global Investment Company

L.R. Rilett, Ph.D, PE
Director, Nebraska Transportation Center
Distinguished Professor of Civil Engineering
University of Nebraska-Lincoln

Bradley A. Moline
President
Allo Communications

Daniel J. Duncan
Executive Director
Nebraska Innovation Campus

TRANSPORTATION

INFRASTRUCTURE 6

The City of Lincoln transportation infrastructure includes the major 6-lane, I-80 freeway corridor on the north, and US-Hwy 77 by-pass to the west. The majority of the major arterial street system is a grid network (mile line roadways), with multiple other minor arterials and collectors. Lincoln has a total of 23 centerline miles of freeway, and 160 centerline miles of arterial roadways. Lincoln has not had to bisect the community with other north/south or east/west freeway facilities to date. In order to maintain desirable travel times and operations, efficiencies will need to be gained through technology and improved mode share.

Lincoln's current and only mass transit system is StarTran. The system operates a total of 67 full-size coaches and 13 Handi-Vans. StarTran is acknowledged nationally as a leader within the transit industry in the utilization and promotion of alternative fuels. The fleet uses compressed natural gas (CNG) – nearly 30 buses by the end of 2016, and biodiesel – the remainder of the fleet. All StarTran vehicles provide accessible service, and automated vehicle location (AVL) infrastructure. The program offers senior center promotion services and low income bus passes. StarTran also plays a major role in the University of Nebraska operations between City Campus and East Campus. A transit development plan has just recently been completed to evaluate changes in routes and bus stops and proposed modifications.

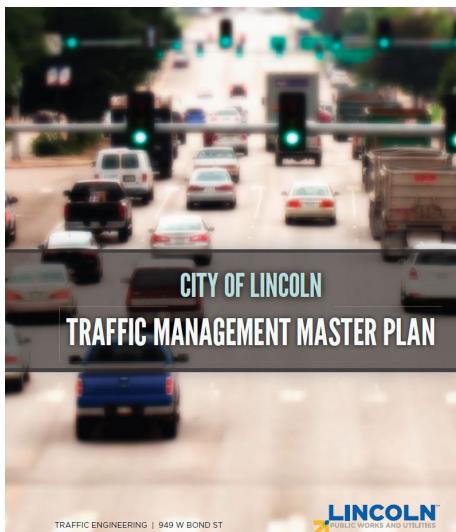


LINCOLN TRANSIT DEVELOPMENT PLAN
Final Report
DRAFT 2

The City of Lincoln has a **robust and redundant** communications network for public building infrastructure and the signal system. Additional copper communications lines are still present at few select locations. Managed Ethernet switch equipment has been phased in upgrades over recent years as the City prepares **this season** for new signal system infrastructure. Earlier this year, the Mayor announced a major communications game changer within the City as part of a public/private partnership. Fiber-to-the-home is being deployed to every residence in a massive overbuild. As part of the contract, the city is receiving high-speed Gigabit fiber connections and IP switch gear at all traffic signal and ITS cabinets. In addition, all public buildings are receiving 10Gig connections as well. This has taken the communications infrastructure for the traffic management system **quickly into the next generation**. The City will also be provided 15 VLAN's at each point on the network for future use.

In addition to the great news regarding communications upgrades, the City just recently announced "**Green Light Lincoln**", a major prioritization to update all 430 traffic signal controllers, new central software, and a traffic management center. The project has already begun and the TMC is under construction with a video wall and new camera management software to be complete this Spring.

The remaining system upgrades will be complete by the end of this season with plans to do corridor wide signal retiming upon implementation. Lincoln is also upgrading several cabinets to state of the art infrastructure and has been programming detection replacement at dozens of intersections with modern camera systems. The impetus for much of this work was the development of a **Traffic Management Master Plan** near the end of 2015.

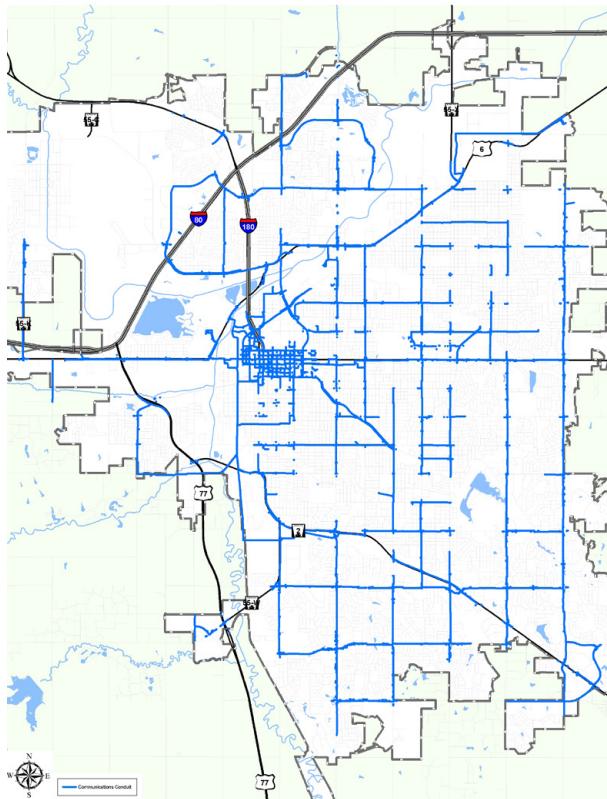


*City of Lincoln
Traffic Management Master Plan*

In the City of Lincoln, the Traffic Engineering team within the Public Works Department is responsible for the planning, design, operation, and maintenance of the City's over 430 traffic signals. In addition, a network of over 70 CCTV cameras, 50 portable and permanent dynamic message signs, and over **150 miles** of signal/communications conduit infrastructure is operated on a daily basis.

In terms of electrification enhancements to the transportation system, LES collaborated with the City Public Works Department over a year ago to install the first **electric vehicle charging stations** within the West Haymarket parking garages. In addition, efficient power for signals and roadway lighting is being provided in the Arena project area by way of a

District Energy Corporation which operates two centralized thermal energy generating plants that serve a wide reach of buildings and facilities. The city has also partnered with LES to install combination **wind/solar generators at traffic signals** on the fringe of the community to provide full battery back-up and supplemental power.



Communications Network

TRANSPORTATION DATA

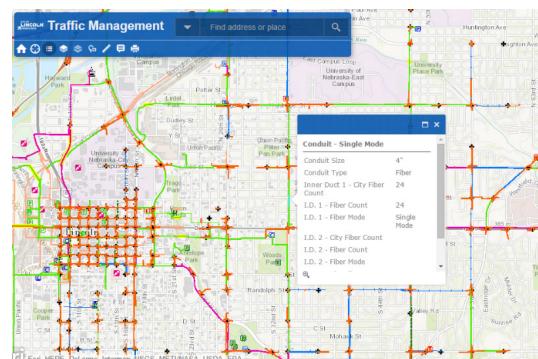
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The City of Lincoln currently collects traffic volume data for eight peak hours out of the day at every signalized intersection and other major intersection locations (roundabouts, intersections on threshold of satisfying signal warrants etc.). The city has begun a practice of solely collecting counts via the signal system or with non-intrusive machine vision cameras. As such, the operation has become efficient and we have counted every desired intersection within a 2 year period. The city also **collects bicycle count data** at designated trail locations via loops in the pavement and piezometer. Wireless magnetic pucks have also been installed on the N Street cycle track and at select locations throughout the City. Finally, Lincoln has also deployed a number of Bluetooth/Wi-Fi detectors at intersections to gain additional data on travel runs for corridor evaluation.



Downtown Lincoln

Currently, the City of Lincoln **shares and coordinates data locally** with the Lancaster County Engineering Department, the Nebraska Department of Roads (NDOR), the University of Nebraska Transportation Center (NTC), and other private traffic engineering consultants. Data is now stored in database files that are automated from the camera counts, and are available upon request. With the installation of the new software platform, additional travel data and signal timing information will be more easily shared with these stakeholders as needed. The City has created a web portal site for easy access to all system information and asset management. A migration plan to upload count data and recent three-year crash data to this portal for open consumption is being developed. An illustration of the web portal is shown below:



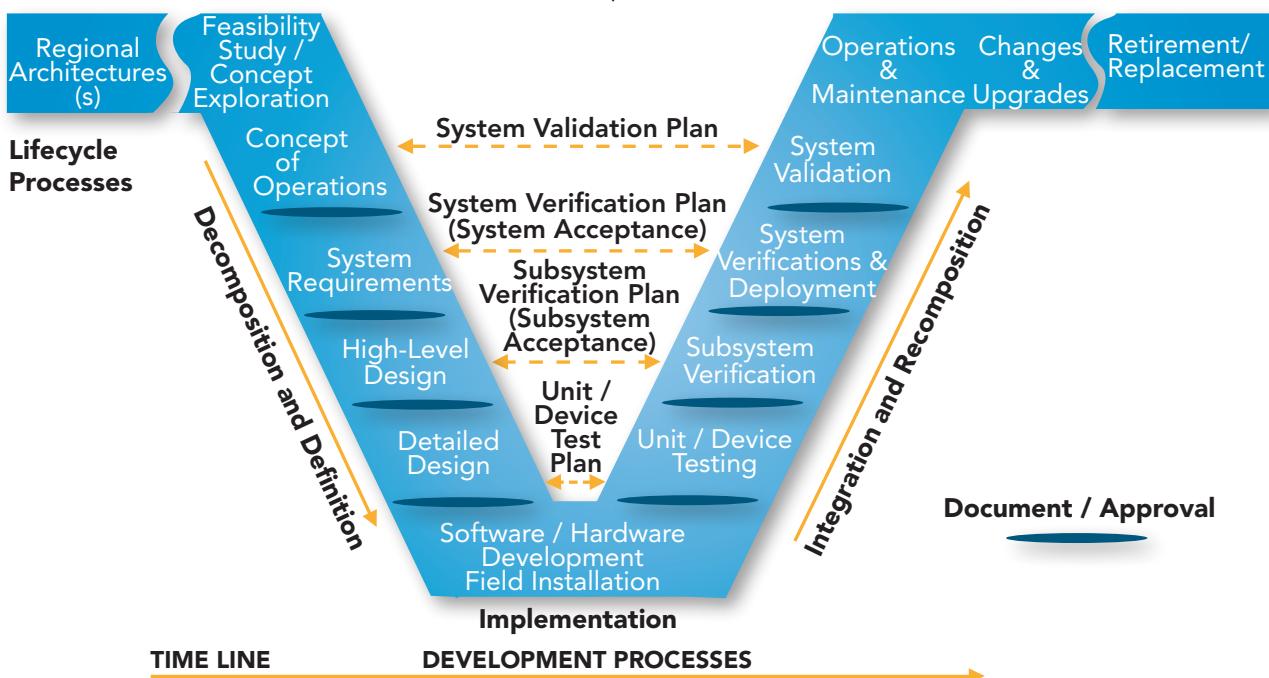
GIS Data
Portal

STANDARDS AND

ARCHITECTURE

8

Standards and architecture for intelligent transportation systems (ITS) will conform to the National ITS Architecture and will be checked throughout the project. The team is very familiar with the Systems Engineering process and national ITS architecture standards. The City of Lincoln is presently beginning an update to its prior architecture, which will result in the latest version, and updated files in a web-based format.



This is being conducted in concert with SE process for a new Adaptive Signal Control Technology (ASCT) project along a major corridor in North Lincoln. As part of that effort, and in concert with the Model Systems Engineering Documents for Adaptive Signal Control Technology, several deliverables have been standardized and are included for local FHWA review on any ITS project:

- Project Plan
- Systems Engineering Management Plan (SEMP)
- Concept of Operations (ConOps)
- Requirements
- Verification Plan
- Validation Plan
- Procurement Plan



In addition, the City of Lincoln has familiarized itself with portions of the newer Connected Vehicle Reference Implementation Architecture and the on-line tools.

PERFORMANCE

MANAGEMENT

9



Specific goals, objectives and quantifiable results will be developed and documented in much more detail upon final design of the systems. The four project components have been identified with a draft list of designated performance measures that can be quantified and documented. There are a number of additional performance measures that can be developed for each objective and additional goals. These performance measures, shown below in **Table 3**, will be included in the systems engineering documents and provide positive reinforcement for the benefits of the Lincoln vision. Online database tools for operational manuals will be housed in the traffic management center for timely reporting by the staff operators and Traffic Engineering Division.

TABLE 3: DRAFT PERFORMANCE MEASURES

PROJECT COMPONENT	GOAL	OBJECTIVE	PERFORMANCE MEASURE
LINC TRANSIT SYSTEM	IMPROVE CAPACITY ON ROADWAYS	Reduce vehicle trips by 20%	Ridership per time range
		Reduce travel times	Average travel times
SENSOR/DSRC INSTALL	EFFICIENT AND SAFE TRAVEL	Improved signal timing	Average travel times
		Improved Safety	Number of crashes
DATA ANALYTICS	IMPROVED SOFTWARE ANALYSIS & USER APPLICATIONS	Application development	Number of apps
		Report Development	Standard reports
EDUCATION	EDUCATE STUDENTS AND PUBLIC ON BENEFITS OF SMART TRANSPORTATION	Build Consensus	Positive survey results
		Career Interest	Class enrollment

COMMITMENT AND CAPACITY



10

As Mayor Beutler stated in our opening cover letter – “**we are fully committed to the successful, on time completion of this project....this is more than a demonstration project – it is opportunity for our city to change thinking, improve our climate, and enhance quality of life**” there is no lack of enthusiasm here in the Midwest. We have the team, leadership, and support from the top down in all City Departments. This project will be led by the Traffic Engineering Division with primary support from leadership within our own StarTran, and Technology Services Divisions. All three disciplines are located with the Public Works Department and work together daily. There will no doubt be additional private consulting assistance, and we have a wealth of local and regional ITS consultant expertise familiar with all Systems Engineering and design requirements. We have programmed additional engineering horsepower within the next two year budget cycle being finalized now, to move forward with many new initiatives in proactive traffic management. Our infrastructure is ready and being improved upon every day.

LEVERAGING FEDERAL RESOURCES



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As mentioned in prior sections, the City of Lincoln has recently launched fully into major technology initiatives that will boost its transportation (and other) capabilities dramatically. The city has partnered with Allo Communications to bring direct, high speed fiber optic connections to every property in the City. As part of the on-going design and installations, the City is receiving robust connectivity to every device in the field including VLAN's. In addition, the City's recent “Green Light Lincoln” initiative is bringing new state of the art signal system equipment on-line that will change the landscape of traffic management in Lincoln. These efforts alone are resulting in over \$120M of investment in Lincoln to facilitate technology projects and the sharing economy moving forward.

