Smart Seattle

A Prototype for the New Century's Digital City

Beyond Traffic: USDOT Smart City Challenge

Application prepared by Seattle Department of Transportation

In partnership with:

City of Seattle

King County METRO

Microsoft

UNIVERSITY of WASHINGTON

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The Year 2020: The Smart City Comes Into View

2017 wasn't the first time Seattle reinvented itself. It had been a perennial occurrence since its birth in the 1850s, a boomtown that faded but somehow always boomed again. In 2015 the city was becoming a victim of its own success. It had recently been named the fastest-growing major city in the US, and its economic growth was explosive. But traffic congestion, which also ranked amongst the country's worst each year, was strangling some of the city's most vital employment centers. To its critics, the fate seemed inescapable. Growth equals congestion, period. The region was moving toward all-day gridlock. Crashes and other unexpected events could commonly send the entire network into crisis.

By 2017, after wining the Smart Cities Challenge, the city started to feel distinctly different. It faced the same challenges of course, but with a new adaptiveness and resiliency. The first changes were subtle. Transit riders, who had become accustomed to being passed up by full buses, noted that they weren't shut out quite as often. New car sharing services were spotted downtown, most of them piloting electric cars.

The tipping point became evident early in 2018, when a "perfect storm" threatened to send the transportation system into an all-night lockdown: a Monday night football game, a multi-car crash on I-5, and construction work on one of the freeway's best-known alternate routes. The lucky ones, who were already home in front of their TVs by 5:00, tuned in to watch the drama. They knew very well what these events always did to Seattle traffic. But in 2018 the crisis never happened... Sluggish, but very much alive, the network healed itself quicker than even imagined. By 8:15 normal operations had resumed. For most of the weary commuters, re-heated suppers were now their greatest concern.

The city was abuzz the next week – but the real transformation, based on millions of small and nearly invisible decisions, was just beginning. A software engineer relocated to Seattle and planned to buy a car after getting settled, but he never got around to it. A downtown office worker began flexing her schedule 20 minutes each day, and regained several wasted hours of commute time each week. A swing-shift warehouse worker started taking safer, more convenient rides home in a car share vehicle instead of driving alone. Deliveries were ordered and scheduled to take advantage of open load zones, and additional TNC vehicles were dispatched to meet each day's travel demand – wherever that demand occurred. "Mobility as a service" flourished far more in Seattle than anywhere else in the nation. By 2020, there was no doubt that something revolutionary had happened here.

Seattle had chartered a different course from other cities in very fundamental ways. The city had the highest adoption rates for electric vehicles in the country, simply because most vehicles were being sold to companies that offered mobility as a service. There was no doubt that this city had become smart, but it hadn't happened by an engineering or computing breakthrough inside a government office. **Instead the city had simply enabled the collective power of millions of smart decisions – in real time – made by the same citizens, taxpayers, and companies who were depending on the outcomes for their everyday lives.**

"Hi Don. Your son Adam was just registered in a $25,000 lottery for downloading a new app. He suggested that you might be interested too. It's a free download that helps you get around Seattle, and saves you time and money as you go! No commitment, just click here if you want to try it out and enter the lottery."

"Hey Logan, me again. I'm Tyrion, your travel concierge. Heads up dude! You're waiting for a bus on Madison, right? They're all packed, big Seahawks game. Take Uber instead. It costs $2.73 more, but I'll pay this time. Click here. I'll credit your account when you get your ride. Save you about 37 minutes tonight!"

"Vivian, quick tip. Either work another 30 minutes tonight or take the 550 bus, OK? 565 is standing-room only. Click here if you want another update in 25 minutes."

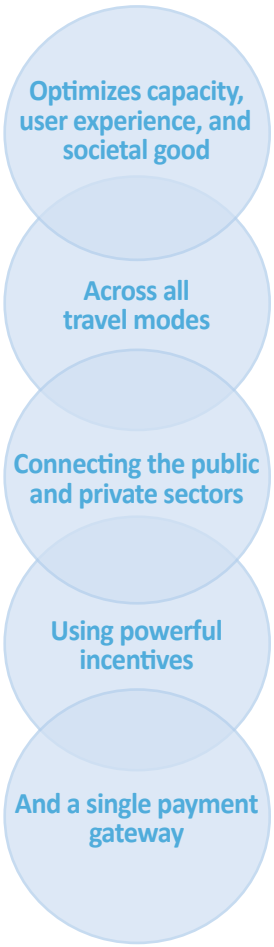
"Evie, it's Dr. Einstein. Hate to brag, but I've saved you a bunch of time and money lately: You've saved $22 since I started riding with you, plus almost 3 hours! Click here to see more. Plus I know who's been saving even more than you, and I've even got tips on how they did it. Actually the top 5 are each winning $1,000. Want to see if you're close?"

Q1: Vision

Define your vision for your Smart City.

Vision

The Seattle Department of Transportation, with an elite team of partners from the University of Washington, Microsoft, and King County Metro, will create an unprecedented urban "Mobility Marketplace": a powerful data platform that consolidates and optimizes all transportation modes in a single environment. The Mobility Marketplace:



Through the Mobility Marketplace, users of all income levels will be able to identify the fastest and most affordable way to get to their destination in that particular moment, using the optimal combination of public and private transportation modes. Payment for their trip is completed with a simple swipe of a smart phone. The City will be able to manage and influence the distribution of people and goods across all modes by employing incentives that influence behavior, and thus distribute loads to various modes over time. The Mobility Marketplace is made possible by an expansive system collecting and sharing data – safely, securely, and efficiently – to participating entities and the public at large.

The project delivers the following:

1. **Data Collection** – The City, King County Metro, and other partners will install sensors and communication systems to collect real-time data about the transportation ecosystem. Technology will be installed on fixed and mobile assets – both publicly and privately owned – including buses and light rail trains, traffic signals, electric charging stations, parking spaces, street lights, and shared vehicles. This will revolutionize the City's ability to achieve a truly comprehensive, real-time knowledge of the entire transportation ecosystem

2. **Data Platform** – The City and its partners will create a sophisticated data and communications platform to process, manage, and distribute the collected data. The platform first protects and encrypts all sensitive data in adherence to federal and state policy. Second, it provides access to the data, as appropriate, to government agencies, private corporations, and individual travelers. Finally, it packages and distributes the data in ways that will optimize its usefulness for all audiences: professional and citizen alike. A disinterested third party will host the platform through a "data collaborative" and will be responsible for the management, distribution, and security of the data and assets.

3. **The Mobility MarketPlace** – Like many modern platforms, the Mobility MarketPlace equips all transportation providers with a place to securely distribute their apps, data, or services to users. However, the Mobility MarketPlace adds several critical levels that passive trip planning apps do not approach:

* USDOT funds will not pay for any incentives. USDOT's Smart City Challenge grants will be used to install data collection equipment, and to develop and manage the data collaborative and Mobility MarketPlace. On-going traveler incentives may be funded through a combination of corporate sponsorships, subscriptions to the data collaborative, and negotiated fees for customers referred to private transportation providers.

pushing timely information to the user, incentivizing* behavior, and providing a seamless, multimodal payment mechanism. It is also through this marketplace that existing services, like Bing and Google Maps, will be able to subscribe to government or third-party data. Subscriptions will allow them to integrate mobility information with their maps and their navigation offerings through APIs. The consolidated distribution of multi-party data will energize a host of new services delivered by the private sector, both from large enterprises as well as the entrepreneurial and NGO communities.

4. **Service Optimization** – The Data Collaborative also provides critical data for transportation service providers and system operators to optimize their services. For example, as travel behavior changes in response to the Mobility MarketPlace, the City can immediately determine which traffic signals need to be retimed- and accomplish that retiming without collecting additional data. As the city grows, transit agencies can add or modify routes based directly on where people and goods are traveling. In a virtuous cycle, optimizing transportation services improves travel options and lowers the per-trip cost for all travelers.

Why Seattle

The City of Seattle is an environment where innovation naturally lives and thrives. The City of Seattle and its partners have developed one of the nation's most aggressive climate action plans – and with its tech-savvy population, and the pioneering spirit of its business community, Seattle has consistently been on the forefront of new transportation technology. Electric and autonomous vehicles are not a speculative planning effort here; they are reality. The current question for Seattle, and the upcoming question for all US cities, is how we will adapt: how we continuously bolster the success of the market's best new innovations, influence their adoption rates, and ensure that they are advancements for societal good as well as *individual* good. Seattle is, in many ways, uniquely prepared to take on the Smart City Challenge.

Unique Proposition	Addresses User Needs	Advances USDOT Interests
• Leverages the collective power of millions of optimized trips to optimize an **entire multi-modal network** • Creates **user-based incentives** to synchronize smart travel behavior that achieves positive societal impacts • Builds the **Mobility MarketPlace – an open-source data platform** – and allows the private sector to grow the concept • Revolutionizes the ability to **ingest data**, providing real-time and historical knowledge of the transportation ecosystem	• Provides a **personalized travel concierge** • Actively **pushes comparative travel options info** and offers to a person's smart phone • Addresses the needs of all system users, including for **low-income and unbanked** people and for **goods movement** • Offers **ease of payment** for all services (public and private) through a single payment gateway • **Reduces transportation costs** by enabling car-free/car-lite living	• **Optimizes systems** in real time across all modes **without building costly infrastructure** • **Spurs innovation and creates an incubator** for the best technology breakthroughs to quickly advance to market • Changes fundamental market economics to d**rive electric vehicle and automated vehicle adoption rates** • **Tests the Data Collaborative model** to acquire, manage, secure, and distribute data and assets

Addressing Challenges

The project directly addresses Seattle's pressing transportation-related challenges as follows:

Description	Response
Insufficient Capacity	
Seattle was the fastest-growing large city in the country in 2014 and continues its rapid growth*. This growth, coupled with a historic underinvestment in public transportation and lack of a subway system, is straining the transportation system, creating capacity challenges.	This project "increases" capacity by optimizing the existing systems instead of building costly physical infrastructure, like roads, or purchasing more equipment, such as buses or trains.
Fractured Transportation System	
Seattle's current array of transportation providers includes three public transit agencies (King County Metro, Sound Transit, and the City of Seattle), private micro-transit and car share providers, transportation network companies (TNCs), taxis, vanpools, and for-hire vehicles. To the user, the system is fractured. Out of habit or for lack of information, residents regularly default to suboptimal trip choices.	This project enables informed and efficient decision-making by providing users with real-time information, incentives, and streamlined payments for all plausible trip options and mode combinations. In turn, the data available on user choice enables transportation agencies and firms to more effectively couple supply to this demand.
Constrained Freight Mobility	
Population growth, plus the trend towards e-commerce, has led to tremendous growth in goods delivery throughout an already freight-heavy city. Seattle is home to the Port of Seattle, including North Harbor of the Northwest Seaport Alliance (NWSA), which operates the third-largest container load center in the US. It is becoming increasingly challenging to complete trips, particularly "last mile" deliveries.	The Mobility MarketPlace has myriad ways to address freight challenges. In making public and private data available, the system facilitates "object pooling." For example, UBER can deliver both a passenger and an unrelated box in a single trip. As desired, the City may choose to use connected vehicle technology to further incentivize object pooling by allowing participating "Freight and Transit" vehicles in the carpool lanes to optimize available system capacity. Coordination and cooperation with the NWSA will increase visibility, and reduce the occurrence and length of drayage truck queues at container terminals in the Seattle Harbor.
Equity	
The rapidly increasing price of housing in Seattle is resulting in low-income residents moving farther from downtown to areas where access to high frequency public transit is weaker. And, for low-income families that remain, the high cost of car ownership coupled with high housing prices.	This project establishes a mechanism for subsidizing low-income residents' use of the full spectrum of transportation options, through low-cost fares. Additionally, the City can leverage the Mobility MarketPlace to incentivize improved service in outlying neighborhoods or outside of traditional commute hours by private transportation providers for both cost and efficiency. Lastly, leveraging the potential of smart kiosks installed at downtown transit stations, travelers without smartphones will be able to access information.
Aging Population	
As in many parts of the country, the number of seniors in Seattle, already 18% of the population, is anticipated to double in the next 10 years. Lacking alternatives to car ownership, seniors often hold on to their licenses beyond a point of safety. Once resigning their licenses, they face significant challenges from the high cost of alternatives to overreliance on friends and family, and ultimately the need for many to move out of their homes.	Providing one-stop shopping for affordable, reliable, and convenient transportation alternatives, this project will help improve the opportunities for seniors to age in place with dignity at a significant cost savings to society.

* 2014 Census data, comparing growth rates of 50 largest cities, July 1, 2012 – July 1, 2013.

Description	Response
Entry of Shared, Electric and Automated Vehicles	
Committed to its Climate Action Goal of increasing electric vehicles, the City seeks to expedite the adoption of electric and automated vehicles entering the Seattle market. However, the advent of shared, electric and automated vehicles has the potential to increase vehicle trips in the City.	By consolidating citywide signals of demand for trips, this project rapidly expands the market for shared mobility services, and accelerates market entry of automated and electric vehicles. Likewise, through partnerships in supply, this project creates a framework to ensure that this shift and its outcomes are aligned with the public good. The University of Washington is willing to perform a detailed test of Level 3 automated transit vehicles in controlled public spaces. In doing so, the nation can gain the data needed to adopt the best policies and regulations to encourage the safe adoption of these vehicles.
Lack of Data	
The public and private sector are motivated to innovate around transportation. However, many of the innovations rely on data and a communications system not currently available. For instance, one innovation in Europe, "mobility as a service," requires a single payment gateway and collaboration between the public and private sectors.	This project invests significantly in data collection and communications to spur a wave of public and private innovations beyond just the "Mobility MarketPlace." Data will all be publicly available, subject to restrictions, and the APIs and source code that underlie the Mobility MarketPlace will be open-source, enabling both fast adoption around the country and the ability to speed further improvements.
Greenhouse Gas Emissions	
Historical investments in hydropower make Seattle's electricity the cleanest in the nation. Seattle's municipal utility – Seattle City Light – has been carbon neutral since 2005. As valued as this advantage is in the fight against climate change, it puts transportation at the center of greenhouse gas emission reduction targets.	By installing environmental sensors on Metro buses as part of our intelligent infrastructure, Seattle will be able to manage localized air quality in real time by incorporated the sensor data into its adaptive traffic control system. Additionally, trip options will be presented by accounting for carbon-dioxide equivalent (CO_2e) emissions in the trip options and incentives presented to users, this project increases the uptake of carbon-neutral travel.
Climate Resilience and Safety	
Consistent with many cities across the country, Seattle faces an impressive collection of natural and human threats, such as earthquakes, severe storms, sea level rise, floods, and landslides. While not unique, these challenges are significant in a transportation network severely strained by the city's rapid growth.	The Mobility MarketPlace can become a powerful tool to influence travel behavior, especially in crisis situations. Ultimately this will reduce the number of single-occupancy vehicles on the road, and spur the adoption of safer automated vehicles and more environmentally-friendly electric vehicles. Additionally, our systems can become a powerful tool to manage mobility in crisis situations, including the use of Metro buses and trains to provide emergency infrastructure such as communications and power generation.

Technical Approach

Data Collection – The City and partners will install data collection equipment at fixed locations and on mobile, private and public vehicles that will complement the plethora of existing data from public and private partners. The equipment will be connected by an open communications architecture consisting of a regional high-bandwidth wireless network and 5.9GHz DSRC, backed by the partner agencies' extensive fiber optic network and built infrastructure. Communications will be an open architecture Ethernet/IP network using multiple technologies. The network architecture will be based on established standards and designed for continuous expansion, improvement, and evolution. All local public agencies will have access to the network. By providing a unified marketplace for mobility services, the private sector will also be empowered to contribute to data collection efforts. Private sector data collection will be required to adhere to the policies and laws enforced through the Trusted Data Platform outlined in the following pages.

Data Collaborative – The data collaborative will facilitate the aggregation and analysis of multi-party data and will be capable of complex real-time analysis, modeling, and decision support. The project partners, along with a wide array of public and private service providers, will use these data to allow the continuous improvement of the transportation system. For example, the data which describe the person throughput in SOVs, shared vehicles, and buses allows the city to optimize both their basic signal timing plans and the number of transit signal priority calls allowed on the arterials. This in turn speeds both arterial and transit movements, and those improvements are tracked, reported, and made available in the Mobility MarketPlace. By taking advantage of the data available through the connected vehicle network, we drive down the cost of managing the entire network, while also providing the tools to continually fine-tune its performance.

The collaborative addresses three key principles with respect to data-sharing: privacy, security, and transparency. Core to the collaborative is a "trust framework" that identifies the parties and their roles and responsibilities as members of the collaborative. The trust framework also establishes rules, guidelines, and a code of conduct to ensure that both data analysis and data handling are conducted in a manner that is compliant with relevant policy as determined by the data owners or governing bodies. Security, policy, and governance are all managed within the trusted data platform layer, ensuring the safe and responsible analysis and manipulation of data within the system. Detailed information is provided in Section 9

Implementation and Operation Approach – Our technical design and project management team will utilize the Systems Engineering process to develop the full concept of operations, design, and testing plan for the overall system and its individual components. The process will be supported by the use of the Connected Vehicle Reference Implementation Architecture (CVRIA v2.1) and SET-IT software. At the conclusion of the design phase, the project will make a full update to the Regional ITS Architecture. Where feasible, our designs will utilize published and de-facto standards such as NTCIP 1211 for Transit Signal Priority. During development of the systems, technical and operating documentation will be created so that system operators can be trained ahead of deployment. Some program elements include unique opportunities to be leveraged, such as Metro's existing Connected Vehicles infrastructure which can be upgraded to deploy the 100 miles of DSRC without the need for extensive design or planning. It may be possible to complete this deployment in the first year of the project and be available for testing new systems.

Program Management
Our program management structure will enable us to manage the multiple elements of the program in an effective and efficient manner. For clear lines of communication and accountability, the City of Seattle will act as the recipient of the federal award and will be responsible for compliance with regulatory and financial requirements. The City will further hire outside program management experts to ensure that the project is delivered successfully.

This program management structure consists of an Executive Oversight Committee (EOC), Technical Advisory Group, and a Systems Engineering Group with multiple element-specific teams. The EOC will be responsible for overseeing the project and will act as a sounding board and provide direction. The EOC, at a minimum, will consist of the key stakeholders responsible for the delivery and implementation of the project such as USDOT, City of Seattle, King County Metro, University of Washington, and Microsoft.

The Technical Advisory Group will act in an advisory role to the Systems Engineering Group, providing expert knowledge and experience. The Systems Engineering Group will do the actual development of the systems and overall integration, with project managers leading the development of each component overseen by an integrated team led by an overall program manager.

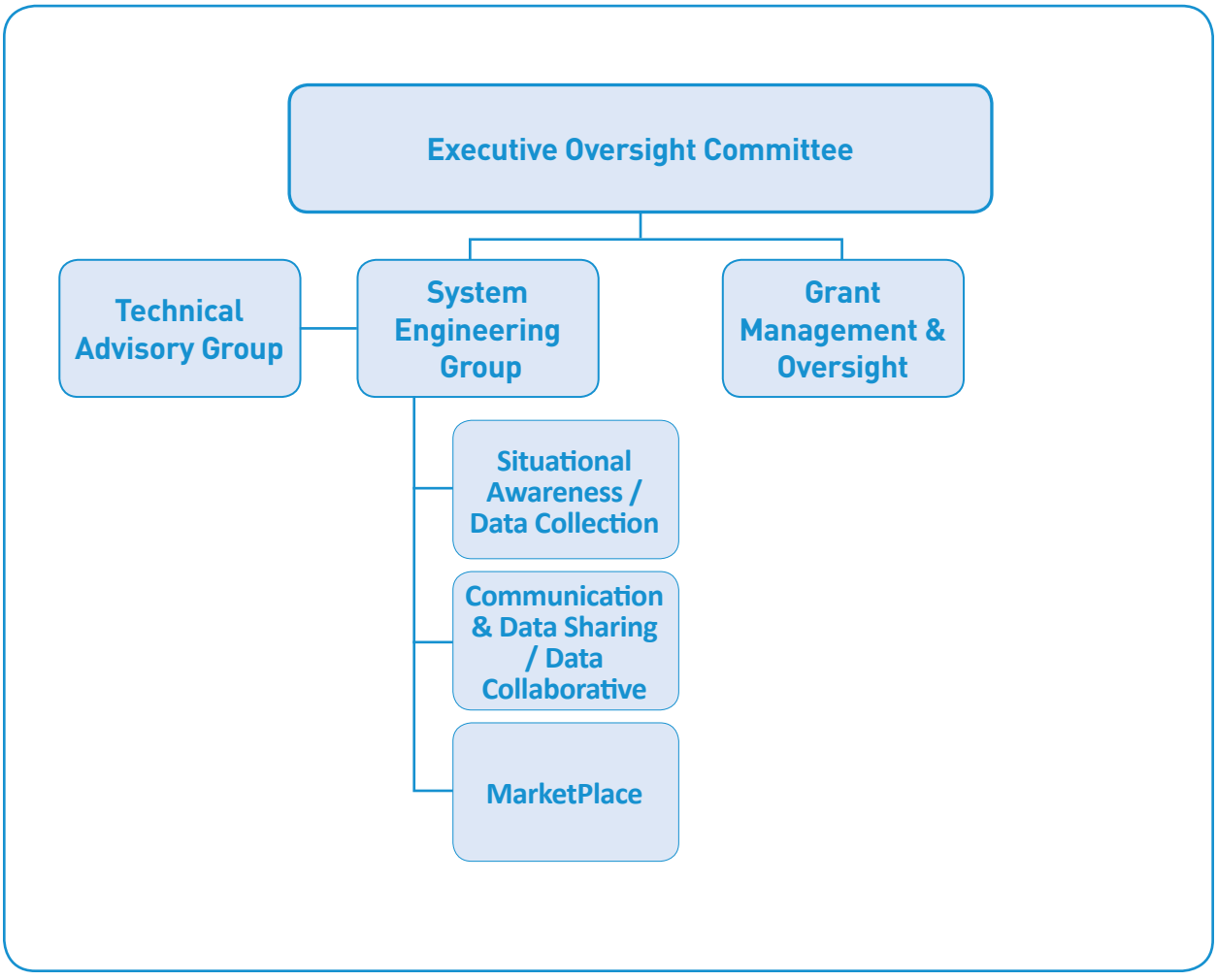


Figure: Program Management Structure

Q2: Population Characteristics

Describe the population characteristics of your city and show how it aligns with the USDOT's characteristics for a Smart City.

Seattle meets USDOT's population characteristics for a Smart City and is listed as a qualifying city on the Smart Cities website.

a) **Population** – Based on 2010 census data, Seattle's population is 608,660, near the upper middle of the USDOT's specified range.

b) **Dense urban population** – Seattle has several dense, mixed-use urban centers. The population density for the overall city is 17 persons per acre, and the employment density is 13.2 jobs per acre (net land acres in Seattle, excluding street right-of-way).

c) **Proportion of the population of its urbanized area** – According to the 2010 Census, Seattle's population represents 20% of the urbanized area. This is significantly greater than the minimum 15% specified by the USDOT.

Q3: Other Characteristics

Describe other characteristics of your city and show how it aligns with the USDOT's characteristics for a Smart City.

Seattle is uniquely poised to be the United States' premier, and USDOT's signature, Smart City. The region is actively and significantly investing in public transportation; is championing leading-edge initiatives in shared mobility, electrification, transportation demand management, parking, bike share, and transit communications; has a progressive technology-driven business community, strong and committed public leadership, and a general population that is highly educated and progressive on transportation issues.

Existing Public Transportation System

Seattle's public transit system is a complex network of services. Bus and light rail serve the highest ridership, but these services are supplemented by commuter rail, monorail, and a rapidly growing streetcar network.

King County Metro is a national leader in introducing new technologies and innovation into public transportation. King County Metro, with partners, has created a 60-mile bus rapid transit (BRT) system and implemented improvements including traffic signal coordination, transit signal priority, bus lanes, queue bypasses, and safety improvements. They have also created a range of tools to give customers up-to-date information on services, service disruptions, and innovations like the TripPool app that enables real-time carpooling. King County Metro was among the first agencies to provide real-time bus arrival information to riders via the Internet and phone. King County operates an energy-efficient fleet, including more than 150 all-electric trolley buses.

Sound Transit operates express bus, commuter rail, and light rail service throughout King County and in two adjacent counties. Sound Transit serves approximately 34 million riders each year. Major capital investments, coupled with the region's rapid growth, are pushing ridership levels up quickly – approaching 41 million riders for 2016.

Conducive Environment

Seattle has the essential elements to be a showcase Smart City.

- **Public Sector Innovation** – The City has established one of the most innovative municipal agendas in the country, particularly related to transportation, energy, and the environment. The Seattle Department of Transportation is hard at work on a Shared Mobility Plan, the first of its kind in the country, which will provide a solid policy and regulatory framework for our Smart Cities proposal. Our municipal parking program regularly wins awards for innovation, such as performance-based pricing on a shoe-string budget.

  Seattle's municipal electric utility, Seattle City Light, has been carbon neutral since 2005, the first electric utility in the nation to achieve this distinction. Seattle City Light has also maintained the longest continually operating energy conservation program in the country and, moving forward, has committed to meeting future load growth with 100% renewable energy.

  King County Metro manages to carry a larger percentage of our commuters on transit than any other city in the nation without an extensive rail system, made effective through the early adoption of technologies to prioritize buses. In addition, King County's RapidRide BRT was the first and only authorized user of Intellidrive, the predecessor of what we now know as Connected Vehicles. In addition, WSDOT was an early adopter of the automated variable speed limit technology aimed at reducing congestion, improving traffic flow, and managing congestion.

- **Smart Land Use** – The State Growth Management Act mandates growth through infill development within an urban growth boundary. Seattle's Comprehensive Plan focuses growth in up-zoned urban villages, around current and planned transit station areas. In the last 20 years, nearly three quarters of new Seattle households have located in neighborhoods that are easy to serve with transit.

- **Tech Culture** – In 2015, Citylab rated Seattle the 8th best city for startups in the world. More than 77 out of every 1,000 jobs are in the tech sector. Tech giants Amazon and Microsoft, powerhouse Boeing, and "smaller" startups such as Expedia, Redfin, Tableau, and Zillow are all anchored here. Additionally, Google, Facebook, Twitter and UBER have significant investments in Seattle.

- **Equity** – Seattle is fundamentally committed to equity, including transportation equity, and implemented a first-in-the-nation racial equity initiative: the Seattle Race and Social Justice Initiative, that has been in place for more than a decade. King County Metro currently offers ORCA Lift reduced-cost transit passes to income-qualified travelers. The City is working with car-share providers to expand into low-income neighborhoods and soon will be providing car-share subsidies for income-eligible residents beginning in 2016. Additionally, the City will launch a low-income bike share program this year.

- **Connected Citizenry** – Seattle's annual tech survey suggests that 85% of residents have Internet at home, 89% of residents own mobile phones, and smartphone ownership is at 58% and rising by 11% per year.

- **Involved Citizenry** – the Seattle public has demonstrated a firm and ongoing commitment to progressive transportation initiatives. In 2015, residents voted in favor of an historic 9-year, $930 million transportation levy that will enable an expansion of public transportation.

- **A National Forum to Showcase Resilience to Climate Change** – The Resilient America Roundtable of the National Academy of Science recently selected Seattle as 1 of only 3 pilot communities in the nation to demonstrate resilience in transportation, along with climate adaptation, equity, and economic growth. The City of Seattle and University of Washington play leading roles in this forum.

Committed, Capable Leadership

The partnership that has been formed for this Smart City challenge is made up of leaders in public government, the business community, and private transportation who are dedicated to transforming transportation in the Seattle Metro area. Each member of our team has the people in place to support and implement this project throughout the period of performance.

- **The City of Seattle** – Seattle is a high-functioning city on the frontlines of technology and transportation innovation. Mayor Edward B. Murray is prepared to make the Smart City Challenge project a signature part of his administration.

- **King County Metro Transit** – King County Metro's Transit General Manager is firmly in support of this project. Metro is committed to the significant equipment and communications upgrades associated with this project.

- **Business Community** – Business leaders enthusiastically endorse the project. Former Governor Christine Gregoire's Challenge Seattle, a business group comprised of CEOs of the 17 largest businesses in Seattle, and the Chamber of Commerce representing a combined workforce of 700,000 (or 32% of the 2.1 million jobs in the region) support the project. In addition, Microsoft is an established partner on our team and is committed to providing the necessary resources and technologies to make this project a success.

- **Private Transportation Providers** – Critical private sector transportation providers including Lyft, Ford, UBER, Car2Go, DriveNow, GM and Zipcar support the initiative.

Commitment to Integrating with the Sharing Economy

Seattle has been on the frontlines of innovation in the sharing economy since its inception and has a fundamental commitment to ensuring the sharing economy is open to all.

- Seattle was the first City in the country to recognize the need to adjust its regulatory framework to address taxis, vehicles for hire (VFH), and Transportation Network Companies (TNCs), and it continues to lead the national shared transportation conversation. The Seattle Department of Transportation, with King County Metro and other regional regulatory partners, initiated the first Shared Mobility Strategic Plan in the country.

- Seattle has always provided a welcoming environment for shared mobility. FlexCar, the country's first car sharing service, launched in Seattle in 1998, before evolving into ZipCar. Altogether, more than a half-dozen technology-driven car share companies currently operate in Seattle, including RelayRides, FlightCar, SideCar, Lyft, and Uber, as well as ZipCar and Car2Go. The City will be providing car-share subsidies for income-eligible residents beginning in 2016. The City is also investigating electric car share.

- The City of Seattle is poised to invest $5 million to expand bike share citywide, with an eye toward launching the first large-scale Generation 4.0 electric bike share system in the United States. The City will encourage low-income ridership with stations in low-income neighborhoods and membership subsidies.

- Seattle will make an award imminently to a street furniture vendor for the addition of bus stops and free-standing kiosks equipped with internet enabled touch-screens, ensuring access to the Mobility MarketPlace for those without smartphones.

Open Data Commitment

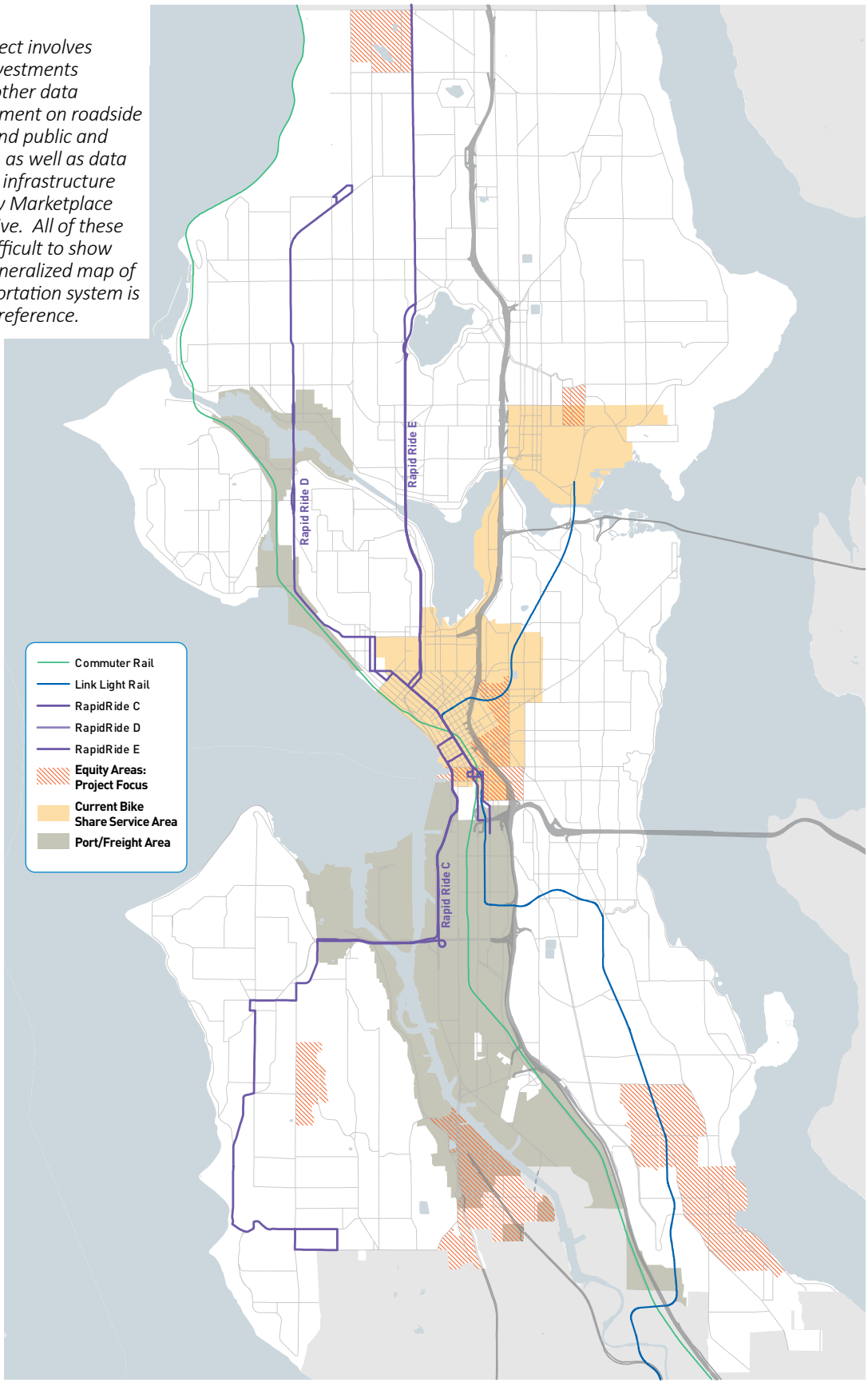
The City of Seattle has operated an enterprise geographic information system (GIS) for 20 years, while SDOT has shared transportation, parking, and other GIS data since 2010, most recently through the City's Open Data Initiative.

- **Open Data Initiative** – Since 2010, Seattle's Department of Information Technology has maintained a robust open data platform, powered by Socrata, with hundreds of data sets including parking, transportation systems, public safety, land use, and many others. In 2015, SDOT established the "Open Data and Data-Driven Reporting Special Interest Group," to collect, develop, and share open data and data-driven reporting resources. The agency has recognized open data, both internal and external, as a fundamental requirement for the sharing economy and the expansion of public-private transportation partnerships.

- **Hackathons and Public-Private Data Sharing** – Also last year, SDOT sponsored a Hack the Commute app contest that engaged over 150 volunteer participants in the use of city transportation and other data sets to build mobile apps. Similarly, the City's bike share operator makes data publicly available and has supported data challenges.

Q4: Map

The Seattle project involves myriad small investments in sensors and other data collection equipment on roadside infrastructure and public and private vehicles, as well as data communication infrastructure and the Mobility Marketplace data collaborative. All of these elements are difficult to show on a map. A generalized map of Seattle's transportation system is shown here for reference.



Q5: USDOT Vision Elements

Describe how your holistic, integrated approach aligns to the twelve USDOT vision elements described in this solicitation.

#1: Urban Automation

The data platform enables urban automation, providing public and private data in real time. We will be looking at automating the feedback mechanism from various control systems, such that the sensors and other data collection infrastructure we install will enable future automation of active systems. Real-time information about traveler decisions made via the Mobility MarketPlace will alert systems such as adaptive traffic control about expected loads to improve proactive management. Examples include pedestrian collision avoidance applications or the ability to leverage Transit Signal Priority technology to initiate crosswalk signals ahead of the bus's arrival. Simultaneously the University of Washington is investigating and is willing to demonstrate implementing Level 3 automated buses for shuttle or loop applications.

#2: Connected Vehicles

This project will add 100 arterial miles of DSRC roadside infrastructure to Metro's existing 4.9GHz Connected Vehicles network during the first year of the award. In addition to building upon this existing network, we will develop wide area wireless communications in the form of a shared regional high bandwidth, low-latency wireless network for public agency operations, allowing Metro to perform all data operations currently done at the transit base anywhere in the service area. This will allow Metro to potentially have the capability to reduce major capital investments.

#3: Intelligent, Sensor-Based Infrastructure

Through this initiative, we will collect and combine live data from operators of all modes of transportation to create and share complete, real-time knowledge of the network's performance, enabling direct and proactive management. This includes:

- On-street parking, loading zones and participating private parking facilities
- Advance notification of demand spikes from sources like ports and stadiums
- Spot location air quality conditions
- •Freight, drayage and local delivery dispatch

We will use Metro's 1,400 buses (representing 12,000 daily vehicle trips) as well as streetcars, private shared vehicles, and other vehicles, as a sensor platform to collect real-time data integral to our intelligent infrastructure, including:

- Automatic passenger counters on all buses by adding software to detect motion as people get on and off
- TSP for all buses, by adding software which takes advantage of the improved location information available through the high speed continuous connected vehicle infrastructure
- Intelligent bike racks and ADA securement
- Air quality sensors
- Video for image-aware systems
- Emergency ad-hoc communications
- Emergency power generation

These data allow us to understand the performance of the transportation system, and therefore identify and take the steps needed to optimize that performance.

#4: Urban Analytics

The data platform will be a secure shared computing and data storage platform capable of managing live data streams, real-time transportation modeling, big data analytics and long-term storage. Drawing on the real-time data collected from infrastructure, we will be able to better measure the performance of our transportation network and uniquely

provide options to users through our Mobility MarketPlace. The data that we collect will be processed and pushed to the public according to policy appropriate to each individual set of data. This will consolidate new and existing data feeds in a single location, improving response time for powering real-time decision tools. Data will be prepared and distributed through APIs created by the data owners or developed by a trusted partner in the data collaborative, at the discretion of the data owner.

#5: User-Focused Mobility Services and Choices

This Mobility MarketPlace is designed to offer travel concierge services with information about their travel options, incentives for making system-optimal decisions, and a single payment gateway that provides a seamless user experience for all public and private transportation products.

Vision Element #6: Urban Delivery and Logistics

This project will allow delivery companies to more efficiently move goods into and out of the city. With data sensors allowing for real-time information regarding the transportation network conditions, and the data collaborative processing and sharing this information, the data platform can provide dynamic routing for truck traffic and promote off-peak and overnight deliveries. It would also enable car share operators to combine passengers and packages in one trip, or to deliver packages to neighborhood freight consolidation centers – eliminating a trip for a small-parcel delivery truck. As automation offers ever-increasing options for residential package delivery, the data platform will optimize the mix of traditional deliveries, AV deliveries, or other currently experimental devices.

Vision Element #7: Strategic Business Models and Partnering Opportunities

Our team is a strong partnership of enOur team is a strong partnership of entities that will continue to work together throughout development of the Smart City project and into implementation, operations, and maintenance. With the commitment of several Seattle-located businesses, such as Microsoft, Amazon, BMW, Uber, and others, we will leverage the planned federal resources through cost sharing and in-kind donations wherever possible. The Data Collaborative model will foster new partnerships as the demands within the city continue to evolve. Please see our Appendix for letters of support gathered from our partners.

Element #8: Smart Grid, Roadway Electrification and EV's

This project will deploy smart charging infrastructure that includes piloting single payments for all charge points regardless of vendor. In addition to expediting EV adoption, this will generate usage pattern data, to further planning and operations. Separately the City will be partnering with BMW to launch electric car share; the City is pursuing an expansion of bike share incorporating electric bikes.

Vision Element #9: Connected, Involved Citizens

The data gathered throughout our transportation network will be processed and made available to the public. We will look to the citizens and businesses of Seattle to play an active role in creating new and innovative transportation services. Further, the Mobility MarketPlace provides options to all users – regardless of age, income, and access to banking accounts and smart phones. By providing subsidies for low-income residents, ensuring access to shared mobility options, emphasizing the ability for seniors to age in place by providing affordable and convenient transportation, and offering non-smartphone information outlets like panels at bus stops, we're making sure that the Smart City concept benefits and involves the entire community.

Vision Element #10: Architecture and Standards

The project will build on Metro's existing The project will build on Metro's existing architecture for connected vehicles. The Seattle region is known for being early adopters of ITS and IT standards. In particular, King County Metro drove the national definition of transit connected vehicle standards for transit signal priority. The standards were enabled by the adoption of other Seattle standards-based systems, including the public service communications systems and deployment of WSDOT's ITS stations along the transit signal priority corridors.

Vision Element #11: Low-Cost, Efficient, Secure, and Resilient Information and Communications Technology

Our project will build on Seattle's existing information and communications technology (ICT). Leveraging existing investments decreases the cost of becoming a "smart city" and improves the ROI for putting this infrastructure in place. In addition to taking advantage of the existing in-place infrastructure, our key project partners of Microsoft and UW will work to ensure that the system we develop considers privacy and security as key functions.

Vision Element #12: Smart Land Use

This project is consistent the region's efforts to reduce reliance on private vehicles, reduce the amount of land and building costs associated with vehicle storage, and better manage increasing travel demands within limited rights of way, all with the goal of creating a denser, more livable city.

Creating Measurable Impact through Technology Solutions

The Seattle Smart City concept involves combining a host of technology solutions to create a novel approach to enabling a healthy transportation ecosystem where suppliers and consumers have much closer to perfect real-time knowledge of the transportation market – and where the overall capacity of the transportation system is optimized, eliminating the need for costly physical infrastructure. Data from the Data Collaborative makes measuring impact possible. Overarching data points include reduction in traffic delays; increase in electric and automated vehicles; and reductions in single-occupancy vehicle trips, overall vehicle-miles travelled, and greenhouse gases emitted.

Q6: Risks

Identify and rate key technical, policy, and institutional risks associated with the deployment vision and discuss plans for mitigating those risks.

The table below summarizes risks descriptions and associated risk levels. A detailed discussion follows on the next pages.

Risk Description	Risk Level
Technical Risks	
Transportation provider data	High
Privacy harm from the collection and use of sensitive data	Medium
Failures of cybersecurity with sensitive data, system controls, and networked devices	Medium
Policy Risks	
Payment gateway based on ORCA	Medium
Equity	High
Institutional Risks	
Private entity participation	Medium
Slow app uptake	Low
Project delivery and interagency coordination	Low

Technical Risks

Transportation Provider Data – High Risk
Data provided for key modes may be limited or not timely enough to be able to effectively incentivize users in real time. This risk will be mitigated by building a core data set that provides coverage for the most critical parts of city (i.e., arterial corridors) and modes of transport. Data can also be purchased from different private companies to supplement the available data. Finally, multiple technology options exist and can be used to collect data (e.g., arterial performance data can be obtained from signal systems, private providers, participating TNC vehicles, or Wi-Fi/Bluetooth instrumentation).

Privacy Harm from the Collection and Use of Sensitive Data – Medium Risk
This project introduces risk related to loss of personal privacy or commercial information. Research has proven that geo-spatial data can be easily used to re-identify persons, even when no other variable is at hand. To mitigate this risk, privacy experts at the UW Tech Policy Lab will work with SDOT and its partners to adopt protocols to govern the collection, use, and distribution of data in the interest of privacy. Working within the Data Collaborative we will develop and implement policies and protocols to govern the data in the interest of subjects, incorporating technological advancements in aggregation, encryption, and authentication.

Failures of Cybersecurity with Sensitive Data, System Controls, and Networked Devices – Medium Risk
The proliferation of information and communication technologies and the rapid adoption of transport technologies with automated and networked control systems envisioned in this project raise the risk of failures in cybersecurity. Each investment has the practical effect of increasing the attack surface for cybercriminals, whose economic or political targets may include sensitive data, system controls, or networked transportation devices, as well as the people who use them. To mitigate this risk, cybersecurity experts at UW and Microsoft will work closely with public and private partners to select secure technologies, test technologies as they are deployed (e.g., penetration tests), and devise mitigating security measures. Similarly, the Data Collaborative will be operated on a platform that is trusted – a trust that is made possible by investments in the technology and organization necessary to keep the data secure.

Policy Risks

Payment Gateway Based on ORCA – Medium Risk
An upgrade of the Seattle region's unified fare payment card, ORCA, is currently in development, a process involving multiple jurisdictions and transit agencies across the region. The ORCA card is the most viable tool currently for the MarketPlace's unified payment gateway, but will depend on high levels of coordination between public entities and between public and private service providers. To mitigate this risk, all lead partners Microsoft, UW and the City are prepared to develop a payment gateway independent of ORCA as needed.

Equity – High Risk
All residents, including low-income residents, seniors, minorities, and those less comfortable with technology must benefit from this project. By linking the ORCA fare card to the Mobility MarketPlace, we have direct access to ORCA Lift, the program already in place to subsidize transit use for these communities. To further mitigate this risk, partners will employ specific efforts to engage the broad spectrum of the population: for instance, emphasizing the ability for seniors to age in place, providing subsidies for low-income residents, incentivizing private transportation providers to provide service in low-income neighborhoods, and having "smart" bus stop panels with the functionality of a smartphone. A robust public engagement process will solicit input and feedback from all members of the community, including those listed above.

Institutional Risks

Private Entity Participation – Medium Risk
As part of its project scoping, the City of Seattle has reached out to many major private companies regarding the data collaborative. All have signed letters of support based on an understanding of the project. While these companies have historically been reluctant to share their data with public entities, Seattle's project adds two things that have never been in the equation before – hugely valuable information for private operators, in the form of data on real-time system performance, and the potential to reach a large new customer base. These two proposal elements have attracted the support of the needed private partners.

Slow App Uptake – Low Risk
To mitigate the risk of slow adoption, we have taken two key steps. First, the data collaborative is designed to encourage other app developers to access the same information (and incentives) and deliver it in newer, better ways. Second, the City has created a built-in audience through its partners. The City of Seattle provides an audience of 176,000 commuters through its mandatory Commute Trip Reduction Program and the Chamber of Commerce provides an audience of 700,000 employees.

Project Delivery and Interagency Coordination – Low Risk
Although our team takes project delivery and excellence seriously and the team has a track record of successfully delivering a large number of projects with comparable size and scope (see Section 12), we have taken further steps to mitigate risk. As noted previously, we have a strong multi-agency oversight function built into our program management approach and plan to hire outside program management experts to ensure that the project is delivered across agency interests. Further, SDOT most recently developed, launched, and is administering a dynamic new system that standardizes the entirety of project management and oversight. This has woven in accountability, real-time risk mitigation..

Q7: Partners

Outline team partners, key stakeholders, and demonstration governance processes. Describe existing and future public and/or private partnerships, including university research partnerships.

Core partners include the City of Seattle, Microsoft, University of Washington, and King Country Metro. In addition to these project delivery partners, a collection of community stakeholder panels and supporters will contribute financial, technical, or other support to project.

Team Partners

The City of Seattle is renowned as a progressive leader for decades, for both technology adoption and sustainable urbanism. SDOT owns and manages transportation assets valued at over $20 billion. The agency is a direct recipient of FTA funds, operating two transit systems (monorail and streetcar) that complement regional transit services.

Microsoft, renowned for revolutionizing personal computing with an unrivaled sense of the customer experience, is breaking new ground in ubiquitous computing and advanced data analytics. Microsoft has the most far-reaching influence in the high-tech community, with the ability to integrate and channel the collective power of the complex and fragmented high-tech industry. The company holds assets of approximately $420 billion, and employs more than 112,000 workers worldwide, with more than 40,000 based in the greater Seattle region

The University of Washington is one of the world's preeminent public universities. It is ranked number #11 by the US News 2016 Best Global Universities Rankings, educating more than 54,000 students annually. The UW is the top recipient in the nation among public universities for federal research dollars and second overall among all U.S. universities, and it ranks among the top universities for technology startups. The UW is part of White House's Smart Cities Initiative Metro Lab Network.

King County Metro operates a fleet of approximately 1,900 buses on over 200 routes. Its annual ridership is over 120 million, making it the 8th largest transit agency in the country. The agency's culture is centered around innovation and providing cost-effective service to a rapidly growing urban area. Extensive descriptions of Metro and its services are included in Section 3.

Key Stakeholders and Partnerships

Public Agencies – Core partners including the City of Seattle and King County Metro, along with additional public agencies such as Sound Transit, WSDOT, and the Northwest Seaport Alliance.

Business Organizations – Challenge Seattle, an initiative hosted by the Greater Seattle Chamber of Commerce, represents a workforce of 700,000 employees – 32% of the Central Puget Sound Region's 2.1 million jobs – and is a signed partner and stakeholder.

University Students – Through our partnership with the University of Washington we will engage a range of student groups on multiple topics. The Urban@Initiative, e-Sciences Institute, and the PacTrans Student Taskforce will provide technical assistance. We will pursue relationships with the business school entrepreneur program, the School of Social Sciences, and other departments for insight and assistance to more effectively promote ladders of opportunity.

Private Transportation Providers – In addition to the market leaders already supporting this application, the project delivery partners will actively engage all current and future transportation providers working in Seattle.

Community Groups – Engaged community groups include Region 10 University Transportation Center (PacTrans), dedicated to developing data driven solutions and decision-making for safe transport in the Pacific Northwest, ITS Washington/ITE Washington Membership, Raisbeck Aviation HS Students, Connected Cars Meetup Group, Open Seattle, and Cascade Bicycle Club.

Governance Process

The City of Seattle will serve as the recipient of the federal award and will be accountable to USDOT. The City will hire outside program management experts to assist with project management. In addition, an Executive Advisory Committee (EAC) consisting of core partners will be established. The EAC will be responsible for the project oversight and will provide direction to multiple working groups as needed. The working groups will be responsible for managing the technical and implementation elements of the project and will consist of stakeholders.

Q8: Existing Infrastructure

Describe existing transportation infrastructure and system features in your city.

- **Arterial Miles** – Seattle has approximately 500 linear miles of arterial roadways.
- **Freeway Miles** – Seattle has 102 linear miles of interstate and state highways.

Transit Services

Major public transit infrastructure within the city includes:

- Amtrak passenger rail station- located downtown with 604,832 passengers in 2014
- 4 commuter rail stations
- 15 light rail stations, with 2 more opening in 2016
- Downtown Seattle Transit Tunnel – The only bimodal (bus/rail) tunnel in the world with 5 stations located under downtown. Cumulative weekday daily ridership exceeds 60,000.
- 3 multi-modal transportation hubs in the Center City

- **Shared Mobility Services** – More than a half-dozen car share companies operate in the city including Car2Go, ZipCar, RelayRides, FlightCar, SideCar, Lyft, and Uber. Car2go has been operating in Seattle for two years and has 750 vehicles. The City is likewise investigating electric car-share.
- **Information and Communication Technology (ICT)** – King County Metro has approximately 100 miles of fiber communication, and the City of Seattle has 150 miles.

Intelligent Transortation Systems

In addition to daily traffic volumes, ITS help SDOT respond to about 25 daily incidents that affect traffic and 100 monthly major events or road closures.

- 200 Traffic cameras
- 34 Dynamic message signs (DMS)
- 12 corridors with travel times on the Dynamic Message Signs
- Travel times posted online for the 12 corridors and entire downtown
- Congestion monitoring posted online for 10 more corridors
- 250 Access points
- 220 Transit real-time information signs
- 14 e-Park facility real-time signs
- 8 parking DMS
- 200 Transit signal priority intersections
- 1,100 traffic signals, including 6 corridors where the signals respond to traffic volumes
- Travelers web site* (iPhone app, Twitter feed**)

* http://web6.seattle.gov/travelers/

** https://twitter.com/SeattleDOT

Q9: Data

Define the data your city currently collects. Describe how these data...may be used to further address city challenges. Describe how transportation data could integrate with other functions or services in a city .... Describe any existing policies and identify their sources.

Currently Collected Data

Data Type	Information Collected
by City of Seattle	
Freeway travel conditions (provided by WSDOT)	Speed/travel time, volume, lane density, tolling data
Arterial travel conditions	Speed/travel time, volume, lane occupancy
Special Events	Date, time, location, expected attendance
Traffic Incidents	Both arterial and freeway, via SDOT/WSDOT traffic operations centers and via Seattle Police Department and Washington State Patrol
Weather	Via roadway weather information sites and National Weather Service and other services
Bike Share	Trip number, trip length, distance, time of day, origin/destination, unique users
Parking	Inventory, transactions, real-time garage activity
Commute Trip Reduction	Mode split, employer participation
Bridge	Bridge open/close time stamp
by King County Metro	
Vehicles	Annual passenger trips, on-time performance, schedule adherence, annual miles, fare collection data, smart card transaction, smart card origins and destinations, transfer locations, transfer time distributions, vehicle service hours, safety incidents, Metro ferry data

New Data Collection and Uses to Address City Challenges

Data collection, which is central to this project, will enable a new wave of transportation decision-making tools for cities and citizens alike. With today's advanced data modeling tools, we have the ability to connect complex big data systems in ways the human brain simply can't compute. The data will exponentially increase the City's understanding of travel demand, geographically and temporally, allowing the City to optimize the flow of people and goods across all modes by delivering real-time information and incentives to users. Likewise, the information can be used as real-time operational inputs to signal system operation for transit deployment, routing and traffic management, to assist with bike share and car share rebalancing, and for transportation network companies. This project will add equipment throughout the city to collect and use data as follows:

Location	Equipment Added	Data to be Collected	Uses of Data to Address Challenges
Parking Spaces (includes commercial parking zones)	Cameras, mobile license plate system, DMS, guidance system	Real-time availability of parking spaces	Users can select best parking option without circling for parking. City can more accurately set prices according to demand. Enforcement is simplified leading to improved compliance
	Rate/pricing engine	Real-time price (Seattle has dynamic pricing)	Mobility MarketPlace will recommend alternatives to driving when parking is scarce or expensive. Users will incorporate pricing into their travel decisions

Location	Equipment Added	Data to be Collected	Uses of Data to Address Challenges
	M-LPR system cameras	Real-time availability of commercial (truck load/ unload) spaces	Facilitates more efficient deliveries Minimizes double parking
Buses, Light Rail and Commuter Rail	Software & improved communications	Improved location tracking of vehicles	Allows real-time arrival updates for customers; supports maintenance and operations
	Software	Real time availability of capacity/ passengers on board	Improves customer decision-making
	Sensors	Real time availability of bike racks	Improves customer decision-making
	Sensors	Real time availability of space for ADA customers	Improves customer decision-making
	Software	Improved on/off boardings by stop	For planning, operations and system management.
	Software & improved communications	Multi-modal trip fare payment	Allows integration of transportation services (public and private)
(On bus ROW)	Cameras	Live video coverag	Improves safety, provides data for maintenance , congestion management and enforcement
	Sensors	Air quality	Incorporated into MarketPlace's incentive algorithm to influence behavior
Public Fleet Vehicles (Incident response, maintenance, public safety)	Sensors	Location tracking/ Incident and emergency response resource availability, AVL (automatic vehicle location)	Ability to efficiently respond to incidents and emergencies quickly and in a coordinated fashion
TNC's/Shared vehicles	Sensors	Traffic speeds	An improvement on fixed right-of-way sensors, this data provides traffic information on the majority of streets in real time
	Sensors	Vehicle location	Improves user decision-making
Traffic Signals and Arterial Detectors	Sensors	Traffic volume, queue length, traffic speed, travel times, congestion locations, current signal phase condition and timing	Combined information will allow signals to adjust to meet real-time conditions
Public Right of Way	Counters	Pedestrian/bike volumes and movements	Supports planning efforts for future projects and pedestrian/bike operational enhancement
Electric Vehicle Supply Equipment (Chargers)	N/A- Built in	Usage data	More informed decisions about where to locate charging stations across the city.
	Sensors	Charger availability	Ability to locate, and potentially reserve, charging spaces
Street Lights	Sensors	Presence of vehicles/ people Air quality monitors	Ability to saves electricity turning on only when vehicles or people approach, as appropriate. Ability to monitor air quality.

Data integration for improved transportation options

The data collection and communication infrastructure installed as part of this project is intended to ignite and support future public and private sector services. Travelers will be able to make mode and schedule decisions based on real-time information and pricing, leading to decisions that are aligned to support the health of the transportation system and public good. Existing trip planning products can incorporate the payment gateway and/or incentives and then push them out to their customers, magnifying the overall impact.

Smart Freight – Optimization of goods movement is as important as the optimization of people movement. The data platform can provide dynamic routing for truck traffic, and promote off-peak and overnight deliveries. It would also enable car share operators to combine passengers and packages in one trip, or to deliver packages to neighborhood freight consolidation centers – eliminating a trip for a small-parcel delivery truck.

In addition to improvements to package delivery, cooperation with the Northwest Seaport Alliance can reduce drayage truck queues at the Alliance's Seattle Harbor container terminals. This in turn reduces truck idling and related greenhouse gas emissions, while providing an opportunity for truck drivers and drayage firms to increase productivity by avoiding busy terminals.

Mobility as a Service – By providing a payment gateway and consolidated transportation data, it is anticipated that the private sector will create "Mobility as a Service" packages in which they allow users to pay a subscription fee for a package of transportation services by different providers.

Operations – In order to effectively manage a multi-faceted transportation system in a city, it is imperative to have the right information about the current state of the system as a whole – across publically- and privately-owned transportation methods. The data collaborative will enable service providers and industry researchers to create better tools for city operators that connect transportation assets across public and private providers. This will lower the cost of operation innovation, and shorten time to market for such services.

Technical Architecture

Communications Networks – Vehicles, infrastructure, centers and travelers will be connected by an open Ethernet/IP network communications architecture using multiple technologies. The network architecture will be based on established standards and designed for continuous expansion, improvement, and evolution. The communications infrastructure will include a regional high-bandwidth wireless network and 5.9GHz DSRC deployed on Metro's RapidRide BRT corridors. These wireless components will be backed by the partner agencies' extensive fiber optic network and built infrastructure. All local public agencies and select private transportation fleets will have access to the network.

Trusted Data Platform – Connecting data across public and private parties has tremendous potential for unlocking next generation technologies. It also comes with significant risk. Before we unlock the potential of these multi-party data collaboratives, we must develop a policy and trust framework for this collaboration to take place in a way that is safe for the public and for individual users.

Parties interested in contributing or utilizing data within the Data Collaborative have the ability to do so under a policy appropriate for a specific user or organization. The Data Collaborative will support real-time advanced analytics and modeling, making the data enticing not just to private sector transportation providers, but to researchers and government agencies alike. The intent is to provide a trusted environment for these public-private collaborations to take place, enabling connected, multi-modal, transportation applications to be built and delivered to the ecosystem without sacrificing security or testing personal privacy.

The Data Collaborative will be operated by a non-governmental, disinterested third party, and advised by a Board of Directors comprised of representatives from participating government agencies and private sector partners. Both public and private sector users will fund the operating costs of the collaborative through a subscription to use the data and services. Once established, a single data collaborative can serve as the foundation for connected services across all agencies in a city or region. It is not limited to the transportation sector. Furthermore, after

testing this model in Seattle, the trust framework, policy, and architecture can be replicated across other cities with minimal technical effort. The City of Seattle is well positioned to establish the first instance of this environment in partnership with Microsoft and extensive support from the University of Washington's Tech Policy Lab and eSciences Institute.

Data Collaborative Secure Asset and Access Management – Security, policy, and governance are top priorities to which we intend to dedicate significant attention. Microsoft has developed an architecture called the Trusted Data Platform that will be the foundation of this development.

The Trusted Data Platform enables the cross-functional sharing of data and assets between public and private entities without compromising security requirements at any level. This infrastructure is designed to manage highly classified secure data as well as publicly developed open data. Access to data is controlled by a series of gatekeepers that enforce policy on behalf of the data owner. In the case of sensitive, government-owned, classified data, the data owner may elect to trust a data science consultancy to, for example, develop a learning model to better understand traveler behavior. The University of Washington eScience Institute will serve as such a consultancy for researchers, non-profits, and commercial sponsors who need support working with large, noisy, and heterogeneous transportation data. Once that learning model is developed with a single trusted partner, classified data is no longer required in order to utilize the output of the model in various services. Those data models can then be made available to a broader set of users based on a different set of policies.

The computing environment provided at each stage of the workflow will draw upon appropriate data management and analytics services provided by commercial cloud vendors. In all cases, the approach is to "bring the computation to the data" rather than "bring the data to the computation": models are assumed to be developed, trained, and deployed within the protected (and scalable) computing environment.

This workflow is essential as many of the challenges facing transportation are solved only when we collaborate across the broad variety of services users rely on for mobility. The Trusted Data Platform provides a framework in order to establish trust across parties under a controlled set of policies.

Policies

The existing data we collect is all consistent with all laws and policies related to retention, public records and privacy. At this point, the data we propose to collect as part of this proposal is similar in nature to that which is currently collected. We plan to continue complying with the same laws and policies and will assess in the development phase any new policies that may become applicable.

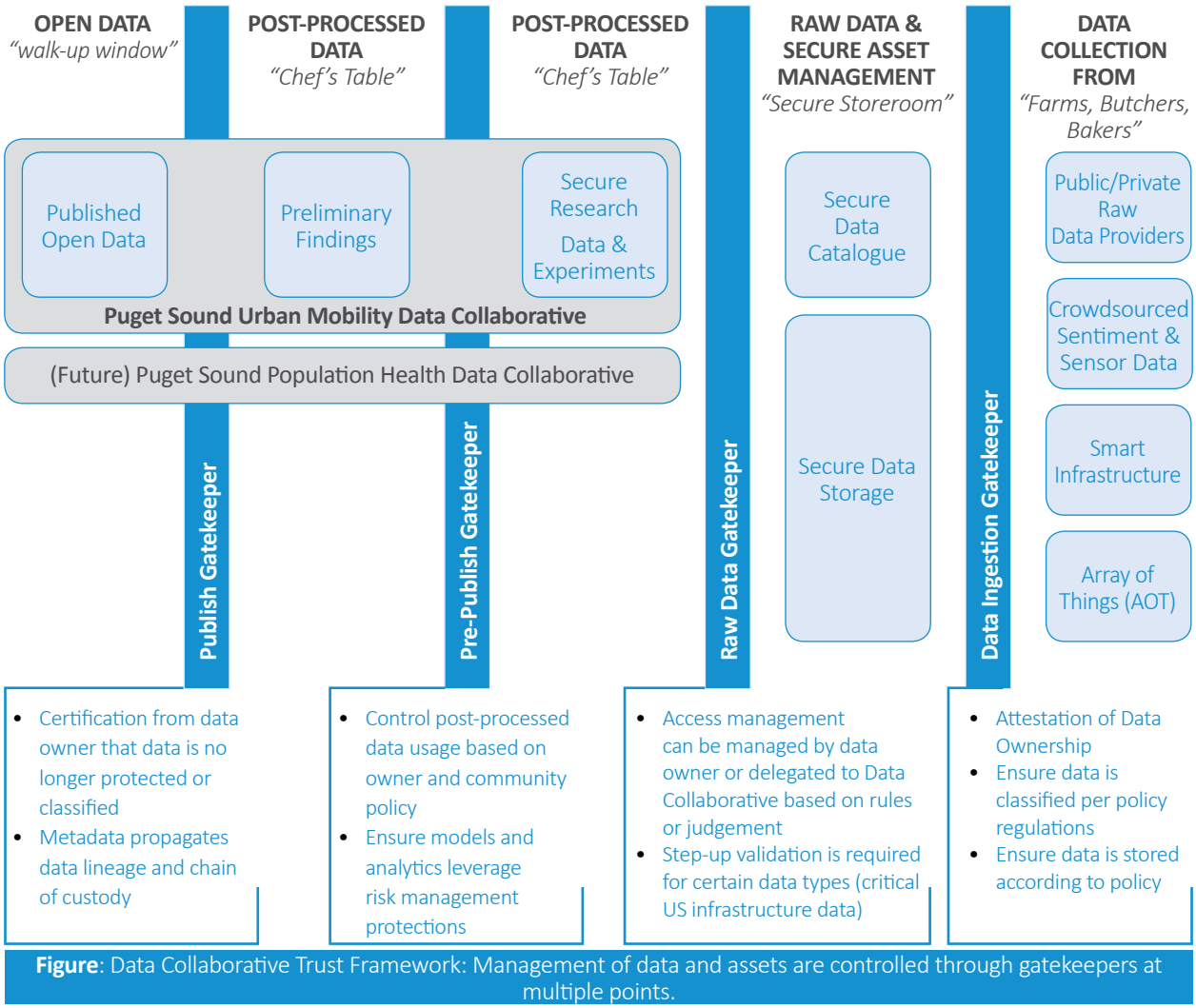


Figure: Data Collaborative Trust Framework: Management of data and assets are controlled through gatekeepers at multiple points.

Q10: Standards

Describe your approach for using existing standards, architectures, and certification processes?

The Seattle region is known for being early adopters of ITS and IT standards. In particular, King County Metro drove the definition of transit connected vehicle standards for transit signal priority. The standards were enabled by the adoption of other Seattle standards-based systems including the public service communications systems and deployment of WSDOT's ITS stations along transit signal priority corridors. For the transit signal priority corridors to be effective, the underlying communications infrastructure could not be deployed without comprehensive, multi-agency communication architecture and cooperative agreements. Moreover, complex projects in general would not be possible without coordination through the regional ITS architecture update process. These processes and coordination relationships are already in place in the city. Several of the Seattle team members have developed project and enterprise architecture models for complex systems such as the Smart City Challenge. The processes in place are evolutionary, not static. The architectures are living documents, capturing changes, lessons learned, best practices, and performance criteria for project implementation. This process is inherent in each agency's project portfolio management process.

With respect to interacting and feeding lessons learned back to standards organizations, many of the key King County IT and Metro staff participate in ITS standard development activities. Our private sector partners are leaders in standard development activities, including participation on the ISO Technical Committee 204 on ITS, which is responsible for a harmonized connected vehicle suite of standards. Others on the team are members of the SAE and IEEE connected vehicle and communications standards groups who are promulgating Internet of Things, Communications (DSRC), Big Data and Connected Vehicle standards, all of which will be critical in deploying a consistent set of standards for this challenge.

Q11: Measureable Goals & Objectives

Provide measurable goals and objectives for your vision and describe your approach for monitoring the impact of the demonstration.

Our Seattle Smart City project has the following established goals:

- Enhance user mobility options and safety through the collection, dispersion, and distillation of comprehensive transportation data
- Achieve positive social, economic and environmental outcomes by optimizing use of the various modes and vehicles
- Create an environment that is replicable in other cities across America

Through the sensors and other sources of data that feed into our Data Collaborative, we'll be able to monitor usage of every transportation mode that participates.

In Phase II, we will conduct a full analysis and quantify the goals and metrics. **Some specific metrics are outlined in the following tables.**

Performance Metrics by Goals & Objectives
Reduction in drive-alone trips
• Drive-alone trips reduced (including single-occupancy transportation network company vehicles)
Reduction in travel time
• Total travel time reduced • Congestion-related delay reduced • Disruptions minimized
Reduction in crashes
• Total crashes reduced • Serious-injury and fatal crashes reduced
Travel experience
• Reliability of services • Traveler satisfaction/customer satisfaction
Reduction in peak period private vehicle travel demand
• Private drive-alone trips reduced in peak hour • Private drive-alone trips reduced in peak quarter hour
Reduction in greenhouse gas emissions
• Pounds of C02 reduced
Adoption of electric vehicles
• Percentage of new car sales

Performance Metrics by Goals & Objectives
Increase in transit ridership and improved transit rider experience
• Productivity • Ridership • Service quality • Safety and security
Data contribution and usage
• Number of partners contributing data to the Data Collaborative • Data accessed by users in the Data Collaborative • Data Models and APIs created by Partners • Number of trips influenced by Mobility Marketplace
Integration of public and private transportation operators
• Percent of private transportation operators participating • Number of multi-modal trips paid for via MarketPlace • Time savings gained from use of private sector alternatives
MarketPlace adoption
• Users accepting incentives • Trips optimized by mode/time

Q12: Capacity

Provide evidence that establishes your capacity to take on a project of this magnitude.

The City of Seattle and its partners are fully equipped and enthusiastic to take on the Smart City Challenge. From executive leadership to infrastructure readiness, the city is well-positioned to provide a replicable model for highly successful Smart City projects.

Capacity for Large Projects – The City of Seattle has recently managed a series of large, high-profile projects, many including federal funding. Examples include the Mercer Corridor Reconstruction Project completed in 2015 ($150M), the Spokane Street Viaduct Expansion completed in 2012 ($163M), and the South Lake Union Streetcar completed in 2007 ($53M).

Executive Commitment – Seattle's Mayor, Ed Murray, and King County Metro GM, Kevin Desmond, are dedicated proponents of urban innovation and firmly behind the Seattle Smart Cities initiative. They are joined by Governor Jay Inslee, the Port of Seattle's CEO Ted Fick, Northwest Seaport Alliance CEO John Wolfe , and many others who have submitted letters of support.

Workforce Capacity – Seattle's project delivery approach recognizes that a robust and truly visionary Smart City project will not be fully delivered by agency staff. Contracted services will play a significant role in the partners' timely project implementation, and Seattle is fortunate to have one of the country's largest and most vibrant tech communities at its disposal. No city in the US boasts a better environment to immediately acquire and train top tech talent.

Infrastructure Readiness – Seattle and its partners own and operate approximately 250 miles of fiber. This allows full functionality of the project's DSRC and data collection components immediately upon installation.

Management Capabilities – Since 2013, SDOT has developed and fine-tuned an asset management plan that supports state-of-the-art business practices in financial management, risk management, and triple-bottom-line decision-making. Additionally, the City will be hiring outside project management experts to assist.

Q13: Leverage Funding

Describe any opportunities to leverage Federal resources through cost share, in-kind donations, and partnering.

Each of the project partners has made significant investments, and continues to invest heavily, in smart city projects. A few of the most significant and far-reaching investments supporting this USDOT Smart Cities project include:

- **Microsoft Trusted Data Platform** – Microsoft is establishing a next-generation model of public-private data collaborative, using the USDOT-funded collaborative as a template for emergency response, utilities, and numerous other public-service domains. The Data Collaborative that is established by this Smart City project is expected to become a template for trust frameworks that enable public-private collaboration in all government or public service sectors.

- **Seattle Transportation electrification initiative** – This initiative is working to electrify a significant portion of the city fleet by 2027 and accelerate the adoption of electric vehicles and other electrified transportation options across the City – including transit, car share, corporate fleets, and more.

- **SDOT Bus Rapid Transit program** – SDOT is investing $63 million for extensive improvements to the city's frequent transit service network, part of bringing 10- to12-minute transit service to 72% of Seattle's population by 2025 (increased from 26% in 2015).

- **King County Metro vehicle electrification progra**m – Metro currently has underway a software-based transit signal priority system and an existing integrated onboard platform that will host the new sensors. Likewise the region has underway an upgrade to the ORCA unified payment system.

The City and its partners seek to continue their pioneering, groundbreaking approach to Smart City solutions and thriving urban environments. Extensive previous investments, coupled with a perfectly timed infusion of Smart City Challenge funding, will open the door for a newly sustainable transportation ecosystem. In close collaboration with USDOT and the national Smart City Community, the City of Seattle is prepared to become the recognized, replicable model for Smart City projects throughout the nation.

Smart Seattle

A Prototype for the New Century's Digital City

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