

Proposal for
U.S. Department of Transportation
Beyond Traffic: The Smart City Challenge

Ubiquitous Mobility for Portland



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Part 1 – VISION NARRATIVE

Introduction

The City of Portland has embarked on a Smart City transformation - a paradigm shift in our transportation system.

The City of Portland is in a moment of significant opportunity with in-migration rates among the highest in the country and robust job growth. However, increasing rents, road safety, and property values threaten our ability to remain a city for all. In the face of such growth pressure, the City is committed to overcoming our legacy of transportation and economic development projects that have dismantled minority and low-income communities. Concurrently, the City is committed to achieving an 80 percent reduction of local carbon emissions by 2050.

Together with our partners, Portland Bureau of Transportation (PBOT) will use the Smart City Challenge grant to address these core issues, advance our goals, and leverage existing investments. We will deploy Ubiquitous Mobility for Portland (UB Mobile PDX) to realize this transformation.

UB Mobile PDX is an operational paradigm that leverages current technologies to provide common access for a spectrum of users - from the well-resourced early adopters to those that are technically left behind, many of whom are low-income and from communities of color. UB Mobile PDX provides a connection to the uniquely diverse transportation ecosystem of Portland and allows for frictionless movement throughout our city and region. UB Mobile PDX engages all current and future connected modes, including transit, connected and autonomous vehicles, rideshare and bikeshare, electric vehicles, and taxis. This data driven ecosystem will not only provide access and information about low-cost transportation choices, but will also support Portland's equity, economic development, and climate action goals. UB Mobile PDX provides key data points that will be used to make our city smarter for current and future Portlanders.

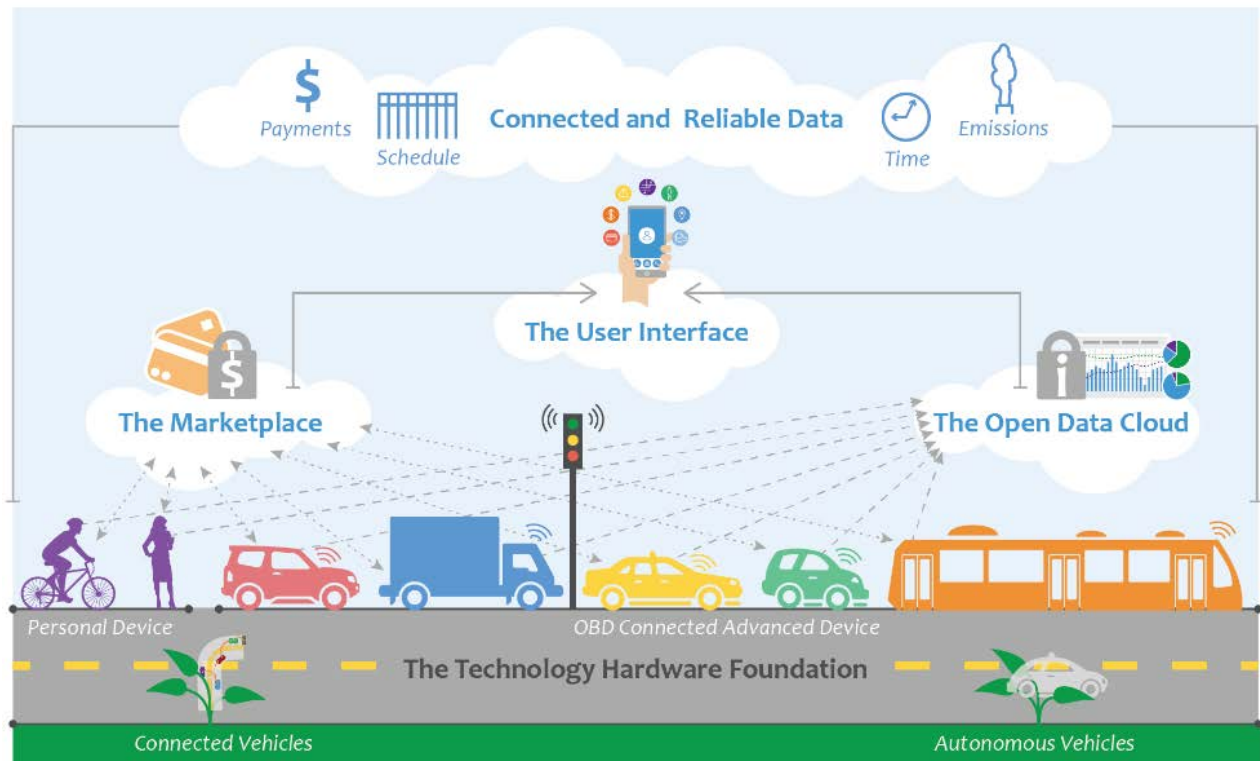


UB Mobile PDX is presented in *Figure 1: UB Mobile PDX Framework*, and includes the following:

- A marketplace, user interface, and open data cloud: that provide pioneering secure open data systems to promote a completely new way for citizens to access mobility.
- A technology hardware foundation: of an intelligent and connected system of Actors that promotes transformative uses of and access to information.
- A variety of real-world implementation projects in priority demonstration zones: to monitor outcomes, promote equity in investment, and automate transportation system improvements through direct, active use of information collected in real time.

Detail on the UB Mobile PDX projects, vision, and approach to each U.S. Department of Transportation (USDOT) Vision Element are provided in **Section 2**.

Figure 1: UB Mobile PDX Framework



We stand ready to not only become the Smartest City in the nation, but also to collaborate with USDOT to export success and spur action by other cities — improving safety, enhancing mobility, and addressing climate change locally and beyond. UB Mobile PDX is inspired by future-thinkers and climate-focused community members. It is grounded in field-tested approaches and locally established, industry-leading data integration systems. Portland is distinctly prepared to deliver our shared vision for a first-of-a-kind modern transportation system:

- Portland's **planning system** is structured to promote complete neighborhoods, decrease reliance on automobiles, encourage implementation of low-carbon transportation options, and focus growth in and around the Central City. While these priorities have helped establish Portland as one of the "most livable" cities in the U.S., minority and lower-income communities still face disproportionate transportation challenges. Partnerships with service providers, community, and educational institutions will be leveraged to place UB Mobile PDX devices in the hands of those who need them most.
- Portland's leadership in **open-source data standards and architectures** as well as **public-private partnerships** has transformed mobility options. TriMet, which provides bus, light rail, and commuter rail transit services in the Portland metro area, successfully collaborated with Google to develop the General Transit Feed Spec (GTFS) in 2005. GTFS has proved to be a catalyst for the entire industry globally. Today, TriMet is actively engaging in the development of GTFS SUM, which connects transit to shared mobility providers. This complex problem-solving ethos will be carried forward to UB Mobile PDX to further

streamline transportation data that improves safety, efficiency, and sustainable movement of people and goods.

- The Oregon Department of Transportation's (ODOT) Road Usage Charge (RUC) was the first of its kind in the U.S. and is being used as a design model by states around the country. RUC provides an *open architecture market and a secure and private environment* to users. The system has already begun to solve issues such as privacy, security, and data ownership that are critical to the success of the marketplace.
- Since becoming the first city in the U.S. to authorize a plan to reduce carbon emissions in 1993, Portland has reduced carbon emissions by 14 percent from 1990 levels. *Portland's Climate Action Plan* is a national model that will be leveraged to implement low-carbon transportation solutions, such as electric and autonomous vehicles.
- Portland's history of policy innovation and sustainable solutions for the built environment has enhanced performance of our existing infrastructure, gained global recognition such as the C40 Climate Leadership Awards, and created a distinct culture of creativity and collaboration. *Alignment between leadership, universities, institutions, private sector partners, and involved citizens* means that Portland embodies a shared vision of a more sustainable and equitable future.

Our proposal lays out a vision of place-based and people-focused multimodal transportation innovation that incorporates integrated technologies and policy ideas.

"As a working parent, getting the kids to daycare and myself to work on time is a constant struggle. With **UB Mobile PDX**, I can quickly find the fastest and cheapest option – especially on those days when I clock out late or traffic is bad."



~Jasmine, age 32
Outer SE Portland

Section 1: Portland's Smart City Enabling Environment

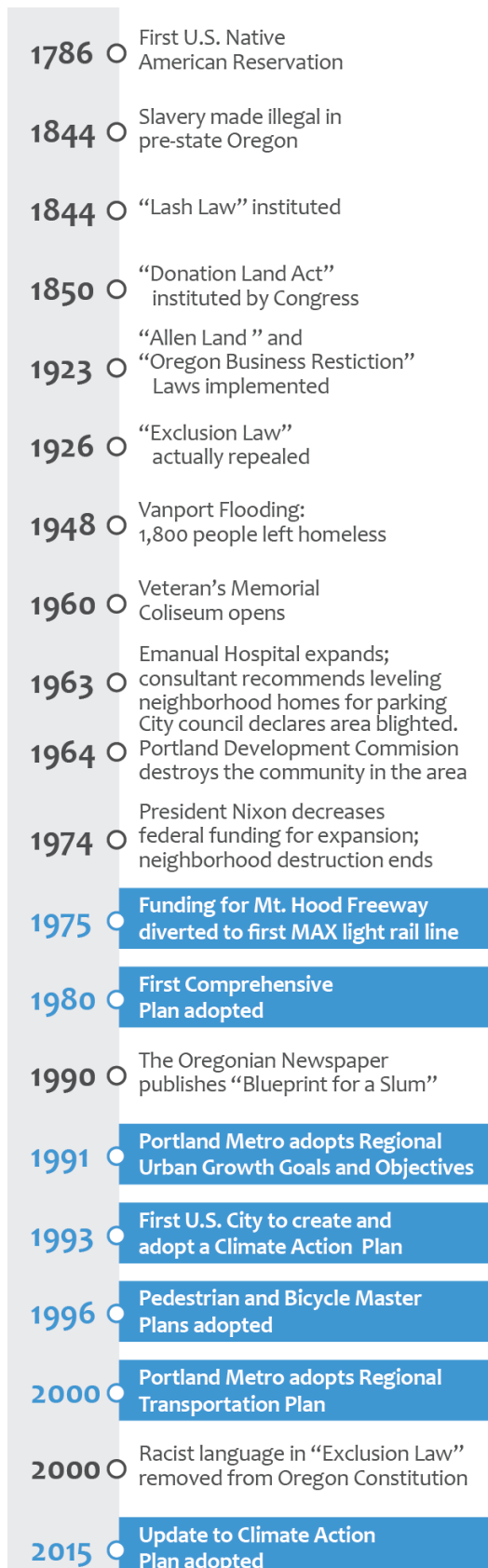
City Characteristics

In 1973, the Oregon Legislature established a first in the nation requirement that each city in the state adopt an urban growth boundary. Spurred on by Hector McPherson, a Lynn County Dairy farmer, the adoption of Senate Bill 100 established Oregon as a leader in conserving essential farm and natural resources and making urban services more efficient. Nobody at the time called it Smart Growth or a paradigm shift. But that is what it was.

Fast forward to 2016. These principles of growth management have helped Portland preserve its livability in the face of dramatic growth. Portland continues to be a national leader for progressive land use and transportation policies, and an innovator in providing a multimodal transportation system for its citizens.

Portland, Oregon is located in the Willamette Valley region in the Pacific Northwest, at the convergence of the Willamette and Columbia rivers. Portland has a population of 583,776 in a region of 1,849,898 (US Census, 2010). This represents 31.6 percent of the regional population and 145 square miles. Portland has a population density of 4,375 per square mile.

Figure 2: Portland, Oregon's Development Timeline



Portland has emerged as a leader on equity and inclusion in an ongoing effort to correct the historical inequities evident in the City. From the birth of the neighborhood system in the 1970s, Portland has sought to include people from all walks of life in governance, planning, and decision making. The City, however, has faced significant challenges to living up to these ideals. As *Figure 2: Portland, Oregon's Development Timeline* illustrates, long before the City embarked on smart planning, transit oriented growth, and addressing climate change, Portland had grown up fostering historic inequalities. Highway construction, stadium construction, and urban renewal eliminated or significantly impacted vibrant African-American communities, homes, and commercial areas in the name of building a better Portland. Even as the City adopted and implemented its first Comprehensive Plan, "redlining" was being practiced in Portland neighborhoods and was only brought to light by the Oregonian newspaper series "Blueprint for a Slum" in 1990, which detailed the lack of mortgage lending in North and inner Northeast Portland.

Through planning for climate action, bicycle and pedestrian connectivity, and urban renewal, uneven progress was made at addressing racial inequality and gentrification. With increasing growth pressure and in-migration rates, City demographics are changing. Nearly 50 percent of current school-aged Portland Public School (PPS) students are children of color. Portland's vision is to administer and deliver City services that provide all Portlanders access to the opportunities necessary to satisfy their essential needs, advance their well-being, and achieve their full potential.

The Smart City Challenge is an opportunity to help correct these historical inequities. The priority demonstration zones of Columbia Corridor and Powell/Division Corridor were selected in part due to direct impacts of the development projects mentioned above. UB Mobile PDX will address ladders of economic opportunity in low-income areas where people ride transit, bike, and walk at higher

rates than anywhere else in the city. Safety will be addressed in these areas, where currently traffic related fatalities are twice as likely to occur as in other areas.

As part of this commitment to equity, PBOT will partner with community colleges and universities, local K-12 schools, and local service and community organizations to get the required tools into the hands of these communities. UB Mobile PDX and the priority demonstration zones create a framework for integrating displaced or underserved communities into the new economy. Portland and its partners can help disadvantaged communities' better use transportation to save time and money, get to jobs, and achieve better health outcomes.

Transportation in a Smart City is not the means to an end, but rather about improving people's quality of life when they are travelling in a city. Portland leadership understands this and that makes us uniquely qualified for this award.

Existing Transportation System

The City of Portland has an extensive transit system that provides the required options to make UB Mobile PDX successful from day one. The City contains 223 miles of freeways and 226 miles of arterial streets. Portland also has 39.5 miles of light rail (MAX) with 5 lines and 70 stops, 12.78 miles of Streetcar Urban Circulator service with 76 stops, and close to 1,400 miles of bus transit service with over 4,500 stops. The Aerial Tram connects the City's South Waterfront district and the main campus of Oregon Health & Science University. And Portland has 350.4 miles of bikeway and 77.4 miles of neighborhood greenways.

The Portland Streetcar, owned by the City of Portland, operates two lines within the Central City. The North-South Line connects the heart of downtown on the west side of the Willamette River and has been central to dense urban residential development and job growth. The A and B Loop Line provides a circulator loop around the Central City with an additional focus on innovative economic development and job creation. The full loop service fulfills the vision from Portland's 1972 Downtown Plan and knits together the east and west banks of the Willamette River. The Streetcar, with about 15,000 boardings a day, provides direct mobility and also attracts development (7,400 housing units directly related to Streetcar and many more within a short distance of Streetcar) that foster mobility without adding more cars to the roadways.

The City of Portland, in partnership with the Port of Portland, Metro, ODOT, and private sector freight and logistic industry stakeholders, is embarking on a Smart Freight Regional Strategy to facilitate the more efficient movement of goods, employees, and container services. The Strategy is focused on creating a coordinated and comprehensive data hub within various transportation services providing for the following:

- Intensive intelligent transportation system (ITS) management of key freight routes
- Congestion pricing or tolling on key freight corridors

"For years, I drove to work downtown because I thought it was faster. A colleague showed me **UB Mobile PDX** and I started to think differently about my commute.



Turns out, Portland has many great options and riding MAX is actually faster than driving at rush hour. I love seeing the dollars saved add up on my app!"

~David, age 50
NE Portland





- Facilitated cargo, container, and freight services into and out of the Port of Portland's aviation, marine, and industrial properties and along regional truck routes
- Coordination of port cargo schedules and rail schedule data

This effort will enhance business growth opportunities by providing cost effective and reliable market access. Additionally, it will reduce emissions, provide ladders of opportunity in key economic growth areas, and facilitate Transportation Demand Management to move employees to and from employment centers.

UB Mobile PDX Key Projects and Site Map

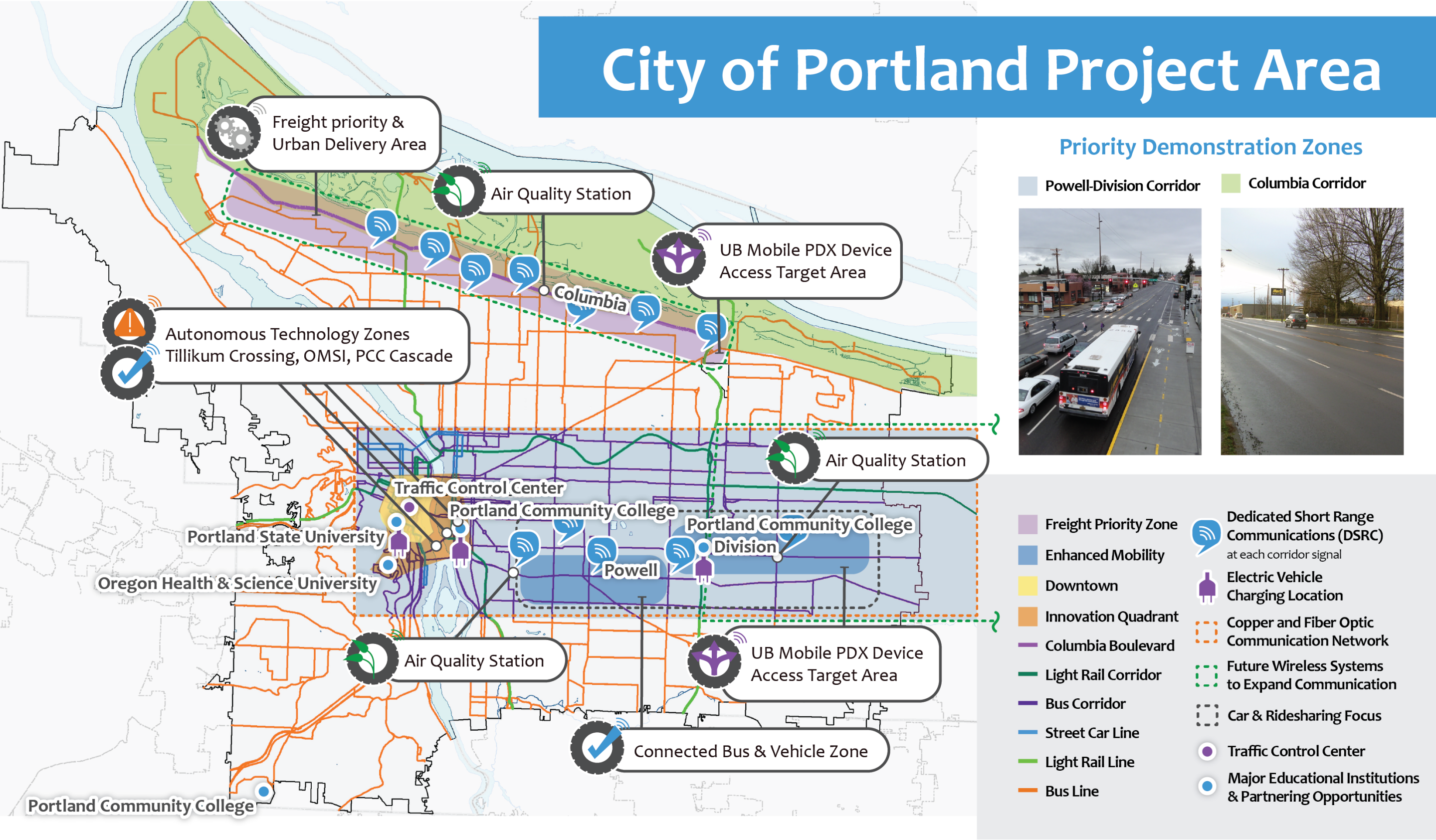
The City of Portland will demonstrate to the world what is possible through implementation of UB Mobile PDX. As shown in *Table 1: UB Mobile PDX Vision Projects* this includes implementing the following outcome-based projects that help realize our vision.

Table 1: UB Mobile PDX Vision Projects

 <p>People Focused</p>	<p>Launch the UB Mobile PDX Marketplace and Open Data Cloud with private sector and academic partners to ensure security and equity in device access. Pilot integrated Wi-Fi at transit stations and on transit vehicles, starting with the Portland Streetcar.</p>
 <p>Autonomous</p>	<p>Leverage private sector partnerships for a driver-assistance and collision-avoidance bus and train pilot on Portland's new car-free, multimodal Tilikum Crossing to provide a dynamic link to the Innovation Quadrant and enhance safety on the bridge while allowing operations at higher speeds. Autonomous vehicle pilots will also be explored at nearby academic and institutional campuses.</p>
 <p>Connected and Multimodal</p>	<p>Deploy two connected vehicle pilots with a TriMet bus fleet and car-share vehicle fleet. Communication infrastructure throughout the priority demonstration zones will be enhanced with Wi-Fi and Dedicated Short Range Communication (DSRC) radio capabilities. Connected vehicle technology, such as smart on-board diagnostic (OBD) ports will be integrated into the vehicle fleet. MobileEye technology will also be explored for integration with TriMet's bus technology Automatic Vehicle Location (AVL) system. At the central traffic control center, Portland's central signal system will be upgraded for DSRC in partnership with our current vendor Transcore.</p>
 <p>Low Carbon</p>	<p>Collaborate to become a Zero Emission Vehicle City by 2035 through implementation of smart grid technologies. Electrify priority demonstration zone transit corridors and integrate electric vehicle (EV) charging stations into street lighting systems. Demonstrate dynamic wireless charging of EVs in key locations to enable daytime charging, thus permitting a direct path from renewable energy generation to the user.</p>

Key existing transportation system components and the above technology-based solutions to help realize our vision are highlighted on *Figure 3: UB Mobile PDX Base Map*.

Figure 3: UB Mobile PDX Base Map



Environment Conducive to Demonstrating Proposed Strategies

A number of initiatives make Portland an ideal enabling environment for UB Mobile PDX and the Smart City Challenge grant. Portland has a long history of being early adopters of new technology and transportation. We were the first U.S. city to build a modern streetcar system and the first U.S. city to launch a carshare program. TriMet was the first transit agency to provide real-time trip data to the public, and was on the forefront of opening up its application programming interface (API) to third-party software developers. And Portland has the highest per capita ownership of hybrid vehicles.

Current initiatives that demonstrate Portland's continued commitment to innovative transportation solutions include the revolutionary Hop Fastpass, new bike counting and sharing system, and ongoing leadership in multimodal transportation electrification as discussed below.

The City of Portland and TriMet, along with regional transit partner C-Tran in Vancouver, WA, are currently embarking on a state-of-the-art, electronic transit fare system called Hop Fastpass. This contactless payment system was designed with a geographically redundant and robust backend using open architecture APIs to easily expand and support future services and to capture data as part of UB Mobile PDX. Hop Fastpass will integrate payments for buses, light rail, and the Portland Streetcar and can be used by other modes. The Hop Fastpass infrastructure is being designed in an open and flexible (yet secure) way that will accommodate many other types of use. It will offer a website for employers, schools, and social service agencies, and another website for consumers, as well as mobile Apps for Android and iOS. At full public roll-out in 2017, it will also be compatible with Apple Pay, Samsung Pay, Android Pay, and contactless bank cards, whereby customers can tap their phone or bank card to board. As part of the Smart City Challenge, we will work with TriMet and our partners to integrate cash payment options to promote accessibility to unbanked community members. Other concepts that could be explored after the Hop Fastpass system comes online include expanding the system to the small transit systems that connect satellite communities into the region and elsewhere in the state, as well as bike and ride storages areas in the region.

Additionally, PBOT is implementing a bicycle ride counting system. As this rolls out and as part of UB Mobile PDX, PBOT will integrate Bluetooth-enabled data streams for the existing bikeway system and the new Portland bikeshare program BIKETOWN. By pulling together these active mobility open-source data streams, Portland can enable better outcomes for the end user with time benefits, money savings, and better health.

"I am a PCC student with work, family, and school responsibilities. Before UB Mobile PDX, I would check the bus schedule before I left campus. Now, I can check the schedule in real time and even grab a rideshare or BIKETOWN bike rather than waiting for the bus when I'm short on time."



~Javier, age 24
North Portland

Oregon was an early, and continues to be, a global leader in transportation electrification. In 2010, it was the first (and still only) U.S. state to receive the prestigious international "E-Visionary" award. It is one of the top 10 U.S. markets in EVs and chargers per capita, and has one of the most robust DC Fast Charging networks in the U.S. Oregon is a zero emission vehicle (ZEV) mandate state and part of the International ZEV alliance, with a stated goal that all new vehicles sold will be zero-emission no later than 2050. Portland General Electric, the major utility serving Portland, has also been an EV leader – and recently proposed legislative changes in Oregon will also direct and require major utilities to prepare strategies for transportation electrification. Finally, Oregon's low-cost and low-carbon power make EVs even more attractive; the Union of Concerned Scientists recently calculated that an electric car in Oregon gets the equivalent of 94 miles per gallon.

Continuity of Committed Leadership and Capacity to Carry out the Demonstration

Portland's Smart City Challenge goals are broadly supported by City leadership. The Mayor, Commissioner-in-Charge of Transportation, Director of Transportation, and the Director of the Bureau of Planning and Sustainability are committed to seeing UB Mobile PDX implemented. The City, through its existing collaborative relationships with Portland State University (PSU), ODOT, the Metro regional

government, the Port of Portland, and TriMet will continue to work collectively in this multi-agency effort.

The Portland metro area serves as an economic driver for a state with an economy founded on wood products and natural resources and transformed by durable manufacturing. The City of Portland's Economic Development Strategy lays the foundation to build the most sustainable economy in the world. This requires a balanced focus on job growth, innovation in sustainability, and equality of opportunity. Portland holds a unique competitive position as a national leader in the industries and talent supporting sustainability, which will translate into revenue and profit growth for the city's existing business base. These industries include clean technology and sustainable industries, advanced manufacturing, apparel, and software. The City intends to expand exports, support the innovation efforts of higher education institutions, and align workforce development to match the skills needed in sustainable industries.

"For years now, states, cities, and communities across the country have watched Portland, Oregon emerge as a leader in urban transportation. From streetcars to light rail to bike lanes, Portland has been touted by more than one Secretary of Transportation for its forward thinking." - U.S. DOT Secretary of Transportation Anthony Foxx, October 2014 visit to Portland. "



Secretary Anthony Foxx (right) and City of Portland Mayor Charlie Hales (center), U.S. Conference of Mayors 2016.

The City has shown leadership, through the Portland Development Commission (PDC), in helping investment and opportunity for small, new technology startups in the metro area. The City of Portland, through PDC, is an investor and key public partner in the Portland Seed Fund, a privately managed fund and non-resident accelerator focused on providing emerging companies with the capital, mentoring, and connections to propel them to the next level. GlobeSherpa, the company that created TriMet's mobile payment App, is a graduate from this program and has continued to grow jobs and innovation. Further demonstrating the City's commitment to inclusion, the Inclusive Startup Fund provides early-stage investment capital and mentoring to local high-growth companies founded by underrepresented groups across a variety of industries. PDC and Multnomah County each contributed \$500,000 and Oregon Governor Kate Brown and Business Oregon committed \$250,000 to launch the fund last year¹.

Portland is a national leader in safe, effective, and sustainable transportation solutions. The transportation system is a nearly \$10 billion investment in assets that facilitate the movement of people, goods, and services within Portland. PBOT employs more than 750 people at 2 locations in downtown, a maintenance facility in inner North Portland, the Portland Streetcar office in Northwest Portland, and the Sunderland Recycling Facility in Northeast Portland.

PBOT developed Portland Progress, the 2-year work plan that represents a blueprint for how the bureau can build a better Portland. Portland Progress action items are informed first by the multiple long-range plans that guide all City agencies: the Portland Plan, the Comprehensive Plan, Climate Action Plan, and specific to PBOT, the Transportation System Plan. The plan contains 176 steps grouped into 6 themes serving the public. The following four themes directly relate to the Smart City Challenge.

- **Build A Future Where All Can Grow And Thrive.** Portland continues to expand and grow in population, employment, and visitors. The city will continue to grow, so PBOT will need to plan and anticipate the challenges of growth by improving connectivity, moving freight more efficiently, and addressing inequities of the past that hinder the future.

¹ See more at <http://www.pdc.us/inclusive-startup-fund.aspx>

- **Embrace Vision Zero.** This theme addresses the need to use street design and public education, and to work with partners in law enforcement and the State Legislature to create streets where everyone, from the youngest to the oldest and people of all physical abilities, can move safely.
- **Effectively Manage City Assets.** Approximately one-fifth of the land area of Portland is held in public rights-of-way. This theme addresses the need to make the most of the City's street space by prioritizing among competing uses, supporting the role of streets as community places, and better managing parking.
- **Contribute To The Health And Vitality Of Our People And Our Planet.** Healthy and connected neighborhoods are a fundamental goal of the Portland Plan. This theme aims to improve community health and livability by creating safe, active transportation options.

Commitment to Integrating with the Sharing Economy

In 1998, the City of Portland launched the nation's first carsharing program and is now home to four carshare companies. Early on, the City recognized the value and growth of the sharing economy and sought to accommodate the expanse of this new market through lodging with Airbnb and other companies, while still preserving the character of the City and protecting neighborhood livability. PBOT took the lead in crafting regulations to allow Transportation Network Companies (TNCs) in the Portland market, thus providing for equitable treatment of existing taxis and town cars, and introducing more competition to the market. Car2Go now operates a fleet of 530 cars, the largest fleet in the U.S.

Portland's new bikeshare program BIKETOWN will launch in July 2016. In partnership with SoBi, Motivate, and Nike, PBOT is working to create an App that will not only give users real-time data on the location of the bike, but also include real-time route finding. It will be the most technologically advanced App on the bikeshare market. Portland will be the first city to introduce variable pricing and gamification to its bikeshare with the technology on the bike. Instead of rebalancing the bike system with trucks, Portland will use pricing and incentives, thereby reducing the overall carbon footprint of the bikeshare system.

Commitment to Making Open, Machine-readable Data Accessible, Discoverable, and Usable by the Public to Fuel Entrepreneurship and Innovation

The Portland region has a long history of making open, machine-readable data accessible, discoverable, and usable. PBOT partners, including ODOT, TriMet, Metro, and more have made data open and publically accessible through systems such as the TripCheck Traveler Information Portal (TTIP) – hosted by ODOT, the regional archive of transportation data for the Portland metropolitan agencies PORTAL – hosted at PSU, and Civic Apps – hosted at City of Portland. Examples of currently-available data on these systems include the following:

- Travel time data collected from Bluetooth sensors on City and State roadways
- Data from the regional arterial traffic signal system, including traffic volume and signal timing, particularly data from an adaptive traffic signal system along the Powell/Division Corridor
- Transit schedule data available through TriMet's public data feed in GTFS format
- On-time performance and ridership data from the TriMet AVL and Automatic Passenger Counter (APC) systems
- Data on traffic incidents from ODOT's Advanced Traffic Management System
- Freeway speeds, volumes, and travel times from all regional freeways, including road closure data
- A wide variety of geographic information system (GIS) data including streetlights, building footprints, zoning, and hydrography

The existence of archives and websites such as TTIP, PORTAL, and Civic Apps shows the region's commitment to open, accessible data. ODOT is currently enhancing TTIP in anticipation of connected vehicles (CVs), looking at how CV data is captured into TTIP, and how CVs will consume roadside data following through TTIP.

PORTAL is the official transportation data archive for the Portland metropolitan region as specified in the Regional ITS Architecture. PORTAL facilitates the collection, archiving, and sharing of data and information for public agencies within the region. USDOT is familiar with the capabilities of PORTAL through PORTAL's contribution to the ITS JPO's Research Data Exchange, created through the ITS JPO's Connected Data Systems Program. PORTAL has ongoing support through funding from the regional ITS coordinating committee, TransPort.

The City of Portland has made sharing transportation data to fuel entrepreneurship and innovation a standard operating practice. The data collected, as described above, is made available to agencies, project partners, and stakeholders through a variety of existing websites and is shared among agencies on a dedicated fiber network. The PORTAL makes data available as well as supports simple visualization and tables on that data. Data not available for download on the website is available through PSU. TriMet makes an additional set of data available on its data website, and City of Portland makes a wide variety of GIS data available on its CivicApps website. Finally, Portland has created a custom fiber network, called the ITS Network, to facilitate data exchange among agencies and partners, including City of Portland, ODOT, TriMet, and PSU.

The open data sharing applications seek to support smart land use and community reinvestment in underserved sections of our community, while reducing congestion and increasing the safety of travelers. PBOT wants to create an environment where alternative, multimodal trip options are not only encouraged, but also commonplace. However, current data sources (for example, American Community Survey and regional travel surveys) do not provide data often enough or at a fine enough scale to accurately track our progress in increasing multimodal travel.

Because of these problems, PBOT has limited ways to study mode share and mode share changes. As UB Mobile PDX becomes popular, it will provide an opportunity to see real mode split in the city. It also provides a chance to see the real-time evolution of mode share which greatly improves our predictive modeling capabilities. Because the data can be collected in real time, we can produce a predictive model on mode share that accurately accounts for seasonality.

The vision for UB Mobile PDX is to continue the evolution of the National ITS Architecture and Connected Vehicle Reference Implementation Architecture (CVRIA) to incorporate technological developments and evolving user needs with a particular focus on connected vehicle requirements. For newly collected data, the project partners will coordinate and develop data sharing protocols based on existing protocols and the National ITS Architecture.

With this data, PBOT can more intelligently devise a strategy for increasing alternative and active mode use, improving safety, and reducing greenhouse gas (GHG) emissions.

Section 2: Portland's Vision for a Holistic Smart City Program

Our visionary approach successfully integrates societal trends - including Mobility on Demand (MOD), shared-use transportation, crowdsourcing, and preference for lower-carbon options — and technological advances including automation, vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), smart probes, and electrification — to unlock innovation and realize measurable outcomes for a Smart City.

"At my age, driving isn't easy, and the walk from the bus stop home can be daunting. With **UB Mobile PDX**, I don't have to stay home. I can easily call a rideshare to pick me up from the bus stop and take me to my front door.

The information – and volunteer who taught me to use it – has given me my freedom back!"

~Marylin, age 68
East Portland



Societal Trends + Technological Advancements =
Ubiquitous Mobility for Portland

This will be done through implementing key projects as discussed above, including the following:

- Launching UB Mobile PDX Marketplace, User Interface, and Open Data Cloud
- Implementing a driver-assistance and collision-avoidance bus and train pilot on Portland's Tilikum Crossing and leveraging private sector partners for an autonomous vehicle pilot areas
- Deploying two connected vehicle pilots with TriMet's bus fleet and carshare vehicle fleet and improve or install upgraded communication infrastructure throughout the priority demonstration zones
- Implementing smart grid technologies including electrification of priority demonstration zone systems

The measurable outcomes targeted through these projects are based on addressing Portland's most pressing challenges and highest priorities:

- **Unprecedented growth.** In a growing city, our residents must find new ways to access jobs, services, education, retail, and recreation. We also must find new ways to manage our transportation system to allow for robust economic growth – which depends on both mobility and access – while continuing to focus on investments in biking, walking, safety, and connectivity rather than widening roadways or building new freeways. UB Mobile PDX addresses both the demand side – providing new access to information about how to get around and supporting a growing suite of public and private sector options – and the supply side by improving system efficiency. Our priority demonstration zones for technology-based solutions will help Portland – and cities around the country – understand how these emerging technologies can make our streets safer and more efficient and demonstrate how we can bridge the digital divide.
- **Social equity.** As we make infrastructure investments, the City is conscious of ensuring these investments promote equity rather than deepening divides. This means focusing on traditionally underserved communities, engaging residents in meaningful ways so that all citizens have the opportunity to influence decision making, and improving safety. UB Mobile PDX is a platform for ensuring that the technology revolution changing the way our transportation system works – from connected and autonomous vehicles, to ride sharing and new ways to pay for our system – reaches low-income and minority residents. Using UB Mobile PDX, we can bring transportation costs down, increase choice, and ensure that these benefits are experienced equitably throughout the city.
- **Climate change.** Portland has a goal of reducing daily vehicle miles traveled by 30 percent from 2008 levels by 2030 as well as improving the efficiency of freight movement. UB Mobile PDX is an important part of meeting this goal by providing residents with better information about how to get around and how their choices impact GHG emissions in the region, and supporting the growth of transit, ridesharing, and bikesharing options that can only become more robust through increased use. Integration of gamification in active transportation options will also help to promote better health outcomes. And finally, using data collection and smart signal technology, UB Mobile PDX will also improve freight efficiency in and through the city.

Key Features of Portland's Smart City

In Portland's Smart City: Payment for mobility services and cost of supplying service will be transparent and correlated.

The current transportation funding system, largely through the gas tax, parking, and other tax revenue, has become disjointed and regressive. Within the UB Mobile, Portland will develop a secure Marketplace that will collect payments for using mobility infrastructure and services. A transparent marketplace will enable users to select the most cost-effective systems and the City will optimize use and cost by providing updated information to help enhance mobility choices. In addition, the City will be able to provide equity with targeted subsidies for individuals with special requirements that result from physical or financial challenges or because they live in locations currently underserved by low-cost mobility options.

In Portland's Smart City: The Internet of Things will be used to collect information and intelligent systems will analyze the information to optimize operations.

UB Mobile PDX will launch an Open Data Cloud that receives non-personally identifiable information (PII) from all participants. The data integration approach will protect privacy by augmenting data from strategic sensors to collect, analyze, and report data anonymously. At very low cost, vehicles will be fitted with smart probe devices connected to the vehicle OBD port. Cars and trucks will become smart mobile probes, gathering data through CANbus information about speed, breaking, slipping, bumps, and crashes, and analyzing the data and reporting anomalies. The data will be collected and analyzed by a network of researchers granted access to the database, similar to the current PORTAL system managed by our partner PSU. To support data warehousing, PBOT will leverage key private partnerships as well as explore large-scale green data center solutions. They will develop a suite of algorithms which the system operations manager will use to inform city, county, and state agencies. The net result will be improved service, improved operating efficiency, and lower cost.

In Portland's Smart City: Users will be well-informed.

Portland has a leading set of transit system communication tools for riders. Currently, industry is providing drivers and transit user's information tools such as traffic maps from Google, Inrix, HD Radio, Garmin, and a host of others. UB Mobile PDX will integrate and enhance this information with reliability, schedule, GHG emissions, and cost data. User-driven Apps and dashboards will be created for download and the team will leverage partnerships with private sector information providers delivering knowledge to the public. At the same time, through the Open Data Cloud, the system's operation managers will access available data to optimize the safety, equity, environmental impacts, and efficiency of their operations.

In Portland's Smart City: Traffic flow will be managed for safety and low-carbon efficiency.

Portland traffic signals are currently fitted with a robust communication system that connects 70 percent of the City's system. The system is shared by all agencies in the region and are jointly managed with ODOT from the PBOT control center to the Regional ITS Network. Portland uses the Transcore Transuite system, which is the same partner used by the New York City USDOT Connected Vehicle Pilot Deployment. The ITS Network is used to communicate to the PSU data center PORTAL. Portland has a long history of working with TriMet on innovation like transit signal priority and enhanced preemption for light rail. PBOT has also pioneered truck priority which will be deployed in the Columbia Corridor to enhance freight delivery. These applications will be further enhanced by the additional data integrated into UB Mobile PDX and the emerging DSRC technology as it is increasingly integrated into new connected vehicles. Traffic signals will become increasingly smart. The capability to receive information by drivers will be limited by the vehicle technology, not the system. By collecting vehicle data regarding fuel consumption and emissions using the OBD port and correlating the data with signal phase timing (SPaT) information and signal priority strategies, Portland will be able to link GHG emissions and traffic management at the vehicle level with air quality measurement devices in the field, thus offering the first ever opportunity to measure and manage transportation flow for optimal GHG emissions.

In Portland's Smart City: Autonomous transportation will be realized.

Autonomous vehicle technology can improve the safety of our transportation network, energy efficiency, convenience, operating efficiency, and equity. UB Mobile PDX will provide the means by which autonomous vehicles can become mainstream. We have no doubt manufacturers will successfully solve technical issues, but there remains the issues of acceptance and adoption. To aid in this transition, Portland proposes to establish autonomous transportation pilot zones, beginning academic and institutional campuses, as well as a driver-assistance and collision-avoidance bus and train line on the new car-free and multimodal Tilikum Crossing. While these areas fall outside the priority demonstration zones, they provide a critical link to Downtown Portland and complement the nearby Innovation Quadrant.

"I am a father of three and glad that **UB Mobile PDX** provides our city's decision-makers the real time information they need to improve pedestrian and bicycle safety in my neighborhood."



~Mark, age 42
SW Portland

In Portland's Smart City: Fossil fuel consumption will be reduced and renewable energy will be the primary sustainable energy source.

Vehicle electrification is here. In conjunction with our partners, we will explore implementation of dynamic wireless charging for EVs as well as stationary wireless charging at dedicated carshare, bus, and vehicle or truck fleet parking locations within the priority demonstration zones. Development and demonstration of wireless charging is critical to our effort to increase charging of EV batteries that permits a direct path from renewable solar photovoltaic energy generation or renewable wind generation to the ultimate user. Portland is already home to the first solar-powered, battery-driven fast charger for EVs, developed by local company EV4Oregon, with support from key partner Drive Oregon. We will build on this success to continue to maximize renewable integration through vehicle charging. UB Mobile PDX will promote innovative new programs within the priority demonstration zones, such as a network of electric bike and scooter sharing pods powered by solar-powered charging stations.

Ubiquitous Mobility for Portland - Key Components

UB Mobile PDX will enable Portland citizens and visitors to reach their destinations in the most affordable, quickest, safest, or most eco-friendly way possible. It will empower people to move more effectively and freely through the city and provide the reliability necessary to maintain demanding work, family, or academic schedules. Most importantly, through strategic partnerships, PBOT will provide low cost mobile devices and applied education for how to use the tool to control groups in each priority demonstration zone to promote access to the system. Based on the overarching framework of UB Mobile PDX (as shown in *Figure 1: UB Mobile PDX Framework*), the key components to be implemented as part of the Smart City grant include the Technology Hardware Foundation and



Actors, the Marketplace, the User Interface, the Open Data Cloud, and finally the Priority Demonstration Zones for technology and infrastructure implementation:

THE TECHNOLOGY HARDWARE FOUNDATION AND ACTORS

The foundation of UB Mobile PDX is the availability of data from the environment, vehicles, and people. The Portland approach divides the people, vehicles, sensors, and devices on the city stage into groups of “actors.” Stationary actors generally include infrastructure systems such as intersection signals, lighting, weather, cameras, and other imbedded sensors. The mobile actor group is very large, potentially including hundreds of thousands, and includes vehicles, trains, busses, trucks, bicycles, and pedestrians. Data from many stationary actors is already being collected and archived and procedures for that collection are in place. For the mobile actors, during development and the demonstration, we will offer and install low-cost OBD-connected smart devices to citizen participant vehicles. Commercial vehicles will be encouraged and eventually required to equip their fleet. Pedestrians, bicycle riders, and passengers on public vehicles such as busses and trains or in commercial vehicles such as taxis, will be connected by their personal smart phones (public and commercial vehicles will be connected independently of passenger connectivity). Eventually, as the advantage of UB Mobile PDX becomes evident, we expect a second wave of users to voluntarily “opt-in” to the system and pay for their own device.

Wherever possible, data will be collected and processed at the edge – on or near the sensor. This is enabled by affordable and intelligent sensor technology. For example, the OBD smart device will provide two-way communication with the Open Data Cloud, providing pre-analyzed secure information and receiving transaction information. These same devices will act as smart probes to collect, analyze, and communicate anonymously all types of system information (free of PII) to the Open Data Cloud. OBD interface can provide related Information such as weather, generated from windshield wiper operation to wheel slippage collected from a vehicle, or congestion information which might be inferred from a combination of global positioning system (GPS) location, speed, and breaking/acceleration patterns.

Edge processing will be facilitated by intelligent gateways that aggregate and process multiple instruments such as on train cars. Communication to the Open Data Cloud will leverage cellular 3G, 4GLTE, Bluetooth, Wi-Fi, or systems in development such as DSRC or 5G. Interoperable regional architectures for these systems will be used, including IEEE 802, IEEE 1609 (for cryptology/security), and SAE J2735 Messages. It is important to note that the Portland strategy will be radio agnostic.

Clearly some particular applications such as V2V communication collision avoidance will require new technology. The Portland strategy is to pilot and demonstrate what is possible now while building the road to the future.



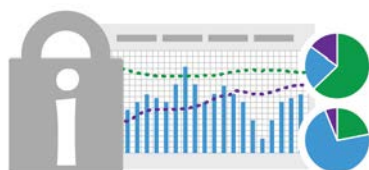
The Marketplace

THE MARKETPLACE

The Marketplace will use intelligent devices to collect and communicate information and enhance mobility, reliability, transportation efficiency, and reduce transportation-related GHG emissions. The Marketplace will be developed as an exchange market that allows drivers, passengers, transit riders, bicyclist, and pedestrians to buy and sell mobility in a secure and private environment with transparent pricing across mobility modes. The Marketplace will provide user options to aggregate mobility payments, including public transportation fares, tolls, taxis, public and private parking, road usage charges, and peer-to-peer sharing payments that enable integrated pricing policies to drive customer behavior. This will allow mobility users to make informed choices and allow a Smart City to send pricing signals to users to optimize actual costs to both the user and city.

The basis for development of the Marketplace is significantly underway. ODOT's third generation road mobility pricing RUC provides a successful model for secure payment management and exchange. As previously mentioned, TriMet's Hop Fastpass will be the nation's most advanced open architecture transit payment system designed by multiple vendors and managed to be non-proprietary. The intent is to link the knowledge of the two systems with other payment systems such as taxi, ridesharing, carsharing, biking, and walking to create a cross transportation mode marketplace. Additional features of the Marketplace include the following:

- Users will be presented with a full view of mobility alternatives.
- Transit and peer-to-peer sharing economy providers will have intelligent tools to enable introduction of selective pricing and behavioral pricing signals.
- Public and private sector partners will join to create "affinity networks" (that is, groups of system users and businesses with common interests) that pull individuals into groups with common goals, motives, and behaviors.
- Individual privacy and security will be assured by using intelligent secure devices at the point of transaction. The devices will provide only the minimum information necessary to accomplish the transaction and all transaction information will be encrypted.
- The systems will continue to accept payments from various sources, which can also be expanded upon as technology and applications evolve. Solutions for cash payments and access for unbanked populations will also be integrated.
- The system will follow the ODOT RUC pilot (legislated) requirements by removing PII information from records 30 days after payment.
- The convenience, incentives, time, and cost savings of the Marketplace will draw participants into the system.



The Open Data Cloud

THE OPEN DATA CLOUD

The Open Data Cloud provides the analytics to enable UB Mobile PDX. It is critical that the Open Data Cloud is scalable, secure, performant, and affordable.

Scalable to support rapid growth in data, traditional and non-traditional data types (for example, images and tweets). **Secure** to protect access

to protected or private information. **Performant** to provide near real-time response to support decisions by mobile actors engaged in the system. **Affordable** in terms of dollar per terabyte and dollar per extract, transform load.

Delivering this combination of results will be achieved with open source distributed data tools at a fraction of the cost of commercial relational systems. Access to the Open Data Cloud will be based on a secure API. City systems, the Marketplace, and commercial applications will be able to securely access the Open Data Cloud data to improve controls, and deliver customer value.

Potentially the greatest value from the Open Data Cloud will be the availability of historical data for analytics, modeling, and predictive controls. Access to this rich data set will enable transportation planners with unprecedented visualization of patterns and opportunities. Development of predictive and dynamic traffic management, routing, and charges can dramatically improve system efficiency and provide improved service and transit times to individuals and commercial users of the Portland infrastructure. Additional features of the Open Data Cloud include the following:

- Data fusion, integration, and standards: transportation agencies have long been siloed in use and terminology. Integration with existing systems such as PORTAL, TTIP, Civic Apps, the RUC system, and others will be required. The API will need to transcend individual agency needs and provide a shared view of current and historic transportation information.
- Experience developing TriMet's open data standard: GTFS along with data management expertise at PSU will help the team address data fusion and integration issues. By making our architecture and internal standards open and documented, Portland's architecture and standards can be used as the basis for standards and will be available for other cities to use and leverage.
- Privacy and Security: security needs will inform every data item and interface. The ODOT RUC system has addressed privacy issues in the collection of data from OBD smart devices. Combining data sources together may create additional privacy issues. The team will conduct a thorough security (risk and vulnerability) assessment on applications and transmissions and develop the most appropriate security approaches to secure information and transactions. This assessment will include data provided to the Marketplace, API, mobile applications, and any other sources and consumers of Open Data Cloud data.
- Scale and responsiveness: with the rapid rise of "things" (cameras, sensors, and gateways), the importance of a scalable data environment is critical. In addition, to create a compelling and usable solution, the Marketplace response must support the real-time needs of travelers through nearly instantaneous results. This can be achieved through implementing a No-SQL distributed data store to provide scale and performance at a cost-effective price point. Furthermore, the platform will be flexible enough to cope with both structured and unstructured data.



The User Interface

THE USER INTERFACE

Marketplace and Open Data Cloud information will integrate at the users' smart phone, tablet, or personal computer. APIs and applications will be developed for download to provide specific and user-driven information to support MOD and provide features that could improve mobility, increase cost efficiency, improve sustainability, and lower an individual's GHG footprint. Apps developed with data from the User Interface may suggest alternatives that save time or money on a user's daily commute. The User Interface will provide a dashboard for UB Mobile PDX participants to see their own information presented against a backdrop of all users, thus creating an enhanced user experience. Additional features of the User Interface include the following:

- Affinity groups are likely to be created based on mobility preferences. Users, at their option, may choose to share and receive select data as part of an affinity group in exchange for valuable points, gifts, or social encouragement.
- User-driver Apps will provide accurate data on trip cost, schedule reliability, and GHG emissions to increase use of active modes of transport, including transit.

PRIORITY DEMONSTRATION ZONES

Many UB Mobile PDX solutions are enabled by open-source data and user-driver MOD preferences (as described above), while other technology-based solutions will be pilot tested in priority locations throughout Portland. Selected priority demonstration zones are at the right scale to demonstrate the

An important part of Portland's model of success in innovation has been to focus on civic centers and transportation corridors, to test innovative approaches, and measure the effectiveness.

impact of UB Mobile PDX and are places where we can leverage other community and infrastructure investments. More importantly, our demonstration zones offer an opportunity to provide access to the benefits of UB Mobile PDX to people who are often relegated to a second tier in both infrastructure investments and technology access. Through partnerships with established community organizations that serve and advocate for low-income and minority residents, public schools and community colleges, we will bridge the digital divide and get devices into the hands of the people who stand to gain the most from enhanced access and mobility.

The Columbia Corridor and the Powell/Division Corridor will be design labs for specific infrastructure implementation as well as for baselining, monitoring, and reporting against UB Mobile PDX outcomes. Each corridor will have specific outcomes targeted based on leveraging complementary investments as well as their unique development challenges, including equity, safety, congestion, access, mobility, and climate change.

- **Powell/Division Corridor:** The Powell/Division Corridor is in east Portland and is home to the region's most diverse population. As many as 70 languages are spoken at some elementary schools in the area. The Powell/Division Corridor, particularly east of 82nd Avenue has changed dramatically in recent years due to gentrification of Portland's closer in neighborhoods and arrival of new refugees and immigrants. The recent Outer Powell Safety Project (ODOT) and Powell/Division Transit and Investment Study (Metro/TriMet) have used new models of engagement to develop projects that benefit residents including developing land use policies and strategies to prevent displacement as new investments are made in the corridor. The City is in the project development stage with the Federal Transit Administration to obtain bus rapid transit (BRT) funding in this corridor. Currently, there are existing air quality sensors and adaptive system technology with Bluetooth sensors and transit priority in the corridor. Additionally, the Powell/Division Corridor has a unique placement as an education corridor. It connects Mount Hood Community College, Portland Community College, the Oregon Museum of Science and Industry, PSU, and Oregon Health Sciences University. People in between these institutions need fast, reliable, efficient, and flexible transportation options, often within the constraints of busy lives. UB Mobile PDX has the potential to make managing work, family, and education possible for some of our region's most vulnerable community members. This corridor is also one riddled with safety challenges. Division Street and Powell Boulevard are both identified as high crash corridors. Many parts of Powell Boulevard lack sidewalks and bike facilities. These neighborhoods need improved crossings for pedestrians and bicyclists particularly as they access schools and transit stops. Places most critical for pedestrian and bicycle access are adjacent to busy, high-speed roadways. UB Mobile PDX offers the promise to explore autonomous technology-based systems for driver assistance and collision avoidance on the bus fleet features that sense pedestrians and cyclists to improve safety for vulnerable users. In the Powell/Division Corridor, UB Mobile PDX will leverage transit and safety investments with increased access to shared ride services, bikeshare, and peer-to-peer car sharing to provide enhanced choices for getting around. The existing infrastructure

provides data about the (SPaT) status that can lower emissions and reduce congestion in a critical area for access to jobs. Communication infrastructure throughout the corridor will be enhanced with WiFi and DSRC radio capabilities. CV technology including OBD ports will be integrated into the vehicle fleet, as well as integrated dynamic wireless charging and EV charging stations in key locations throughout the corridor.

- Columbia Corridor:** the Columbia Corridor is home to 60,000 jobs, many low wage, and is a designated regionally significant industrial area. Average wages in the Columbia Corridor are \$44,800 per year. Because of the low density characteristics of warehousing, business parks, and industrial land, the corridor is difficult to serve with public transit. At the same time, many workers find the necessity of car ownership a barrier to employment. Providing low-wage workers with better ways to access work enhances the ladder of opportunity for families in Portland. Improving both access and mobility in the corridor can also improve freight mobility and reliability as corridor businesses ship goods using port, airport, and highway facilities. UB Mobile PDX will leverage the investments already made in the corridor, such as freight priority already on North Columbia at Macrum. DSRC will be piloted in the Corridor to provide additional freight signal priority and air quality monitors will be installed to identify benefits and impacts of system management strategies. Commercial freight vehicles will be integrated into the EV charging program pilot demonstrations, such as wireless vehicle charging units in designated freight parking locations.

“I deliver freight to restaurants all over the city. UB Mobile PDX tells me the best route for the day and where I can find parking. Predicting where traffic isn’t has allowed me to add five more stops to my route each day and reduced the mileage fee that my company pays.”




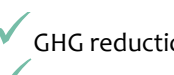
~Marcella, age 33
SE Portland






USDOT’s Twelve Vision Elements

















Implementation of the proposed technology and MOD solutions will synergistically combine to create measurable impacts while reducing costs. The focus will be on high-value benefit and rapid deployment outcomes including safety, mobility (reliability), efficiency, sustainability (equity and inclusion), and climate change.




The priority demonstration zone projects as presented above, as well as additional potential solutions to advance USDOT and the City of Portland’s vision for a Smart City are linked to each USDOT Vision Element in *Table 2: USDOT Vision Elements and UB Mobile PDX*.

Table 2: USDOT Vision Elements and UB Mobile PDX

Vision Elements – Application of Ubiquitous Mobility for Portland	
Vision Elements & Outcomes	Technology-Based Solutions in Priority Demonstration Zones
#1: Urban Automation   ✓ GHG reduction ✓ Safety	<p>Portland will provide the means by which autonomous vehicles can become a viable business through establishing autonomous vehicle pilot zones. This will begin with a driver-assistance and collision-avoidance on Portland’s new car-free multimodal Tilikum Crossing. Safety outcomes of this pilot will enhance bridge operations by allowing operations at higher speeds (currently limited to 25 miles per hour). Additional autonomous vehicle pilots will be explored in proximity to this area, with PSU, Portland Community College, Oregon Museum of Science and Industry, and/or Mount Hood Community College as partners. These pilot zones will provide critical proof of concept for future public autonomous vehicle implementation projects. Additionally, with this grant, TriMet would introduce the Mobile-Eye collision-avoidance systems in buses within the target corridors to increase safety for all users of the transportation system.</p>

Vision Elements – Application of Ubiquitous Mobility for Portland	
Vision Elements & Outcomes	Technology-Based Solutions in Priority Demonstration Zones
#2: Connected Vehicles  <ul style="list-style-type: none"> ✓ GHG reduction ✓ Equity & inclusion ✓ Efficiency 	<p>Connected vehicle technology will be deployed universally through the UB Mobile Technology Hardware Foundation approach (mobile and stationary actors), as well as piloted specifically in the Powell/Division Corridor and Columbia Corridor. TriMet light rail vehicles and buses would be fully equipped with onboard data hubs to integrate all sensor information including GPS and allow better rider information, and traffic, operations and maintenance diagnostics leading to greater effectiveness of transit service and cost-effectiveness of all efforts. Leveraging the \$150 million dollar investment in the new 15-mile Powell/Division corridor BRT, a CV pilot in this zone will take advantage of the existing infrastructure in the corridor to complete an advanced transit signal priority implementation.</p>
#3: Intelligent, Sensor-Based Infrastructure  <ul style="list-style-type: none"> ✓ GHG reduction ✓ Safety ✓ Mobility 	<p>Implementation of UB Mobile PDX and, specifically, the smart devices equipped on participating actors, will provide hundreds and eventually thousands of new intelligent sensors. These traveling sensors will provide mobility information to the Open Data Cloud for analysis and system management improvements. There is also opportunity to extend the investments made in Portland's priority demonstration zones to increase coverage of existing sensors. An arrangement between PSU and the City resulted in a collaboration to implement a permanent research station in an existing traffic signal cabinet. Testing for a low-cost air quality sensor that can be integrated with traffic signal data collection is ongoing. The research program includes implementing effective traffic signal settings based on conditions on the street to improve safety for all modes. This effort will extend existing research being conducted by the University Transportation Center at PSU.</p>
#4: Urban Analytics  <ul style="list-style-type: none"> ✓ GHG reduction ✓ Safety ✓ Mobility 	<p>Extend existing data management partnerships between PSU, government agencies, and new data sources such as RideApp (also known as Knock), Strava, and Sobi (bikeshare provider) to collect open-source, real-time transportation, bike and active mode data. Integration of EV charging and on-street parking data will be explored for use as well. Similar to PORTAL, the Open Data Cloud will collect data from many sources and integrate it into UB Mobile PDX. Our stakeholder team, including PSU, ODOT, and TriMet, have already worked together to facilitate complex data transfer and data sharing. The team is prepared to take this one step further and make data analytics more active, whereby we will automate system improvements through direct active use of data collected in real-time. Combining all this open source data together and making it useful in combination, especially in real-time, is difficult to do. But our team is uniquely positioned to be successful.</p>
#5: User-Focused Mobility Services and Choices  <ul style="list-style-type: none"> ✓ GHG reduction ✓ Safety ✓ Equity & inclusion 	<p>For the user, a series of customizable Apps or dashboards will provide access to three sectors of the mobility market: private mobility, peer-to-peer based sharing economy, and public providers. The user will have access to information that provides a seamless overview of all options possible to make a trip from A to B, including transit, walking, and BIKETOWN, to services like Car2Go, Lyft, getaround, spinlister, LIFT paratransit, RideConnection, Amtrak, personal vehicles and others. The User Interface will provide visibility of options with respect to cost, schedule reliability, and GHG emissions and be customizable based on user preferences and priorities.</p>
#6: Urban Delivery and Logistics  <ul style="list-style-type: none"> ✓ Safety ✓ Mobility ✓ Efficiency 	<p>The opportunity to improve freight logistics within the city is woven into the fabric of the Portland proposal. Commercial vehicles participating in the system may be given signal phase timing priority based on multiple variables including class of vehicle, in system use of designated truck corridors, time of day, or location in the city. The advanced traffic maps will provide drivers with better information about alternative routes. Data analysis will give the opportunity to produce customized routing recommendations based on vehicle class. By using the city-wide freight logistics data, it should be possible to design a master coordination system to manage in-city deliveries so as to avoid double parking of trucks (and resulting congestion). It will also be possible to support management of freight parking behavior with pricing signals.</p>

Vision Elements – Application of Ubiquitous Mobility for Portland	
Vision Elements & Outcomes	Technology-Based Solutions in Priority Demonstration Zones
#7: Strategic Business Models and Partnering Opportunities   GHG reduction  Safety  Mobility	<p>Unlocking mobility as a service will aggregate all mobility related payment systems including public transportation fare collection, tolls, public and private parking, RUCs, and peer-to-peer sharing payments. The Marketplace will provide a means to gamify by allowing users to direct a portion of transportation revenue funds (points) to a location and mode of their choice. This gamification will be tied to the user interface and incentives for users, such as saving carbon, or improving health outcomes, can be quantified and shared or even awarded per user-driven preferences.</p>
#8: Smart Grid, Roadway Electrification, and EVs   GHG reduction  Mobility  Equity & inclusion	<p>Achieving a smart grid will include cooperation with our public utility partners and the private sector, namely the development community. PBOT and the Bureau of Development Services will collaborate to determine policies and updates to City Code necessary to meet the City's recently declared goal to be a Zero Emission Vehicle City by 2035. This will include cooperating to establish building code requirements for charging stations both on- and off-street. We will leverage Portland's globally recognized expertise in urban planning and land use to integrate ubiquitous charging into existing urban infrastructure in the right-of-way, such as street lights and parking meters, to build out visible "pods" of DC Fast Chargers, and to develop codes and procedures to integrate charging into new streets and new developments. Our key partner, Drive Oregon, has identified a number of additional potential electrification projects that will be explored.</p>
#9: Connected, Involved Citizens   Equity & inclusion  Mobility	<p>The Smart City Challenge effort will be integrated with the award-winning public outreach campaigns that have been successful at increasing the diversity of stakeholders in Portland plan making. This project is important to achieve our objective of addressing the equity needs of the community and as such we will work with our partners to ensure UB Mobile PDX devices get into the hands of community members who need them most within the demonstration zones (such as a school partnerships or workforce training program). A key challenge to address is insuring that in providing these tools, government is not increasing the digital divide. PBOT has committed to installing WiFi in Portland Streetcar stations and cars, as well as collaborating with TriMet to expand Wi-Fi access across all transit modes. Additionally, gamification can be used to increase the use of these tools and further engage the community.</p>
#10: Architecture and Standards   Mobility  Efficiency	<p>CVRIA and National ITS Architecture will be used to provide a definitive and consistent framework to guide the planning and deployment of ITS. Portland's history with the standards led to cooperation that are now national models for regional collaboration. UB Mobile PDX will continue the evolution of the architecture to incorporate technological developments and evolving user needs with a particular focus on CV requirements and that promote a common framework for the ITS community.</p>
#11: Low-Cost, Efficient, Secure, and Resilient Information and Communications Technology (ICT)   Mobility	<p>Smart City systems are subject to security threats like any other information technology system. This is true not only for systems that process personal or financial information (such as Hop Fastpass collection systems), but also for many other types of ITS systems. We will work closely with private sector partners to mitigate security risk associated with our equity and inclusion priority of providing UB Mobile PDX devices and transit-oriented Wi-Fi hotspots. Comprehensive security needs for these systems will be addressed through a broad range of threat assessments common in the industry.</p>

Vision Elements – Application of Ubiquitous Mobility for Portland	
Vision Elements & Outcomes	Technology-Based Solutions in Priority Demonstration Zones
#12: Smart Land Use   Equity & inclusion  Efficiency	<p>The legacy of land use that is integrated and supportive of multimodal travel is another strength of our application. Oregon Senate Bill 100 that mandated the establishment of an urban growth boundary around each of the state's cities led to the creation of Metro, the only elected regional government in the U.S. This legislation also provided motivation for a comprehensive system of transit, a relatively dense downtown, and the preservation of farms and forests close to the urban core. While this system promoted a number of city-wide benefits such as investment in MAX, it also accommodated investment projects that increased the cost of living in these neighborhoods, disproportionately impacting poor communities. Today, Portland is experiencing unprecedented rates of growth. Through implementation of UB Mobile PDX, the City will measure and document impacts in the identified priority demonstration zones. This will be done in concert with place-making initiatives and updates to the Comprehensive Plan and Transportation System Plan, which are currently under review.</p>

Section 3: Address Issues Identified in Beyond Traffic 2045

It is important to think beyond traditional definitions of mobility when evaluating how to measure the effectiveness of UB Mobile PDX. UB Mobile PDX is about creating new ways to improve our ability to access the services, goods, and places that make up our lives – personal mobility – in more efficient ways. These new ways of getting around can improve mobility, safety, efficiency, and sustainability, and help address climate change.

Beyond Traffic 2045 provides a framework for new thinking about a transportation system. It looks at transportation challenges in five key areas: How will we move? How will we move things? How will we move better? How we will adapt? How will we align decisions and dollars?

How we move

As demographics change in Portland, our residents will need new ways of getting around. Millennials are choosing to drive less, which makes better connected systems for biking, walking, transit, and ridesharing critical to meeting their needs. Boomers are increasingly choosing to reduce driving as they age but desire continued mobility. About one-third of people over age 65 have a disability that limits mobility², but many of these people still have the desire to move around their communities independently.

Portland's population is growing quickly and growth in the City is outpacing growth in the suburbs. This population growth creates opportunities for 20-minute neighborhoods where people can meet their daily needs on foot or bike. It also creates challenges with increasing traffic congestion that not only impacts commuters but also hampers the ability to move goods to support a vibrant economy.

UB Mobile PDX provides a new model for moving people in Portland. The Marketplace allows drivers, passengers, transit riders, bicyclists, and pedestrians to buy and sell mobility in a secure and private environment with transparency. This Marketplace and related User Interface can change the way we travel, making decisions about mode transparent and driven by cost-benefit rather than by habit. Through this new Marketplace, we can provide new mobility choices to those who need or want them, and make our transportation system more efficient by helping residents optimize mode choice for each trip. Data collection in the system will allow us to modify the price signals in the system to ensure equitable access to transportation choices, and ensure that transportation choices connect jobs and workforce housing.

"I am a transportation engineer at the City. With UB Mobile PDX, I use real-time data from our own fleet vehicles to better time traffic signals to improve system efficiency. Little changes make a big difference – these changes made 3 planned intersection widening projects unnecessary!"



~City Traffic Engineer

² U.S. Department of Transportation. Beyond Traffic 2045 Blue Paper. Accessed at <https://www.transportation.gov/sites/dot.gov/files/docs/TheBluePaper.pdf>.

How we move things

Freight – by truck, air, ship, and train – is the backbone of Portland’s economy. As congestion on the highway and roadway system increases, the cost of moving goods increases and compromises economic growth. The ability to move things efficiently both within and through Portland is critical to our economic growth and vitality. Neighborhood businesses are impacted by increased delivery costs caused by unpredictable travel times in the region. Export-focused businesses in the region such as the technology, manufacturing, and agricultural sectors are impacted by their ability to collect freight and move it to intermodal shipping hubs like the airport or port facilities.

UB Mobile PDX will optimize the system using new data collection to inform ITS applications. These ITS applications will improve freight reliability. Freight users will also be able to access better real-time data to predict travel times and choose the best time of day or route to travel. Finally, as we provide information that helps to optimize system use by individuals, people may choose non-single occupant vehicle trips leaving more space on our roadways for trucks.

How we move better

Transportation technology is changing. Autonomous and connected vehicles are moving out of the realm of science fiction and into our daily lives. Smartphones enable new transportation technologies like ridesharing and bikesharing, and big data will influence how transit agencies and roadway agencies manage their systems. Smartphones provide easy, immediate access to congestion information, transit schedules, rideshare vehicle availability, and proximity to bikeshare, as well as easy comparisons of cost and travel times across modes.

UB Mobile PDX is built on connected private vehicles, pedestrians, trucks, busses, and trains providing information to the system and to the users. The user interface will take this to the next level to enable Portlanders access to accurate and user-driven data on cost, schedule reliability, and GHG emissions across the mobility market of the public, private, and sharing economy. Operationalizing transportation data and information will allow Portlanders greater mobility regardless of how they get around.

How we adapt

Climate change is impacting our transportation system and our transportation system impacts climate change. The transportation sector is the second largest contributor to GHG emissions. In 2015, the Portland metropolitan area adopted Climate Smart Communities³, a strategy for reducing GHG emissions by 20 percent by 2035 as a way to address climate change. Through this work, the region learned that the same strategies that reduce GHG emissions also improve regional mobility, safety, system efficiency, health and equity, and agreed-to performance monitoring. UB Mobile PDX offers the City of Portland an opportunity to move beyond the strategies outlined in the Climate Smart Strategy while achieving the same benefits.

How we align decisions with dollars

One of the biggest benefits in the deployment of UB Mobile PDX is access to data that will provide for better informed investment decisions in our transportation system and mobility options. Being able to look more holistically at the travel patterns of our citizens, of the multimodal connections that they make, and of the impacts and outcomes associated with specific investments will allow us to target resources in projects and programs that get the best return on investment from a triple bottom line standpoint. Our region is committed to the concept that social, environmental, and financial factors all must be considered when making investment decisions. With historical data silos, it’s challenging to truly be able to evaluate investments in this way, but with city-wide implementation

“I walk everywhere in my neighborhood, but sometimes wish the streets were safer. I know UB Mobile PDX is the first step in getting cars and trucks that warn drivers of potential crashes with pedestrians onto our streets. I can’t wait for a future when more people use this technology and pedestrian fatalities are a thing of the past!”




~Monica, age 46
NW Portland


³ Metro. 2015. Climate Smart Strategy. Accessed online at <http://www.oregonmetro.gov/sites/default/files/ClimateSmartStrategy-FinalVersion-2014.PDF>. May.


of UB Mobile PDX, the data will allow us to effectively align our decisions and our dollars in the most impactful ways.


Goals and Performance Measures


Closely aligned with the Beyond Traffic 2045 issues, PBOT identified the following goals and key performance indicators (KPIs) for UB Mobile PDX:

- 

Safety: advance Portland’s stated Vision Zero goal and deploy lessons learned from the New York City CV Pilot Deployment project to improve safety for all travelers regardless of how they choose to get around. *KPI: make Portland’s transportation system the safest possible and move toward zero traffic-related fatalities and serious injuries in the next 10 years.*
- 

Mobility: enhance reliability by reducing congestion and increasing access to destinations throughout our community. *KPI: predict trip time with at least 80 percent accuracy across all modes.*
- 


Efficiency: support a robust local and regional economy and improve access to employment and education for residents. *KPI: reduce transit and freight trip travel times by at least 5 percent during peak periods and 15 percent during off-peak periods. Reduce congestion and non-recurring congestion by 10 percent.*
- 

Sustainability: improve equity, the economy, and the natural environment. *KPI: achieve at least 80 percent access to reliable transportation data. Achieve a 25 percent mode split for transit and double existing mode split for biking and walking.*
- 

Climate change: reduce GHG emissions and improve resiliency. *KPI: reduce GHG emissions from light vehicles by 20 percent by 2035.*

These KPIs will be monitored and measured in the priority demonstration zones (Powell/Division Corridor and Columbia Corridor) using the objective, measure, and monitoring approach described in Table 3: Key Performance Indicator Measurement and Monitoring Approach.

Table 3: Key Performance Indicator Measurement and Monitoring Approach

Objective	Measure	Monitoring Approach
Safety		
 Reduce serious and fatal crashes at high crash locations	Number of serious and fatal crashes at high crash locations	Use vehicle Basic Safety Message (BSM) data to identify locations where driving events (such as speed, hard breaking, vehicle type, and windshield wiper use) indicate risk. Integrate BSM data from mobile devices as available.
Reduce serious and fatal crashes involving vulnerable users (including motorcycles, bicyclists, and pedestrians)	Number of serious and fatal crashes involving vulnerable users Participation in BSM broadcast for mobile devices	Use mobile BSM data utilization rates to track participation by vulnerable users.
Reduce over-limit speed and red light running infractions	85 percent speed compliance Red light violations	Use data generated by signal controllers to measure intersection entry on red light. Use combination of in-vehicle and infrastructure sensor data to measure vehicle speed by corridor.
Reduce driving under the influence by establishing a “ride home” partnership with TNCs and city parking services	TNC rides provided by target area Number of impairment citations Pre-paid “morning after” parking utilization	Use Portland Police DUII citations, Oregon Liquor Control Commission DUII data by retail location, transit, APC, TNC reports, and parking meter data to track impact on DUII citations in relationship to ride home program.

Objective	Measure	Monitoring Approach
Mobility		
 Make transit more effective	Transit travel times	Provide greater capture and analysis of operational, automatic passenger counting, and GPS data captured by all 600+ TriMet buses as well as 100+ light rail vehicles.
Make transit convenient and reliable	Transit reliability by route Transit route transfer adherence	Use Computer Aided Dispatch (CAD) and AVL, system data to identify travel time variability by route and route connectivity performance.
Make active transportation and shared transportation choices convenient	Mode share to key destinations	Use transit APC, continuous bike and pedestrian counters, crowd-sourced Apps, bikeshare activity, and TNC report data to calculate mode share by location.
Improve reliability for drivers	Travel time reliability System delay	Use combination of in-vehicle and infrastructure sensor data to calculate reliability and delay by corridor.
Improve reliability for freight deliveries within the city and goods movement through the city	Freight system travel time reliability	Use combination of in-vehicle and infrastructure sensor data to calculate reliability and delay by freight corridor.
Efficiency		
 Make transit and freight trips more competitive	Transit–Auto Travel Time Ratio Transit Signal Priority Performance Assessment	Use AVL Transit Data and Inrix, Bluetooth, and DSRC Data for Vehicle analysis. Signal performance measurement.
Reduce non-recurring congestion	Crashes Freeway Speeds	Use ODOT safety database and emerging information from OBD and DSRC as well as data from TNCs and car sharing.
Improve travel time reliability	Transit On-Time Performance Freight Delivery Metrics	Use AVL Transit Data and private sector data from fleets.
Increase accessibility to goods, services, activities, and destinations for people and businesses	Homes within a 20-minute walk of commercial services and neighborhood amenities Travel time isochrones for employment and industrial areas	Use GIS data to document features including street connectivity, sidewalks, protected crossings, services and amenities, and topography. Use travel time data to create isochrones to assess market reach for different travel periods.
Sustainability		
 Support growth of a vibrant economy	Mix of land use types Reliable and timely access to key destinations Gross Regional Product (GRP)	Use GIS data to calculate jobs to housing ratio by neighborhood. Use CAD/AVL/APC data to measure availability and quality of transit services within a 10-minute walking area; also see transit reliability metric. Track GRP to targeted annual growth rate of 2 percent or more
Support improved equity in the City of Portland	Transportation and housing cost across income levels Access to biking, walking, and transit facilities by minority and low-income households	Evaluate availability and costs of transport compared to household income. Use GIS and probe data to track travel time by mode between Transportation Analysis Zones and identified environmental justice communities
Climate Change		
 Reduce region-wide per capita roadway GHG emissions from light vehicles	GHG emission rates	Use combination of in-vehicle and infrastructure sensor data to calibrate emissions model.

Section 4: Commitment from Public and Private Sectors

The Portland Metropolitan area has a long history of collaborating on transportation initiatives and groundbreaking sustainable development projects, and UB Mobile PDX is no different. The City of Portland is an inaugural member of the White House Smart Cities initiative and we have demonstrated successful private sector partnerships, experience that can help guide other cities on this path. To realize our vision for the Smart City Challenge grant, various academic, private sector, and institutional partnerships will be brought to bear.

The City of Portland is uniquely positioned to attract private and public partners to implement UB Mobile PDX. As an example of our ability to build partnerships, the City recently announced that Nike will sponsor our new next-generation bikeshare. Portland is home to a growing number of technology firms that are committed to advancing Smart City technologies. Firms like Intel, Jaguar/Land Rover (which has a Research and Development office in Portland), Daimler, and others have a stake in Portland’s success and have already demonstrated their commitment to this proposal through in-kind contributions of staff time, resources, and creative thinking. PSU is home to Transportation Research and Education Center (TREC), one of the strongest transportation research programs in the country.

Portland brings a collaborative approach to innovation that began with our decision to compete in the Smart Cities Challenge and will extend to our implementation of UB Mobile PDX. Our proposal grew out of a meeting of more than 20 representatives of academia, consulting, public sector, and technology firms – all who committed their time to develop a proposal. Our ability to leverage partners – both private and public – will continue throughout grant implementation.

Key partners as well as additional potential partners are identified in *Table 4: Key Partnerships*.

Table 4: Key Partnerships

Key Partnerships		Potential Additional Partnerships	
TriMet	Drive Oregon	Pacific Northwest National Laboratory (PNNL)	Booz Allen Hamilton
Metro	CH2M	Kittelson & Associates	Jaguar Land Rover
Port of Portland	Intel	Cisco	Information Technology Industry Council
PSU	ODOT	Qualcomm	Clemson University
TREC at PSU	General Motors	Daimler	Mentor Graphics
Oregon State University	Lyft	Google Fiber	Sanif
University of Oregon	Car2Go	Pangia Motors	GENIVI Alliance
Oregon University System	DKS Associates	Toyota	Verizon
Advanced Computing Center at Oregon Health & Science University	MobileEye	Freedom Pop	Advanced Traffic Products
Portland Public Schools	Savari	Getaround	
Portland Business Alliance (PBA)	Inrix		
Oregon Technology Association	RideScout		
Transcore	T4 America		
	NAMAC Oregon		
	Portland General Electric		

Leveraging Federal Resources

The City of Portland is in a unique position to leverage federal resources to implement UB Mobile PDX. The City is in the project development phase for a transformative BRT system that represents significant high capacity transit in the Power/Division Corridor. As we develop the Marketplace, we will leverage existing systems developed for RUC and TriMet’s Hop Fastpass payment system to allow us to build onto existing consumer-facing financial systems rather than building a new system. We will also leverage BIKETOWN and up to \$10 million investment from Nike and \$2 million in startup equipment

and installation funds from the City of Portland. We have developed partnerships with service providers who can manage consumer financial transactions. And finally, we have several key partners including GM, Lyft, Intel, among others, that will include private investment in the applicable areas.

The TransPort committee, the ITS Network, the PORTAL data archive, TTIP, CivicApps website, and TriMet data website are all multi-stakeholder systems that will all be used to maintain systems, interfaces, and data integrity. TriMet, Metro, and PSU have some of the best open source data collection and sharing programs in the nation. UB Mobile PDX will leverage these programs to advance implementation of a Smart City in Portland and also to share data about the Smart City with other interested cities.

While being city-wide in scope, UB Mobile PDX will focus on priority demonstration zones including the Powell/Division Corridor. This corridor is already receiving significant attention including a transit corridor investment as well as walking, biking, and safety improvements as part of the Powell/Division BRT Project and other ongoing City, ODOT, and TriMet projects such as the Outer Powell Safety Study and the recently completed Tilikum Crossing. UB Mobile PDX will leverage the change occurring in the neighborhoods along Powell Boulevard and Division Street to create a new paradigm for personal mobility.

The City of Portland is committed to leveraging existing projects and resources for UB Mobile PDX. Grant funds will be supplemental to existing projects – not a backfill for these projects. Existing staff working in the policy, planning, and projects group; signals and streetlighting; and transit partnerships on current or funded projects will be leveraged to implement UB Mobile PDX.

Section 5: Technical Capability

Program Management Approach

PBOT understands how vital project management is for a culturally transformative and multi-stakeholder project of this magnitude. Working with a key partner such as CH2M, we will apply a performance management framework and rapid implementation of delivery tools to define project roles, expected outcomes, and KPIs to measure and report impacts of UB Mobile PDX and demonstration projects. The CH2M project management approach tracks performance against developed metrics and detects deviations from the defined path early to make timely corrections and maintain the schedule and budget. Identified delivery tools will provide the team with consistent processes, standards, and protocols for UB Mobile PDX implementation and successful infrastructure demonstration projects in select testbed zones. Furthermore, we will ensure project participants clearly understand their roles from day one and achieve the defined outcomes of their roles.

A programmatic approach can save between 15 and 25 percent of capital costs and between 10 and 20 percent from the schedule.

CH2M's Performance Management Framework and delivery tools focus on establishing metrics and promoting a culture of accountability by developing a common set of criteria to measure and compare actions and outcomes.

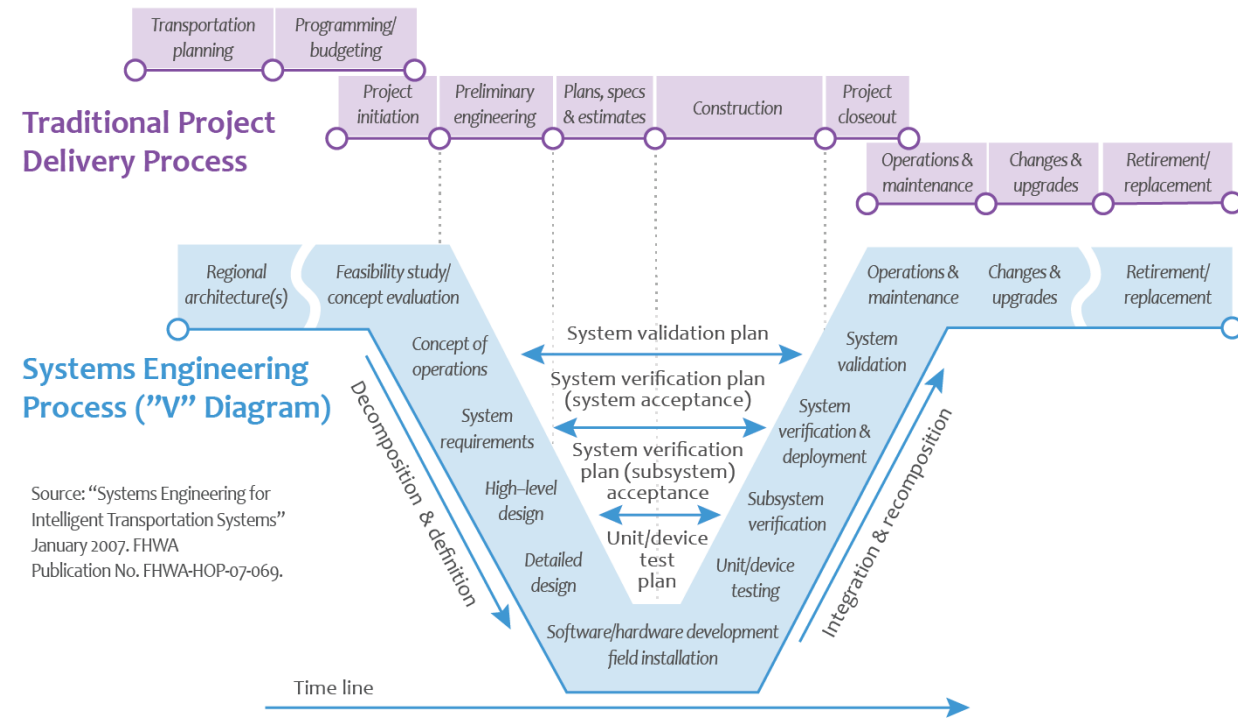
Integral to this approach, the team will conduct kickoff chartering sessions to integrate project management, infrastructure, data management, operations, legal, university partner, and public and private stakeholder groups to define shared scope, goals, behaviors, expectations, and roles and responsibilities. This process is critical to drive integrated performance among project stakeholders working toward a common set of outcomes (see **Section 3**, Goals and Performance Measures).

Risks and Mitigations

Risks associated with implementing Smart City technologies range widely from acute risk related to passenger vehicle safety and user privacy to broad public acceptance or rejection of the program. A comprehensive risk management strategy is warranted. Technology deployment risks are best managed through disciplined use of the systems engineering process. Often depicted as a “V” diagram

Figure 4: Systems Engineering Process “V” Diagram as a way of relating the different stages in the system life cycles to one another, systems engineering is a formal process by which quality is continuously promoted. Systems engineering may be described as a “requirements-driven development process;” that is, the user (stakeholder) needs and requirements are the overriding determinant of the system concept, design, and component selection and implementation. Moreover, applying the systems engineering process is required for most ITS projects that involve federal aid.

Figure 4: Systems Engineering Process “V” Diagram



A high-level risk assessment and discussion of the 12 vision elements are identified in *Table 5: Vision Elements Risk Profile*. Although risks are always associated with the demonstration and deployment of new technology, these risks can be adequately mitigated to achieve project goals.

Table 5: Vision Elements Risk Profile

Vision Elements Risk Profile			
Vision Element	Risk Profile	Mitigation	Risk Rating
#1: Urban Automation	Technical risks for the demonstration of semi-autonomous and fully autonomous vehicles on the transportation sites and campuses of project partners include equipment failures and accidents, as well as necessary state legislature approval. These include both program risks and operational risks. The program risks will be addressed by system engineering techniques to ensure delivery of workable solutions are on time and within budget. The operational risks will be covered by traditional insurance instruments associated with operations and maintenance of public transportation. There may be a need or opportunity for public participants to sign a limitation of liability for certain types of autonomous vehicle operation. Policy risks include the adoption of business rules for the operation of vehicles and public participation. Institutional risks include delays associated with implementing new technology.	Systems engineering Custom insurance coverage Limitation of liability	High

Vision Elements Risk Profile			
Vision Element	Risk Profile	Mitigation	Risk Rating
#2: Connected Vehicles	Data security and privacy comprise moderate institutional and policy risks for connected vehicle operations. This will be mitigated by engaging a data security provider and using evolving USDOT CV standards. In addition, connected vehicle technology deployment carries program and operational risks. Unlike autonomous vehicles, a connected vehicle is not reliant upon the connectivity for safe operation, and, therefore, liability is limited. Damage to a vehicle is possible, but unlikely. Program risks will be managed using systems engineering techniques to govern design and implementation. Risk of development prior to the completion of CV standards could be realized in the case of premature obsolescence.	Data security provider Systems engineering Custom insurance coverage	Moderate
#3: Intelligent, Sensor-Based Infrastructure	Implementation of additional types and quantities of sensors is not outside of the normal course of City operations. Modern sensors are typically low cost, low-power, off-the-shelf devices. In the urban environment, there is the possibility of accidental damage, theft, or vandalism as with any City property exposed to the public; however, the risk of injury associated with public exposure to the devices is minimal.	Systems engineering Standard insurance coverage	Low
#4: Urban Analytics	Data analytics are a combination of data engineering and data processing to derive useful information from data and share it. The risks in analytics are technical and institutional. Inconsistent data formats and frequencies are common data engineering problems that introduce risk. The most common technical problem in analytics is the lack of qualified subject matter expertise in interpreting the meaning of data. The most common institutional problem is an unwillingness to share raw data with a frequency that serves real-time applications. Both of these problems are mitigated by the selection of the right program partners.	Qualified partner selection	Moderate
#5: User-Focused Mobility Services and Choices	For the user, the risks associated with development of user Apps and dashboards are well known and readily mitigated. User acceptance of Apps can be tested by standard industry means. Development time and cost are also standardized and quantifiable.	Systems engineering Focus group use	Low
#6: Urban Delivery and Logistics	The risks and mitigations for freight logistics are similar to those discussed for Vision Elements #2, Connected Vehicles, and #5, User-focused Mobility Services and Choices. An additional risk is one of policy and public acceptance, in that advantages provided to commercial enterprise by government can sometimes experience opposition from the public and competing businesses.	Systems engineering Public outreach	Moderate
#7: Strategic Business Models and Partnering Opportunities	Not unique to Portland, successful implementation of Smart City technologies will rely on strategic partnerships between public, private, and academic sectors. Portland has a long history of inter-agency collaboration and developed academic partnerships specific to transportation solutions.	Partnerships	Low
#8: Smart Grid, Roadway Electrification, and Electric Vehicles	The risk profile is similar to Vision Element #1, Urban Automation, in that demonstration involves developing systems that will become operational and used by program participants.	Systems engineering Custom insurance coverage Limitation of liability	Moderate
#9: Connected, Involved Citizens	There is moderate risk associated with not successfully engaging citizens in priority demonstration zones and equipping them with the necessary devices and knowledge to participate to achieve equity goals of UB Mobile PDX. In addition, without early user integration additional users will not buy into the system.	Public outreach Partnerships	Moderate

Vision Elements Risk Profile			
Vision Element	Risk Profile	Mitigation	Risk Rating
#10: Architecture and Standards	Although there are no appreciable risks associated with conformity to standards and architectures, there is a risk of developmental obsolescence associated with demonstrating technologies for which standards are not yet fully developed.	Systems engineering Conformity to standards	Low
#11: Low-Cost, Efficient, Secure, and Resilient ICT	Data security in the development and deployment of ICT systems is moderate for these applications and can be readily addressed through engaging a security provider, as discussed in Vision Element #2, Connected Vehicles.	Systems engineering Security provider	Moderate
#12: Smart Land Use	Typically, there is policy risk in any changes contemplated to urban land use, in that laws and regulations are threaded through the existing fabric governing land use. Due to Portland’s track record of smart land use and associated decision making, this risk is negligible.	Policy development	Negligible



Congress of the United States
Washington, DC 20515

February 2, 2016

Secretary of Transportation Anthony Foxx
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

Dear Secretary Foxx:

We are writing in support of the City of Portland's submission to the United States Department of Transportation's Smart City Challenge and its effort to create a Smart Mobility Platform. Portland has long been a global leader in addressing climate change, striving to overcome the obstacles of the past to become a more equitable and inclusive community for everyone, and transforming how our residents access schools, jobs, commercial areas, and recreation.

This effort provides a unique opportunity for Portland to demonstrate the safety benefits, mobility enhancements, better health outcomes, and cost savings that come with an integrated approach to transportation and urban mobility. Implementation of the Smart Mobility Platform will enhance system accessibility and integration for users of all modes, while optimizing data analysis behind the scenes to continue improving the functionality of the transportation system. This will address the transportation challenges of today and provide a catalyst for continued innovation in transformative mobility solutions to meet the demands of tomorrow.

Portland's dynamic history with corridor-based planning, local impacts of infrastructure investment and greenhouse gas reduction priorities have all influenced the selection of the priority demonstration areas outlined in their proposal. The Columbia Corridor and the Powell/Division Corridor will be design labs for specific infrastructure implementation as well as for baselining, monitoring, and reporting against the Smart Mobility Platform outcomes. Each corridor will have specific outcomes based on leveraging current investments and their unique development challenges, focusing on innovative solutions related to equity, congestion, mobility, safety, and climate change.

We support the City of Portland's submission and believe that it will achieve the goals of US DOT's Smart Cities Challenge.

Sincerely,



Earl Blumenauer
Member of Congress



Kurt Schrader
Member of Congress



Suzanne Bonamici
Member of Congress



CITY OF
PORTLAND, OREGON
OFFICE OF PUBLIC SAFETY

COMMISSIONER STEVE NOVICK
1221 SW 4th Ave. Suite 210
Portland, Oregon 97204
Phone: 503-823-4682
Fax: (503)-823-4019
novick@portlandoregon.gov

February 3, 2016

Dear Secretary Foxx,

Portland has long been a leader in smart growth, addressing climate change and ensuring equity in the community. We feel that through the Smart City Challenge, Portland can transform itself with the Ubiquitous Mobility for Portland (UB Mobile PDX) platform. This opportunity will help Portland overcome both past and current obstacles to become a more equitable and inclusive community and transform how our community accesses schools, jobs, commercial areas and recreation.

Portland is unlike any other city in the country, and this grant provides the opportunity to demonstrate the safety benefits, mobility enhancements, improved health outcomes and cost savings that come with an integrated, community-minded approach to transportation. The implementation of UB Mobile PDX will be a groundbreaking step towards addressing the most pressing challenges of our time, continuing Portland's leadership in developing transformative mobility solutions.

Portland's history with corridor-based planning, emphasis on policy that allows for the reduction of greenhouse gas emissions and experience using federal investments to bolster our transportation infrastructure, have informed the projects on which we would use our Smart City funding. The Columbia Corridor and the Powell/Division Corridor will serve as testing grounds for the country to observe specific infrastructure implementation as well as for baselining, monitoring and reporting against UB Mobile PDX outcomes. These corridors were selected because we are coordinating complementary investments to address equity, congestion, mobility, safety and climate change.

The City of Portland fully supports this effort to establish the project and start realizing the benefits of UB Mobile PDX that will integrate applications and technology to achieve the goals of the USDOT's challenge.

Thank you,

Charlie Hales

Mayor, City of Portland

Steve Novick

Commissioner, City of Portland



Oregon

Kate Brown, Governor

Department of Transportation

Office of the Director

355 Capitol St NE

Salem, OR 97301

February 1, 2016

Leah Treat
Director, Portland Bureau of Transportation
1120 SW Fifth Ave, Suite 800
Portland, OR 97204

Director Treat:

The City of Portland has the support of the Oregon Department of Transportation (ODOT) to establish this project and start realizing the benefits of Smart Mobility Platform that will integrate applications and technology to achieve the goals of the USDOT's Smart Cities Challenge.

ODOT is a key partner in Portland and its ongoing efforts to transform itself into a smart city by creating the Ubiquitous Mobility for Portland (UB Mobile PDX) platform. Portland has long been a leader in addressing climate change, striving to overcome the obstacles of the past to become a more equitable and inclusive community, and transforming how its people access schools, jobs, commercial areas, and recreation.

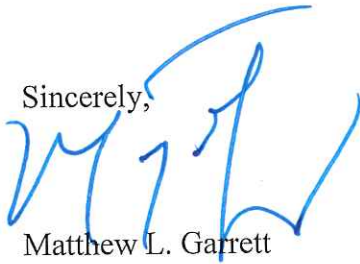
We realize that Portland provides a unique opportunity to demonstrate the safety benefits, mobility enhancements, better health outcomes, and cost savings that come with an integrated approach. Implementation of UB Mobile PDX will be a groundbreaking step toward addressing the most pressing challenges of our time and providing a catalyst for continued innovation in transformative mobility solutions.

ODOT has spent years developing and testing a road usage charge (RUC) which could benefit from this data platform. UB Mobile PDX could accelerate and advance the concept while helping achieve the goals of the program. Portland will also benefit from a wealth of knowledge and best practices ODOT has learned through developing this alternative revenue source. Together, this platform will enhance the mobility of our communities while providing the tools to more efficiently manage our transportation system.

Portland's dynamic history with corridor-based planning, local impacts of infrastructure investment, and GHG reduction priorities have all influenced the selection of priority demonstration areas. The Columbia Corridor and the Powell/Division Corridor will be design labs for specific infrastructure implementation as well as for baselining, monitoring, and reporting against UB Mobile PDX outcomes. Each corridor will have specific outcomes targeted based on leveraging current complementary investments as well as their unique development challenges, including equity, congestion, mobility, safety, and climate change.

ODOT will also be looking to ensure whatever Portland creates can be replicated within the region and the State to provide these tools, ideas, and lessons learned to a broader public. Our statewide focus can help this vision translate to cities beyond Portland and embrace new partnerships moving forward.

Sincerely,

A handwritten signature in blue ink, appearing to read 'M. Garrett', is written over the word 'Sincerely,'.

Matthew L. Garrett
Director



January 28, 2016

The Honorable Anthony Foxx
Secretary, US Department of Transportation
1200 New Jersey Ave, SE
Washington, DC 20590

Dear Secretary Foxx,

I am pleased to express TriMet's enthusiastic support for the City of Portland's Ubiquitous Mobility for Portland (UB Mobile PDX) application to the USDOT Smart City Challenge.

TriMet embraces new technology. We already know the value of being smart and open with our data and are eager to take this even farther. TriMet was one of the first transit agencies to offer real-time arrival information via phone, web, or text for every single one of our 6,500 stops and stations. We worked with Google to create the worldwide GTFS standard and TriMet was the first transit system in the world to be on Google Transit. We also provide real time data through open API's, leading to many apps that provide real-time arrival and trip planning for our service; more efficiently and perhaps better than if we had tried to build the app ourselves. With our fare payment app already in operation for all our modes, we are introducing a system-wide electronic fare that will greatly improve simplicity for our riders and improve our understanding of trip-making so our services can be more efficient. Our state of the art CAD/AVL system provides a great platform for additional connected vehicle technology and communications for our buses.

Imagine in a few years, you're traveling in Portland in a Lyft car, but nearing a MAX light rail station. Your mobility app could offer the advice that getting off at the station and taking light rail would save you X minutes and Y dollars *and* update the information dynamically based on traffic conditions and your location. Or perhaps it would offer a bikeshare trip to complete your travel because it knows you prefer active transportation choices when available.

I believe the City of Portland is uniquely able to deliver on the Smart City promise. There is a history of strong collaboration across every jurisdiction. Land use and transportation policies are in place and well-supported to ensure the new information, analysis and capabilities really do improve mobility. We have great private sector partners with the know-how and the motivation to make it happen.

TriMet stands ready to work with the City of Portland to invest in the hardware, software and data integration strategies that will make the vision of a Smart City become a reality.

Sincerely,

A handwritten signature in blue ink, appearing to read "Neil McFarlane".

Neil McFarlane
General Manager

January 29, 2016



Leah Treat, Director
Bureau of Transportation
121 SW Fifth, Suite 800
Portland, Oregon 97024

Director Treat,

The Port of Portland is a partner in the Portland region and keenly aware of the importance of a fluid and cost effective transportation system for Oregon and Portland's economy to thrive. Portland's ongoing efforts to transform itself into a Smart City by creating Ubiquitous Mobility for Portland (UB Mobile PDX) is consistent with its leadership on other undertakings including climate change, striving to overcome the obstacles of the past to become a more equitable and inclusive community, and transforming how its people access schools, jobs, commercial areas, and recreation and how business moves its products.

We realize that Portland provides a unique opportunity to demonstrate the safety benefits, mobility enhancements, better health outcomes, and cost savings that come with an integrated approach. Implementation of UB Mobile PDX will be a groundbreaking step toward addressing the most pressing challenges of our time and providing a catalyst for continued innovation in transformative mobility solutions.

Portland's dynamic history with corridor-based planning, local impacts of infrastructure investment and GHG reduction priorities have all influenced the selection of priority demonstration areas. The Columbia Corridor and the Powell/Division Corridor will be design labs for specific infrastructure implementation as well as for baselining, monitoring, and reporting against UB Mobile PDX outcomes. Each corridor will have specific outcomes targeted based on leveraging current complementary investments as well as their unique development challenges, including equity, congestion, mobility, safety, and climate change.

The City of Portland has the support of the Port of Portland to establish this project and start realizing the benefits of UB Mobile PDX that will integrate applications and technology to achieve the goals of the USDOT's Smart Cities Challenge.

Sincerely,

A handwritten signature in black ink, appearing to read 'Curtis Robinhold', is written over a light blue circular stamp. The signature is fluid and cursive.

Curtis Robinhold
Deputy Executive Director

Mission: To enhance the region's economy and quality of life
by providing efficient cargo and air passenger access
to national and global markets, and by promoting industrial development.

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Research & Strategic Partnerships

Jonathan Fink
Vice President

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Portland, OR 97207-0751 jon.fink@pdx.edu

Leah Treat, Director
Portland Bureau of Transportation
1120 SW 5th Ave. #800
Portland, OR 97204

January 30, 2016

Dear Director Treat:

As you know, Portland State University is the primary academic partner for most of the City of Portland's Bureaus. We have deep and longstanding relationships with your Bureau of Transportation (PBOT), as well as with the Bureau of Planning and Sustainability (BPS), Bureau of Environmental Services (BES) and Housing Bureau (PHB). Each of these partnerships will contribute directly to achieving the goals of the proposed Ubiquitous Mobility for Portland smart cities program (UB Mobile PDX).

Through our Transportation Research and Education Center (TREC), PSU is deeply involved with developing region-wide studies for how transportation systems can be made more efficient, more modern, less carbon dependent, safer, and more equitable. TREC houses one of the US DOT's five National University Transportation Centers, the National Institute for Transportation and Communities (NITC). TREC has brought in more than \$30M of federal funds, which have supported programs overseen by PBOT, ODOT, TriMet, and Metro. With our NITC funding, TREC has several completed and ongoing projects examining multimodal mobility, livability, and equity along the Powell Division corridor. A Federal Transit Administration-funded project is examining how transit and innovative technologies can help in responding to emergencies. TREC has also supported database experts in our Computer Science and Engineering Department, who run the Portland Regional Transportation Archives Listing (PORTAL), one of the most comprehensive multi modal, open-source transportation databases in the nation. We will build directly on these research investments in this smart city effort. The faculty, staff, and students in TREC, who come from PSU's College of Urban and Public Affairs and Maseeh College of Engineering and Computer Science, will help achieve our city's smart city goals related to transportation articulated in the UB Mobile PDX proposal.

PSU's Institute for Sustainable Solutions (ISS) works closely with the leadership and staff of the Bureau of Planning and Sustainability in achieving the goals of the City's Climate Action Plan. ISS helped BPS obtain over \$300K in funding from the Bullitt and Miller Foundations to conduct research on issues related to transit-oriented development, green infrastructure, public health, and renewable energy use, all part of UB Mobile PDX's larger goal of reducing the carbon footprint of our city and region. ISS's Sustainable

Neighborhood Initiative supports dozens of student senior capstone projects along both the Powell Division and Columbia Transit Corridors. ISS is also partnering with BES on environmental issues related to transportation.

PSU's Toulan School of Urban Studies and Planning collaborates with the Portland Housing Bureau to assess income disparities across the city and design strategies intended to expand access to affordable housing and jobs along different transportation corridors. This expertise will help UB Mobile PDX achieve its equity goals.

PSU, through our Office of Strategic Partnerships, runs the Portland State Business Accelerator (PSBA), Oregon's most successful business incubation facility, which helps launch startup companies from PSU, Oregon State University, University of Oregon and Oregon Health and Science University. PSU students founded Globe Sherpa, a startup that recently graduated from the PSBA and which is one of the key private sector mobility partners for UB Mobile PDX.

Finally, PSU has been a key infrastructure partner in making Portland one of the nation's leading transportation innovators. The university helped pay to extend TriMet's Green, Yellow and Orange light rail lines to our campus, which hosts the most heavily used transit stop in the state of Oregon. More than 70% of PSU's students get to campus via transit, bikes or on foot.

Based on this productive history, we look forward to working closely with PBOT and other Bureaus in the City of Portland, along with the full complement of other public and private sector partners that have come together to launch UB Mobile PDX, our region's vehicle for achieving the ambitious goals of the US DOT's Smart Cities Challenge.

Sincerely your,

A handwritten signature in black ink, reading "Jonathan Fink". The signature is written in a cursive, flowing style.

Jonathan Fink
Vice President for Research and Strategic Partnerships

February 1, 2016

Director Treat,

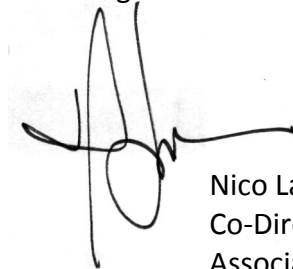
The Sustainable Cities Initiative (SCI) at the University of Oregon is proud to partner with the City of Portland and its efforts surrounding smart cities – specifically through the Ubiquitous Mobility for Portland (UB Mobile PDX) platform. Portland is recognized around the country and around the world for its leadership in many areas that overlap with the work and mission of SCI including climate change, striving to overcome the obstacles of the past to become a more equitable and inclusive community, and transforming how its people access schools, jobs, commercial areas, and recreation.

Because of all of this leadership and the city's track record of success in working across traditional silos, Portland provides a unique opportunity to demonstrate the safety benefits, mobility enhancements, better health outcomes, and cost savings that come with an integrated approach. Implementation of UB Mobile PDX will be a groundbreaking step toward addressing the most pressing challenges of our time and providing a catalyst for continued innovation in transformative mobility and accessibility solutions.

Portland's dynamic history with corridor-based planning, local impacts of infrastructure investment, and GHG reduction priorities have all influenced the selection of priority demonstration areas. The Columbia Corridor and the Powell/Division Corridor – an area we are already working within along with TriMet and Metro – will be design labs for specific infrastructure implementation as well as for baselining, monitoring, and reporting against UB Mobile PDX outcomes. Each corridor will have specific outcomes targeted based on leveraging current complementary investments as well as their unique development challenges, including equity, congestion, mobility, safety, and climate change.

I am proud to state that the City of Portland has the strong support of the Sustainable Cities Initiative to help establish this project and start realizing the benefits of UB Mobile PDX that will integrate applications and technology to achieve the goals of the USDOT's Smart Cities Challenge.

Please do not hesitate to contact us as your efforts continue. We welcome continued opportunities to work collaboratively with your office and the City of Portland on these important and shared goals.



Nico Larco, AIA
Co-Director, Sustainable Cities Initiative
Associate Professor, Department of Architecture
University of Oregon



6206 U of Oregon
Eugene, OR 97403

t 541.346.8591

sci@uoregon.edu
sci.uoregon.edu





Information Technology Group
Advanced Computing Center

1515 SW 5th Avenue, Suite 900
Portland, Oregon 97201

503-346-3575 office
503-998-3957 mobile
corbato@ohsu.edu

February 3, 2016

Dear Director Treat,

In our support and innovation role for Oregon's academic medical university, OHSU's Technology Services Division (TeSD) and Advanced Computing Center (ACC) are a key partner in Portland and its ongoing efforts to transform itself into a smart city through the Ubiquitous Mobility for Portland (UB Mobile PDX) platform. Portland has long been a leader in addressing climate change, striving to overcome the obstacles of the past to become a more equitable and inclusive community, and transforming how its people access schools, jobs, commercial areas, and recreation.

Our group recently has developed a state-of-the art, energy-efficient data center at OHSU's West Campus. Given Portland's relatively cool climate, we are able to utilize ambient air to cool the data center for most of the time. The Data Center West facility supports our advanced research computing services, including Big Data analytics supporting genomics, imaging, and epidemiology. We already have established a robust collaboration with the Metro Data Science group at Portland State University and believe that this will extend naturally to the City's proposal.

We realize that Portland provides a unique opportunity to demonstrate the safety benefits, mobility enhancements, better health outcomes, and cost savings that come with an integrated approach. Implementation of UB Mobile PDX will be a groundbreaking step toward addressing the most pressing challenges of our time and providing a catalyst for continued innovation in transformative mobility solutions.

Portland's dynamic history with corridor-based planning, local impacts of infrastructure investment, and GHG reduction priorities have all influenced the selection of priority demonstration areas. The Columbia Corridor and the Powell/Division Corridor will be design labs for specific infrastructure implementation as well as for baselining, monitoring, and reporting against UB Mobile PDX outcomes. Each corridor will have specific outcomes targeted based on leveraging current complementary investments as well as their unique development challenges, including equity, congestion, mobility, safety, and climate change.

The City of Portland has the strong support of OHSU TeSD to establish this project and start realizing the benefits of UB Mobile PDX that will integrate applications and technology to achieve the goals of the USDOT's Smart Cities Challenge.

Sincerely,

A handwritten signature in black ink, appearing to read "Steven C. Corbató".

Steven C. Corbató, Ph.D.

Director, Technology Services Division, Information Technology Group
Director, Advanced Computing Center



PORTLAND PUBLIC SCHOOLS

501 North Dixon Street / Portland, OR 97227
Telephone: (503) 916-3200 / Fax: (503) 916-3110
Mailing Address: P. O. Box 3107/97208-3107

Carole Smith
Superintendent

OFFICE OF THE SUPERINTENDENT

February 1, 2016

Ms. Leah Treat, Director
Portland Bureau of Transportation
1120 SW Fifth Avenue
Portland OR 97204

Director Treat:

Portland Public Schools (PPS) is proud to partner with the City of Portland in assuring safe routes to school and multiple transportation options for students, parents and staff. We have had a very productive dialogue about these issues as we finalize plans for the reconstruction of school facilities across the City.

We are therefore encouraged by the City's pursuit of a Smart Cities Grant because of the potential to augment our existing work. Most exciting for us is the potential for using the Powell Division Corridor as a demonstration area for the proposed UB Mobile PDX technology. There are tremendous benefits for our students that will be achieved by connecting Portland Community College, Mt Hood Community College and the many K-12 schools within that corridor. This is consistent with Portland's long leadership in addressing climate change and seeking a more equitable and inclusive community, and transforming how its people access schools, jobs, commercial areas, and recreation.

Portland provides a unique opportunity to demonstrate the safety benefits, mobility enhancements, better health outcomes, and cost savings that come with an integrated transportation approach. Implementation of UB Mobile PDX will be a groundbreaking step toward addressing the most pressing challenges of our time and providing a catalyst for continued innovation in transformative mobility solutions.

The City of Portland has the support of PPS to establish this project and we look forward to working with you on the implementation of the program.

Sincerely,

Carole Smith
Superintendent, Portland Public Schools



CH2M Portland
2020 SW 4th Avenue, Suite 300
Portland, Oregon 97201
O +1 503 235 5000
www.ch2m.com

Ms. Leah Treat
Director of the Portland Bureau of Transportation
1120 SW Fifth Avenue, Suite 800
Portland, Oregon 97204

February 1, 2016

Subject: USDOT *"Beyond Traffic: The Smart City Challenge"*

Dear Director Treat,

CH2M is a key partner in Portland and its ongoing efforts to transform itself into a smart city through the Ubiquitous Mobility for Portland (UB Mobile PDX) platform. Portland has long been a leader in addressing climate change, striving to overcome the obstacles of the past to become a more equitable and inclusive community, and transforming how its people access schools, jobs, commercial areas, and recreation.

We realize that Portland provides a unique opportunity to demonstrate the safety benefits, mobility enhancements, better health outcomes, and cost savings that come with an integrated approach. Implementation of UB Mobile PDX will be a groundbreaking step toward addressing the most pressing challenges of our time and providing a catalyst for continued innovation in transformative mobility.

Portland's dynamic history with corridor-based planning, local impacts of infrastructure investment, and GHG reduction priorities have all influenced the selection of priority demonstration areas. The Columbia Corridor and the Powell/Division Corridor will be design labs for specific infrastructure implementation as well as for baselining, monitoring, and reporting against UB Mobile PDX outcomes. Each corridor will have specific outcomes targeted based on leveraging current complementary investments as well as their unique development challenges, including equity, congestion, mobility, safety, and climate change.

The City of Portland has the support of CH2M to establish this project and start realizing the benefits of UB Mobile PDX that will integrate applications and technology to achieve the goals of the USDOT's Smart Cities Challenge.

Regards,

A handwritten signature in dark ink, appearing to read 'David Knowles', written in a cursive style.

David Knowles
Vice President, Portland Area Manager



February 3, 2016

Ms. Leah Treat
Director of the Portland Bureau of Transportation
1120 SW Fifth Avenue, Suite 800
Portland, Oregon, 97204

Regarding: Smart Cities Challenge

Dear Director Treat:

Intel is a key partner with the City of Portland and its ongoing efforts to transform itself into a smart city through the Ubiquitous Mobility for Portland (UB Mobile PDX) platform. Portland has long been a leader in addressing climate change, striving to overcome the obstacles of the past to become a more equitable and inclusive community, and transforming how its people access schools, jobs, commercial areas, and recreation.

We realize that Portland provides a unique opportunity to demonstrate the safety benefits, mobility enhancements, better health outcomes, and cost savings that come with an integrated approach. Implementation of UB Mobile PDX will be a groundbreaking step toward addressing the most pressing challenges of our time and providing a catalyst for continued innovation in transformative mobility solutions.

Portland's dynamic history with corridor-based planning, local impacts of infrastructure investment, and GHG reduction priorities have all influenced the selection of priority demonstration areas. The Columbia Corridor and the Powell/Division Corridor will be design labs for specific infrastructure implementation as well as for baselining, monitoring, and reporting against UB Mobile PDX outcomes. Each corridor will have specific outcomes targeted based on leveraging current complementary investments as well as their unique development challenges, including equity, congestion, mobility, safety, and climate change.

The City of Portland has the support of Intel to establish this project and start realizing the benefits of UB Mobile PDX that will integrate applications and technology to achieve the goals of the USDOT's Smart Cities Challenge.

Sincerely,

A handwritten signature in black ink, appearing to read "Rose Schooler", written over a horizontal line.

Rose Schooler
Vice President, Internet of Things Group (IOTG)
General Manager, Strategy and Technology Office (STO)

Intel Corporation
2200 Mission College Blvd.
Santa Clara, CA 95052



February 1, 2016

Leah Treat
Director
Portland Bureau of Transportation
1120 SW Fifth Ave, Suite 800
Portland, OR 97204

Director Treat,

Drive Oregon is a key partner in support of Portland's "smart city" work in general, and in particular we support the Ubiquitous Mobility for Portland (UB Mobile PDX) platform.

Drive Oregon is a unique public-private partnership, funded in part by the State of Oregon, with a mission to accelerate the growth of the electric vehicle industry and to promote electric transportation in Oregon. The City of Portland, through the Portland Development Commission, helped launch Drive Oregon in 2010 – and the fact that the State of Oregon has invested over \$3 million in our work shows this region's continued strong support.

Drive Oregon also enjoys support from nearly 100 member companies and organizations, from small software startups to several global automakers and charging providers. Our slogan of "Test Drive the Future" demonstrates our belief that Portland is both a leader and an ideal "living laboratory" for transformative mobility solutions. We believe that UB Mobile PDX will be a groundbreaking step forward in this regard.

The City of Portland has our strong support to move this project forward. As we work to achieve the goals of the USDOT's Smart Cities Challenge, Drive Oregon stands ready to provide ideas, introductions, time, energy, and resources to ensure the project's success.

We look forward to further discussing how we can help this project succeed.

Sincerely,

Jeff Allen
Executive Director
Drive Oregon



DATE: February 2nd, 2016

TO: Maurice Henderson, Assistant Director, PBOT

FROM: Nate McCoy, Executive Director, NAMC-Oregon

SUBJECT: Letter of Support for USDOT's Smart Cities Challenge

Assistant Director Henderson,

The National Association of Minority Contractors – Oregon Chapter (NAMC-Oregon) is a key partner in Portland and its ongoing efforts to transform itself into a smart city through the Ubiquitous Mobility for Portland (UB Mobile PDX) platform. Portland has long been a leader in addressing climate change, striving to overcome the obstacles of the past to become a more equitable and inclusive community, and transforming how its people access schools, jobs, commercial areas, and recreation.

We realize that Portland provides a unique opportunity to demonstrate the safety benefits, mobility enhancements, better health outcomes, and cost savings that come with an integrated approach. Implementation of UB Mobile PDX will be a groundbreaking step toward addressing the most pressing challenges of our time and providing a catalyst for continued innovation in transformative mobility solutions.

Portland's dynamic history with corridor-based planning, local impacts of infrastructure investment, and GHG reduction priorities have all influenced the selection of priority demonstration areas. The Columbia Corridor and the Powell/Division Corridor will be design labs for specific infrastructure implementation as well as for baselining, monitoring, and reporting against UB Mobile PDX outcomes. Each corridor will have specific outcomes targeted based on leveraging current complementary investments as well as their unique development challenges, including minority contracting equity, congestion, mobility, safety, and climate change.

The City of Portland has the support of NAMC-Oregon to establish this project and start realizing the benefits of UB Mobile PDX that will integrate applications and technology to achieve the goals of the USDOT's Smart Cities Challenge.

Sincerely,

A handwritten signature in black ink that reads "Nate McCoy".

Nate McCoy
NAMC-Oregon, Executive Director



Portland General Electric Company
121 SW Salmon Street • Portland, Oregon 97204

January 27, 2016

The Honorable Anthony Foxx, Secretary
United States Department of Transportation
1200 New Jersey Ave, SE
Washington, DC 20590

Subject: Portland General Electric Support for Portland, Oregon's Application for USDOT's Smart Cities Challenge Grant

Dear Secretary Foxx:

As a utility that is leading the country in transitioning to clean electricity sources, Portland General Electric (PGE) is striving to help advance a new energy direction in our nation - from how electricity is generated to how it is used by our customers. Electricity is the fuel for modern transportation, economic growth and greenhouse gas reduction. PGE believes transportation is the next great opportunity for making progress on climate goals. Additionally, increasing access to low emission or no emission transportation options at a low cost is an exceptional way to improve the quality of life for our customers.

PGE will be an integral partner with Portland and its ongoing efforts to transform itself into a smart city by actively supporting a Smart Mobility Platform. Implementation of the Smart Mobility Platform will be a groundbreaking step toward addressing the most pressing challenges of our time and providing a catalyst for continued innovation in transformative mobility solutions. PGE serves most of the Columbia Corridor and all of the Powell/Division Corridor where design labs for specific infrastructure implementation, as well as for baselining, monitoring, and reporting against the Smart Mobility Platform outcomes, will be tested. PGE has an opportunity to plan our work in these corridors in a manner that complements the investments that Portland will make.

Portland has long been a leader in addressing climate change and PGE has been a contributor to the city's climate action plan since its first version in 1990. The City of Portland can expect PGE's support in establishing this project and realizing the benefits of Smart Mobility Platform that will integrate applications and technology to achieve the goals of the USDOT's Smart Cities Challenge.

Sincerely,

Dave Robertson
Vice President, Public Policy



January 24, 2016

Peter Koonce
Division Manager
Signals, Street Lighting, & ITS
1120 SW 5th Avenue, 8th Floor
Portland, OR 97204

Re: USDOT Smart City Challenge

Dear Peter,

Please consider this letter formal confirmation that INRIX is pleased to support the City of Portland, OR in their application to the USDOT Smart City Challenge. INRIX, a world leader in providing real time and archival traffic data to the public sector, can assist the City in winning this important grant by providing the experience, data and analytical tools to separate themselves from the competition:

Experience: *For more than a decade, INRIX has been focused on supporting smarter cities.* Examples include assisting London in managing travel during the Olympic games, assisting the Bay Area in improving travel information, performance measurement and project planning, helping Dubai as it prepares for Expo 2020, and identifying transit alternatives for BMW i3 customers in the US and Europe to avoid congestion and optimize routing.

Capabilities: *INRIX has many smart city components live in operation today or on-the-shelf ready for use.* Real-time traffic, incidents and routing are live in the City of Portland, as is roadway performance and trip/OD analytics. INRIX currently powers more connected vehicles than anyone else in the US. Also, traffic avoidance and parking apps, widgets, and SDKs are readily available for adaptation to enhance the City's smart city vision. Increasingly, INRIX solutions are focusing on intermodal connections available to enhance mobility, moving well beyond the optimizing of traffic. INRIX leads the industry in services for electric vehicles, incorporating comprehensive intermodal routing. Platforms are available for deployment that provide analytics related to the movement of people across all modes. Finally, INRIX's unmatched ecosystem of partners and customers offers solution possibilities no single company can provide alone.

Creativity: *INRIX has thrived at practical creativity – pushing the boundaries to offer advanced solutions that are deployable, scalable, affordable and commercially sustainable.* Our direct experience across areas including connected vehicles, traffic management, traveler information, planning, parking, public safety, crowd control, event management, fleets, mobile apps, crowd sourcing, and electric vehicles offers opportunities for unique solutions others cannot imagine or create.

Please do not hesitate to contact me at (509) 994-2274 or via email at ted@inrix.com if I can be of any assistance.

Sincerely,

A handwritten signature in dark ink, reading "Ted Trepanier", is shown on a light-colored rectangular background.

Ted Trepanier
Sr. Director of Business Development, Public Sector

January 19, 2016

Peter Koonce, PE
City of Portland
Division Manager
Signals, Street Lighting, & ITS
1120 SW 5th Avenue, 8th Floor
Portland, OR. 97204

Re: Smart City Challenge

Dear Mr. Koonce:

TransCore is excited about the opportunity to partner with the City of Portland in support of the Smart City Challenge. As you know, we have supported the City's traffic signal control system for nearly 30 years dating back to 1987. We remain committed to Portland's vision in shaping a livable city that provides people and businesses access and mobility.

The Smart City challenge offers an incredible opportunity to push this vision further. TransCore brings expertise and industry-leading knowledge associated with the following vision elements for a Smart City:

- **Connected Vehicles** – TransCore is leading the design of New York City's Connected Vehicle pilot deployment program, one of three Federal Highway Administration pilots announced late last year. The New York City pilot will focus on vehicle and pedestrian safety, initiatives which can easily be deployed in the City of Portland and in other cities throughout the U.S.
- **Urban Automation** – TransCore has successfully implemented adaptive traffic signal control for over 30 cities across North America, including in the City of Portland. TransCore has integrated the Adaptive Control Decision Support System (ACDSS) platform with the TransSuite Traffic Control Software, which provides a proven foundation for the City to expand adaptive signal operations in support of SMART signals.
- **Intelligent Sensor-based Infrastructure** – Additional modules of our TransSuite software are geared towards supporting an Intelligent Sensor-based Infrastructure. Our Traffic Management System (TMS) module has been built to collect data from various data sources and present the information from the different sources into a common display including workstations, web pages and mobile devices. The TMS module currently supports a number of different traffic data collection devices including in-pavement and non-intrusive traffic detectors, Bluetooth readers, and data from third party data providers such as Inrix, Here and Tom Tom.

TransCore looks forward to continuing our long standing relationship with the City of Portland through the Smart City initiative, and fully supports you in your pursuit of a livable city. Please do not hesitate to contact me directly at 801.580.2793 or via email at michael.mauritz@transcore.com with any questions.

Sincerely,
TransCore

A handwritten signature in blue ink, appearing to read "Michael R. Mauritz". The signature is fluid and cursive, with the first name "Michael" being the most prominent part.

Michael R. Mauritz
Senior Vice President

February 2, 2016

General Motors Global Headquarters
MC: 482-C30-B36
300 Renaissance Center
Detroit, MI 48265-3000

The Honorable Mayor Charlie Hales
and Commissioner-in-Charge of Transportation Steve Novick
1221 SW 4th Avenue
Room 340
Portland, OR 97204

RE: Smart City Challenge Grant

Dear Mayor Hales and Commissioner Novick:

We are writing in support of the city of Portland's application for the Smart City Challenge grant. General Motors has is interested in exploring efforts in the areas of multi-modality, car-sharing and dedicated short range communications (DSRC). We are interested in the expansion of smart infrastructure and coordinating first mile and last mile opportunities.

We see Portland as an excellent city to receive the Smart City Challenge grant as it will accelerate the introduction of new technologies and supporting business models. The city of Portland has been progressive in managing growth and incorporating systems to enhance the lives of citizens living in and near Portland.

For all of the above reasons we see Portland as a natural leader to demonstrate a true connected city.

Sincerely,



Daniel A. Turton
Vice President, Federal
and Administrative Affairs



Michael F. Ableson
Vice President, Strategy and
Global Portfolio Planning



John G. Smyth
Executive Director, Global
Research and Development



GENERAL MOTORS



Honorable Anthony R. Foxx
U.S. Department of Transportation
Office of the Secretary
1200 New Jersey Avenue, SE
Washington, DC 20590

February 2, 2016

Dear Secretary Foxx:

I am writing to express Lyft's strong support for the City of Portland's application for the Smart City Challenge grant. The proposed Ubiquitous Mobility for Portland (UB Mobile PDX) platform stands to accelerate the city's transition away from reliance on personal vehicle ownership and serve as a model for other American cities. A recognized leader in sustainable transportation innovation, Portland has laid out an ambitious plan and is well equipped to succeed should they be selected.

The UB Mobile PDX platform would serve as the foundation for a number of initiatives that would advance the goals of DOT's program, including safety, equity, health, and environmental benefits. By integrating APIs from public and private transportation modes into one smartphone app, Portland's plan would enhance the ease and appeal of alternatives to single occupant vehicles and improve the diffusion of flexible, on-demand mobility options like Lyft.

The proposal also contains a role for advanced and clean vehicle technologies, which can help achieve the objectives of the Smart City Challenge. Should the Portland proposal be selected, Lyft would be prepared to collaborate with the city on the advancement of these technologies through our recently announced long-term partnership with General Motors (GM). In the near term, Lyft and GM are working together to develop rental hubs to enable driver short-term access to GM vehicles. If Portland were to receive Smart City funding, Lyft could partner with the city to deploy electric vehicles such as the Chevrolet Bolt through rental hubs, decarbonizing today's fleet while supporting the transition away from personal vehicle ownership. Further, we would welcome the opportunity to collaborate with the city to lay the groundwork for shared, connected, automated vehicles, which Lyft and GM are working together to develop. As reflected in Portland's application, the incorporation of these technologies stands to significantly reduce emissions and travel costs while increasing safety and access to mobility.

We are confident that Portland can achieve the goals of the Smart City Challenge and fully support their selection as a finalist for the grant. Thank you for your consideration of these comments.

Sincerely,

A handwritten signature in black ink, appearing to read "Emily Castor".

Emily Castor
Director of Transportation Policy
Lyft



200 E 6th Street #200
Austin, TX 78701

January 29, 2016

Director Treat:

RideScout is pleased to offer its support in the proposal by the City of Portland for the Smart City Challenge. As a transportation technology working at the forefront of developing integrated solutions across transportation modes, RideScout has significant experience building user-focused mobile applications, advanced traveler information systems, and mobile payment services.

We have optimized the RideScout traveler information mobile app for over 70 U.S. cities, bringing together real-time information for walking, biking, driving, bikesharing, carsharing, and ridesharing. In 2015, we acquired Portland-based GlobeSherpa, the North American leader of mobile ticketing for the transportation industry. GlobeSherpa is the current provider of transport ticketing solutions for 13 major U.S. cities, including Portland, San Francisco, Washington, D.C., and Chicago. Bringing together our core areas of expertise, we will be piloting integrated solutions for public transit and mobility-on-demand (MOD) services Portland in 2016, and look forward to further supporting the City of Portland through this initiative.

We bring to the City of Portland significant technical expertise, industry experience, and strategic transportation industry partnerships to support the advancement of user-focused mobility services, urban analytics, and connected citizens. We are excited about the opportunity to work together on this effort to advance transportation systems to improve mobility for all. Please feel free to contact me at steve@ridescout.com or (580) 483-1611 if you have any questions about our support of this effort.

Sincerely,

Steve Carroll
Vice President, Strategic Development



BOSCH

January 27, 2016

The Honorable Anthony Foxx
Secretary, U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington DC 20590

Robert Bosch LLC
38000 Hills Tech Dr.
Farmington Hills, MI 48331
Telephone +1(248)553-9000
www.Bosch.us

Re: City of Portland's Smart City Challenge Proposal

Dear Secretary Foxx,

It was a pleasure meeting with you on January 7, 2016, at the Consumer Electronics Show (CES) regarding the Smart City Challenge. I am writing to inform you that Bosch has agreed to partner with the City of Portland to deliver mobility innovations and technology integration solutions should it be awarded the Department of Transportation (DoT) Smart Cities Challenge grant.

Portland's vision for a smarter approach to mobility addresses emerging transportation technologies, data, and applications. Bosch's expertise in multiple DoT Vision Elements, alongside Portland's proposed solutions, offer unique, data-driven ideas to improve lives by making all modes of transportation safer, easier, and more reliable.

The development of this preliminary proposal with the input of Bosch and other leading industry and academic organizations makes this proposal worthy of consideration for inclusion in the final five cities that will compete for DoT's award. DoT's groundbreaking initiative will be an excellent platform to accelerate the development and adoption of these technologies and solutions in forward-thinking communities such as Portland.

Yours sincerely,

Mike Mansuetti
President

1776

WHERE REVOLUTIONS BEGIN



January 29, 2016

The Honorable Anthony Foxx
Secretary
United States Department of Transportation
1200 New Jersey Ave S.E.
Washington, D.C. 20590

Dear Secretary Foxx:

I am writing on behalf of 1776 Inc., PBC (hereafter '1776') to support the City of Portland's Smart City Challenge application. 1776 is a national incubator and seed fund that helps engineer the success of startups in highly regulated industries, including transportation and smart cities. The several thousand startups in our network have developed highly-scalable technologies that can quadruple the number of electric vehicles charged at one station, display customizable real-time transit information on screens at transportation hubs, allow drivers to find parking with the touch of a button and much more.

1776 is headquartered in Washington, D.C. in order to take advantage of the city's unique combination of industry and regulatory experts, but our reach is national. We recruit the country's best startups to become a part of our network through our annual Challenge Cup competition, which allows startups to compete for over \$1 million in prizes. This year, the Challenge Cup is taking place in over fifty cities, including Portland.

As a result of the Challenge Cup and our growing global network, we work with hundreds of transportation and smart cities entrepreneurs each year and are uniquely positioned to connect Portland to the United States' best transportation and smart cities startups. Should Portland be the winner of the Smart City Challenge, 1776 could select the startups in its network that best fit the needs of Portland's plan and work with city officials to incorporate those startups' technologies into Portland's implementation.

The vision laid out in Portland's Smart City Challenge application is extremely startup friendly. The ways in which Portland plans to use Internet of Things technology, open source data-sharing and security protocols to implement the Ubiquitous Mobility for Portland program are innovative and revolutionary. Through this program, Portland will open up many new and exciting opportunities for startups in Portland and around the country. For example, Portland's plan to create an Exchange that will allow drivers, passengers, transit riders, bicyclist and pedestrians to buy and sell mobility on one platform will create enormous opportunities for startups operating ridesharing, bikesharing, and wayfinding services.

1776's startups are ready to scale and looking for opportunities to do so. 1776 helps direct these startups towards growth opportunities that they might not find, such as opportunities stemming from the Smart City Challenge. Thus, should the Department select Portland as its Smart City Challenge champion, the Department would be supporting some of the country's most innovative small businesses and entrepreneurs and bringing them to a market they might otherwise overlook.

I urge that every consideration be given to the City of Portland's Smart City Challenge application, which the 1776 startup community strongly supports.

Sincerely,

A handwritten signature in dark ink, appearing to read "David Zipper", with a stylized, flowing script.

David Zipper
Managing Director, 1776 Inc., PBC



11000 SW Stratus St.
Beaverton, OR 97008
1.800.547.5417
www.dat.com

February 2, 2016

To: City of Portland

Re: Letter Supporting the City of Portland Smart City Challenge Proposal

DAT Solutions LLC would like to submit this letter of support for the project submitted for the Global Smart Cities Challenge by the City of Portland. We recognize the challenge rapid population growth presents to cities all over the world. Portland has a historic propensity for innovation, smart urban growth and planning and sustainable policy and practices. That positions Portland as a strong contender to envision and implement the transportation infrastructure changes necessary to accommodate that increase in population.

Based in Portland, Ore., DAT Solutions provides actionable information to transportation professionals in North America. It operates the industry's largest network of load boards and is a trusted source of supply and demand trends, rate benchmarking, and capacity planning information. Related services include a comprehensive directory of companies with business history; broker transportation management software; fuel tax, mileage, vehicle licensing, and registration services; mobile resource management; and carrier onboarding.

Founded in 1978, DAT Solutions LLC is a wholly owned subsidiary of Roper Technologies, a diversified technology company and constituent of the S&P 500, Fortune 1000 and Russell 1000 indices.

DAT's vision is to drive the inefficiency out of freight transportation through real time data insights, which is in line with the goals of the Global Smart Cities Challenge. The USDOT highlights their vision for this project to include the identification of transportation challenges, the determination of which technologies can help to solve the problems at hand, the evaluation of the impact of said technologies, and the understanding of the policy and institutional mechanisms, which will need to be affected to realize the potential of these strategies. We feel our expertise in the following areas will position us as a useful technological resource and business partner, to assist in the realization of that vision, if Portland is elected to move on to the next step in this process.

- Supply and demand analytics
- Truck parking
- Truck congestion analytics
- Truck load and partial load freight matching
- Truckload Freight Rates

We are always looking at ways to use data, technology and innovation to develop solutions to accommodate the growing demands of transportation. We want to offer our support for the proposal envisioned thus far by all parties involved in the Portland Smart Cities Challenge and want to offer our involvement in the next phase of this project.

Sincerely,

A handwritten signature in black ink, appearing to read "Don Thornton". The signature is fluid and cursive, with a large initial "D" and "T".

Don Thornton

Senior Vice President

January 28, 2016

To: City of Portland

Re: Letter Supporting the City of Portland Smart City Challenge Proposal

On behalf of Peloton Technology, I am pleased to submit this letter of support for the Smart City Challenge proposal submitted by the City of Portland. The City's past track record of deploying intelligent transportation infrastructure and bold vision of providing new mobility technologies and services is exciting and it is our pleasure to contribute support, resources, and the viewpoints of Peloton to this vision.

Our company and innovation partners will benefit from this project as it provides a cohesive framework within which to develop the full potential of a number of current R&D and product deployment initiatives.

Peloton is a leader in the development and deployment of truck platooning systems that improve the safety, efficiency and analysis of freight transportation. Peloton-equipped vehicles are at the frontiers of truck automation, collision avoidance, V2X connectivity and cloud-based fleet management. In order to integrate these technologies for commercial deployment, we have collaborated with innovation partners including Lockheed Martin, Volvo, Denso, UPS, and Intel; state DOTs and business development agencies, government, industry and academic researchers; and major for-hire and private trucking fleets.

In line with our commitment to integrating intelligent vehicles and infrastructure in urban and intermodal environments, we would welcome the opportunity to assist the City of Portland in formulating and implementing its response to USDOT's Smart City Challenge. Of the 12 Vision Elements that USDOT encourages applicants to consider, Peloton's prospective contributions fit clearly under the three "highest priority" elements of *Urban Automation*, *Connected Vehicles*, and *Intelligent, Sensor-Based Infrastructure*. Specific urban freight solutions that Peloton can offer to the Smart City Challenge are:

- freight signal priority with automated speed control
- automated traffic jam assist
- automated truck queuing, parking and docking
- improved intermodal coordination via cloud-based networks
- expanded data collection and analysis enabled by real-time V2X communications

Each of these solutions promises to improve the safety, efficiency and mobility of transportation within the City of Portland. Collectively, they have the potential to make the City a model for automated urban freight transportation.



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We are proud to be a part of this exciting vision for the region. If you have any questions, feel free to contact me.

Sincerely,

A handwritten signature in blue ink, appearing to read "S. Boyd", written in a cursive style.

Steve Boyd
VP – External Affairs



Tozny, LLC
421 SW 6th Ave, Suite 300
Portland, OR 97204

To: City of Portland
Re: Letter Supporting the City of Portland Smart City Challenge Proposal

I am submitting this letter of support for the City of Portland's proposed project for the Global Smart City Challenge. Our team is extremely excited about the city's Beyond Traffic vision. It represents technological innovation with a focus on significant quality of life improvements for the people of Portland.

Tozny has extensive expertise in security and privacy practices, and has collaborated with Portland technology companies in the transportation space for several years. The scalable distributed data architecture outlined in the vision will have a positive impact on users and Tozny will offer to lend its expertise and software technology to ensure that the security and privacy of the platform are appropriately robust.

Tozny is a growing startup, based in downtown Portland, Oregon and collocated with our parent company Galois, Inc. Since 1999 Galois has performed computer security research and development services for the US federal government.

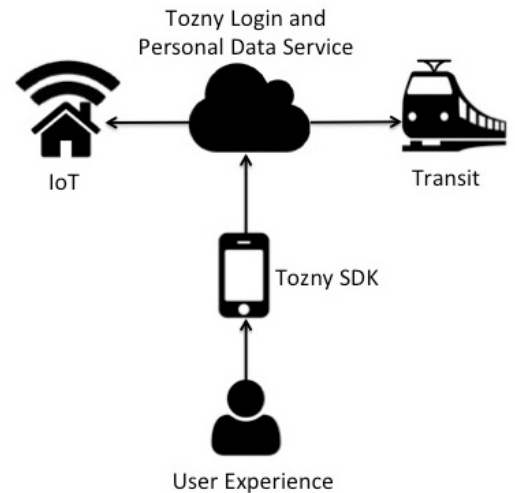
Amid growing concerns that IoT devices and transportation software often do not implement industry standard communication security best practices, Tozny assembled a team that includes Portland companies Galois, GlobeSherpa and IOTAS to address the problem with new technology development.

Tozny's parent company, Galois has been awarded a contract with NIST to build a secure data storage system that enables next-generation IoT and transit capabilities without sacrificing privacy. The National Strategy for Trusted Identities in Cyberspace (NSTIC) is a White House initiative to work collaboratively with the private sector, advocacy groups, public sector agencies, and other organizations to improve the privacy, security, and convenience of online transactions.



Tozny is in the design phase for a new privacy tool called a Personal Data Service (PDS). The goals of this system are highly congruent with the city's vision. The PDS:

1. Securely stores and manages data from multiple data providers on behalf of the user as well as integrating open source data. This capability can implement the city's need to aggregate data.
2. Grants authorized third-party access to data through standard web service APIs. This capability can implement the city's need to share data with citizens, government agencies, and businesses.
3. Empowers the user to exercise informed consent and ensures transparency over the collection and sharing of their personal data, including a portal for managing that sharing.



We believe that the PDS technology could be applied to the City of Portland's vision to help ensure the security and robustness of the system. We are fully supportive of the City of Portland's Smart City Challenge proposal.

Sincerely,

A handwritten signature in black ink, reading "Isaac Potoczny-Jones".

Isaac Potoczny-Jones
CEO, Tozny, LLC

Background on Isaac Potoczny-Jones: Isaac founded Tozny to commercialize Galois' research in identity and security. He has led many successful security and identity management projects for government agencies since he started at Galois in 2004. His projects have included secure cross-domain collaboration (Navy, Intelligence Community), practical solutions in identity credentials for first responders (DHS), federated identity for the Open Science Grid (DOE), anonymous authorization and cross-domain search (DOD), mobile password-free authentication (DARPA), authentication for anti-forgery in hardware devices (DARPA), and privacy-preserving authentication and data sharing (NIST). He has applied the NIST Risk Management Framework to commercial and government projects for security assessment and penetration testing. Isaac is an active open source developer in the areas of cryptography and programming languages. Education: BS Computer Science, The Ohio State University. MS Cybersecurity, University of Maryland University College.