

PORTLAND'S SMART CITIES EVOLUTION

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INTRODUCTION

Smart Cities is not a term that was coined by the City of Portland or any other city or community. Rumor is the origin lies in the private sector. It's been criticized as a marketing term created by companies anticipating a billion-dollar market in civic technology. Perhaps because of its cloudy provenance, there is no standard Smart Cities definition despite lots of discussions about standards. Generally, people may know it has something to do with data and technology, perhaps they have heard of the Internet of Things (IoT) or have read popular media articles about the rise of the autonomous vehicle. It is not always a beloved term by cities (we are not "dumb" now), nor is it necessarily seen as a term that identifies strategies or goals that many communities were not already pursuing.

The City of Portland's understanding of Smart Cities has been evolving through our experiences of the past few years. Today, Portland defines Smart Cities as the efficient use of existing and innovative technologies, data collection and management tools to enhance community engagement and bring public benefits through improved services. Central in any smart city project should be the attainment of at least one of our City goals: to achieve digital equity; improve mobility; have greater affordability; facilitate climate change mitigation and adaptation; improve community health and safety; encourage workforce development; or improve disaster preparedness and resiliency. We also want to enhance the ability of the City and our wider community to transform data into knowledge to inform our decision-making. We also seek new economic and civic technology opportunities. But the fundamental goal of City of Portland Smart Cities projects is simply to make people's lives better.

Eastbound bridgehead connecting the Tilikum Crossing, Bridge of the People, to greenways and bike routes. Portland's newest bridge carries pedestrians, cyclists, TriMet's Max Orange line trains, buses, and streetcars over the Willamette River but not passenger vehicles

The City of Portland has invested in a regional approach to Smart Cities planning, working closely with Portland State University, our local transit agency (TriMet), our regional metropolitan planning organization (Metro), and the State Oregon Department of Transportation (ODOT). We have also built out an internal Smart Cities governance structure to facilitate projects across the City's bureaus and ensure collaborative work with university researchers, the local technology community, and the public. The City has been able to leverage the collection of ideas under the Smart Cities umbrella to develop an integrative and comprehensive approach to innovation, one that successfully navigates Portland's unique commission form of government¹.

INITIAL SMART CITIES EFFORTS

PRE US DOT SMART CITY CHALLENGE

Beginning in 2014, a small group of City staff, Portland State University (PSU) faculty and researchers, staff from the Technology Association of Oregon (TAO), and representatives from the private sector began meeting to identify potential efforts that fell under the Smart Cities umbrella. These project ideas were rooted in how data and technology could be used to improve quality of life.

This initial Portland Smart Cities working group was made up of City representatives with expertise in transportation, planning and sustainability, TAO and other private sector representatives specializing in regional technology businesses and transportation infrastructure, and PSU researchers from computer science, urban planning, environmental science and transportation engineering. Opportunities to join several emerging national Smart Cities initiatives were seized. Portland formed a team to work on a Smart City technology project, referred to as Action Clusters in the Global Cities Team Challenge (GCTC) program led by the National Institute of Standards and Technology (NIST) and the non-profit US Ignite. PSU and the City of Portland were also founding members of the MetroLab Network, a group of city/university partnerships around technology and data. These initiatives were key to helping Portland build our understanding of Smart Cities, develop initial project ideas, connect to other cities and communities, and advance our vision for what Smart Cities means in our community. Portland's participation in these national programs continues today.

UB MOBILE PDX

Then in December 2015 the US Department of Transportation (US DOT) Smart City Challenge was announced. It invited proposals from mid-sized cities in a winner-takes-all competition, with the winner getting a \$50 million grant to implement a smart transportation system. Emails flew, meetings and phone calls were scheduled, webinars watched, and a team was assembled to craft a pre-proposal in two months' time. The effort was led by the Portland Bureau of Transportation (PBOT). The City of Portland, like other cities, was able to base

¹ The commission form of government in the City of Portland means that its members have legislative, administrative, and quasi-judicial powers which differs from most other municipal governments among large cities in the United States. The City has six elected officials comprised of the Mayor, four Commissioners, and the Auditor. The City Council is made up of the Mayor and the Commissioners who also serve as administrators of City departments. See this article for more details: <https://www.portland-oregon.gov/auditor/article/9178>

its proposal on existing long-term and short-term plans for our transportation vision, plans that were rooted in many months of community engagement. Because the City was participating in several Smart Cities groups and national networks, we also had a list of potential pilot ideas and partnerships that had been discussed, ideas that were in search of funding. These were projects that we knew we could run with.

Becoming a finalist US DOT Smart City Challenge was announced in an exciting fashion in March 2016, with Portland's Mayor attending the South by Southwest conference in Austin with the other finalist Mayors and US DOT leaders. We thought there would only be five other cities to compete with, but the pool was increased to seven because of the quality of the proposals and the difficulty in narrowing it down further. With funding to dedicate to the full proposal and exciting partnerships to explore, the challenge began. The next four months were full of writing, draft deadlines, vendor meetings, teleconferences, searches for matching funds, and ensuring time for community and stakeholder engagement.

Our "UB Mobile PDX" proposal ultimately focused on increasing access to transportation choices and connecting mobility and infrastructure investments across the City, therefore bringing better, cheaper and more accessible mobility options to our underserved communities. A key objective was to connect the close-in "Portlandia" neighborhoods with East Portland, an area home to some of Portland's most diverse and economically-vulnerable communities, which had not had the same level of attention and investment over the past several decades.

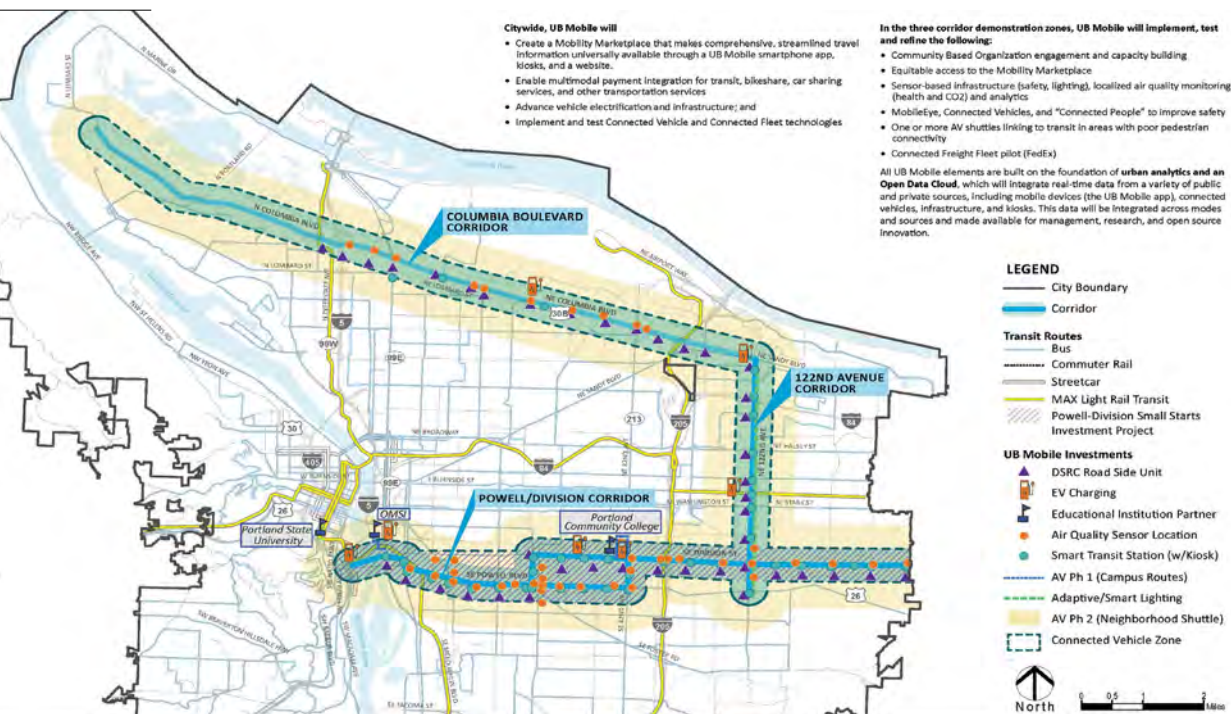


Figure 1: Annotated site map from the City of Portland's US DOT Smart City Challenge proposal, UB Mobile PDX, focused on increasing access to, connectivity, and equity in mobility across the City in three key corridors

UB Mobile PDX included both citywide components as well as the research and testing of Smart Cities technologies in three Portland corridors: Powell/Division in Southeast/East Portland, 122nd Avenue in East Portland, and Columbia Boulevard in North Portland (see Figure 1). The initiative is built on the foundation of a centralized data management and analytics structure, the “Open Data Cloud” (see Figure 2).

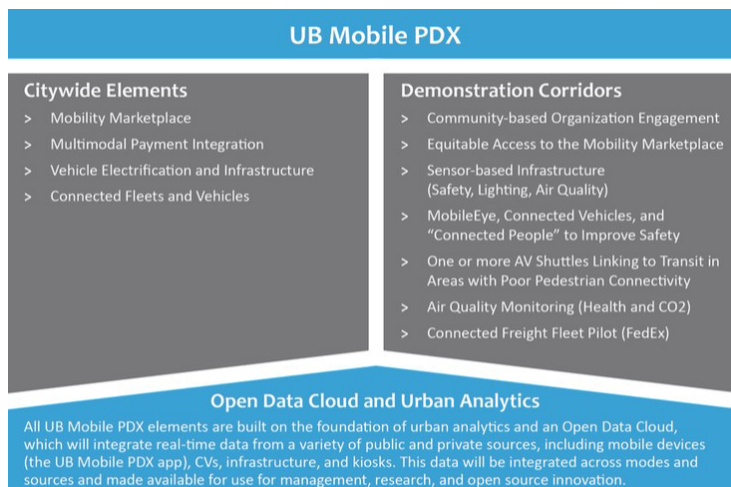


Figure 2: Elements of the City of Portland’s US DOT Smart City Challenge proposal, UB Mobile PDX

We headed into June 2016 with lots of excitement in the air and confidence in the UB Mobile PDX proposal. Then at the end of the month we learned that Columbus, Ohio was selected as the final city and US DOT Smart City Challenge winner. Columbus put together a fantastic presentation and innovative approach to their transportation and community health challenges. Our initial reaction of course included disappointment, but there was also a recognition of the great collaborations and coordination that had been built through the proposal process. The US DOT Challenge and UB Mobile PDX proposal built an incredible team that brought a variety of public agencies, universities, private-sector companies and community-based organizations together at the same table. We decided to dust ourselves off and build on this momentum.

POST US DOT SMART CITY CHALLENGE

The ending of the US DOT Smart City Challenge did not mean the end of moving forward with Smart City projects and plans at the City of Portland. The intensity and pace of meetings with potential project partners, vendors, and the pitches from various technology providers also did not wane. As we continued to evaluate projects over the next eight months, it became clear that we were in a reactive state, allowing vendors to lead the conversation. We needed to become proactive and coordinated to lead with our goals as a City. We needed to ensure that public benefits are the foundation for all of our Smart Cities efforts.

Additionally, there was some scratching of heads regarding how we could broaden our Smart Cities projects beyond transportation. We had an established strong pillar in transportation, but also recognized the potential for public benefits in emergency management, addressing the digital divide, improved community engagement and government performance evaluation. We also knew we needed to learn how these improved data management and smart technologies could be used to help improve access to housing and address issues for those that are houseless; one of our largest challenges and a challenge that many other cities are facing.

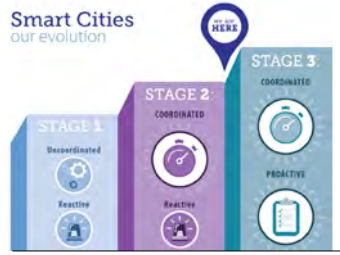


Figure 3: City of Portland's Smart Cities evolution as of June 2017

SHAPING OUR SMART CITIES PROGRAM

SMART CITIES GOVERNANCE STRUCTURE

To address the hurdles discussed above, the City of Portland designed and adopted a new Smart Cities governance structure, beginning with the formation of a Smart Cities Steering Committee (SCSC) (see Figure 4). The SCSC is led by the Bureau of Planning and Sustainability (BPS) on behalf of the Mayor's Office, and coordinated by BPS, PBOT, Bureau of Technology Services (BTS), and the Office for Community Technology (OCT). Formalizing a citywide structure around our Smart Cities work created mechanisms for improved internal and external collaboration, clarifies roles among City leadership and bureaus, and helps us to identify priority focus areas and goals. Coordination also allows us to better leverage resources between bureaus and projects and gain additional help to make projects or funding applications more successful.

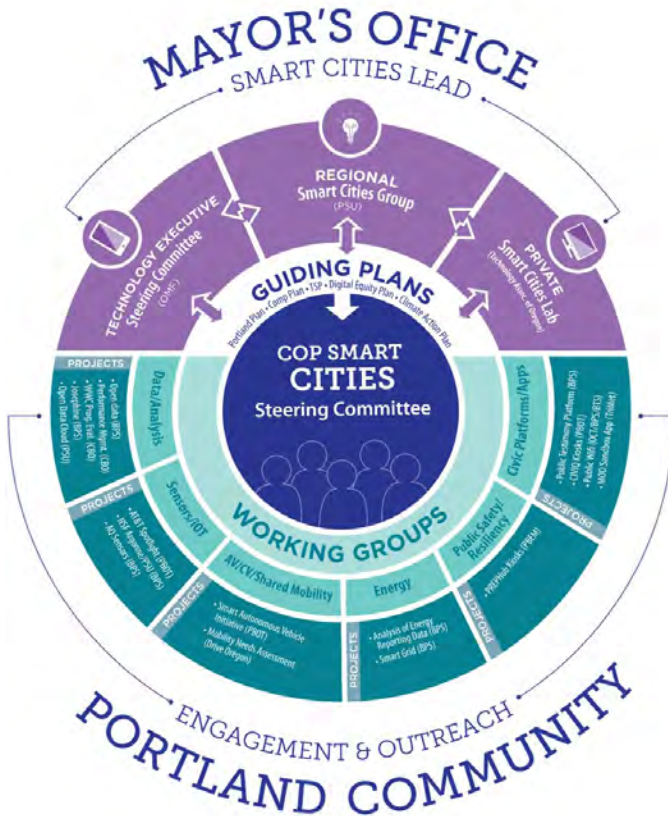


Figure 4: City of Portland's Smart Cities Governance Structure showing a formalized citywide structure for Smart Cities work with mechanisms for internal and external collaboration and identification of priority focus areas and goals

The design and adoption of this structure took several months of work and strategic development and culminated with the formal Resolution No. 37290 adopted by Portland City Council in June 2017. Working through the SCSC allows us to speak with one voice and make sure our central priorities of equity, resiliency, and affordability are evident in Portland's Smart Cities projects. In our upcoming fiscal year budget, we also have dedicated staffing in BPS for Smart Cities priorities which combined with this governance structure builds a foundation for a prudent, proactive and sustainable approach to Smart Cities opportunities.

REGIONAL ACTION PLAN

In parallel to the City of Portland Smart Cities governance structure is an active Portland Regional Smart Cities Committee led by Portland State University. This committee is working to build a comprehensive, long-term vision for the entire region. The committee includes representatives from the City, Metro, TriMet, ODOT, Port of Portland, and non-profit mobility and community-focused organizations like Forthⁱⁱ and OPALⁱⁱⁱ. This group was able to capitalize on the momentum created in the US DOT Smart City Challenge to get organized and bring together funding to develop a Regional Smart Cities Action Plan to advance Smart Cities in the Portland Metro region.

The Regional Action Plan currently being drafted, incorporates interviews from all participating agencies, assesses existing regional projects and creates guiding principles and criteria for evaluating the desirability and feasibility of future projects. The plan will include three 2-year actions based on identified early wins, current resources available, and an assessment of most urgent needs in the Portland region. Expected outcomes also include the creation of a foundation for the expansion of Smart Cities initiatives to benefit needs beyond mobility and transportation, an important issue identified by City of Portland. The Action Plan and regional group will work together on priority initiatives related to carbon-emissions reduction through transportation-related improvements and look at other sectors to address climate change and resiliency through data and technology.

OPEN DATA POLICY AND PROGRAM

In May 2017, Portland City Council enthusiastically adopted an Open Data Ordinance (No. 1883562) to establish an Open Data Policy and Open Data Program for the City of Portland. This action built upon earlier efforts from a 2009 Resolution (No. 367353), led by the City's Bureau of Technology Services (BTS), when Portland became the first city in the United States to declare its commitment to Open Data and to develop an Open Data portal, CivicApps^{iv}. Establishing an Open Data Policy and Program is a critical step to support our Smart Cities efforts to create shared, standardized systems for collecting, managing, analyzing, and distributing data. Below are the five summary goals for City of Portland's Open Data Policy and Program:

1. Increase transparency and improve public trust;
2. Build civic participation and engagement;

ⁱⁱ Forth is a non-profit organization with a mission to advance electric, smart, and shared transportation through innovation, demonstration projects, advocacy, and engagement.

ⁱⁱⁱ OPAL Environmental Justice Oregon is a non-profit organization with a mission to build power for environmental justice and civil rights in communities. OPAL stands for Organizing People/Activating Leaders.

^{iv} <http://civicapps.org/>

3. Improve access to data to inform and improve decision making;
4. Reduce staff time devoted to responding to requests for City data;
5. Grow the likelihood of data-driven innovations in the private sector that increase the social and commercial value of City assets and improve the delivery of City services.

Developing and passing the Open Data Ordinance was a collaborative partnership between BPS, the City Budget Office (CBO), and technical experts from the Center for Government Excellence at Johns Hopkins University and the Sunlight Foundation. These technical partners were a result of the City's partnership with Bloomberg Philanthropies' What Works Cities (WWC) initiative^v. Over the next year, the City of Portland will continue to work in these collaborative partnerships to coordinate a data governance committee across all bureaus and build the implementation plan for a data governance system and Open Data Policy.

ATTACHMENTS AND USE OF CITY-OWNED INFRASTRUCTURE IN THE RIGHT OF WAY

The number of applications for attachments to, and uses of, city-owned infrastructure in the public right of way (ROW) is growing rapidly with no slow-down in sight. For example, the deployment of autonomous and connected vehicle communication will necessitate the installation of new hardware along roadways. In addition, the City and community have a growing interest in distributed, connected sensors for higher density, real-time measurements of infrastructure utilization and environmental variables to help aid data driven decision making. These devices – plus the ones individuals carry around in their pockets or use in their vehicles – largely communicate through the same cellular, wireless networks. To support this growing usage and increase cellular network capacity beyond what can be supplied by traditional cell towers, mobile carriers need to deploy small cell sites^{vi} in high densities across urban areas.

A working group with representatives from PBOT, BPS, OCT, and the City Attorney's Office was assembled quickly in the spring of 2017 to develop a strategic framework for how to manage attachments and city-owned poles in the ROW. Opportunities, issues, and key considerations for the current technology applications were identified along with key steps for a policy review, physical systems review, and needs assessment. We also looked at similar efforts by other cities. This information was used to shape the development of protocols with specifications and requirements and to create an equitable strategic framework that can meet these fast-growing technology demands of public infrastructure while continuing to manage the right-of-way for the greatest public benefit.

SMART AUTONOMOUS VEHICLES INITIATIVE

Autonomous vehicles (AVs) is another example of a coming technology that requires a new look at city policies, so that cities can be participating partners in their deployment while also ensuring the technology applications meets the goals and vision informed by the public. AVs have the potential to bring positive impacts, such as more flexible transportation options that address some

^v See "Finding Out What's Working in America and Beyond", Simone Brody, ISOCARP Review 12, pages 109 – 115, September 2013.

^{vi} Note that the name "small cells" can be deceiving as it does not describe the size of the hardware that needs to be attached to poles, street lights, or signal lights, which can be significant. "Small" describes the shorter range of these stations.

of the issues related to unequal access to affordable transportation outside of Portland’s inner core. But there is also a high risk for negative impacts if cities are not proactive in our response to AVs, such as increased vehicle miles travelled (VMT), worsening congestion, reduced transit ridership, and privatization of public transit.

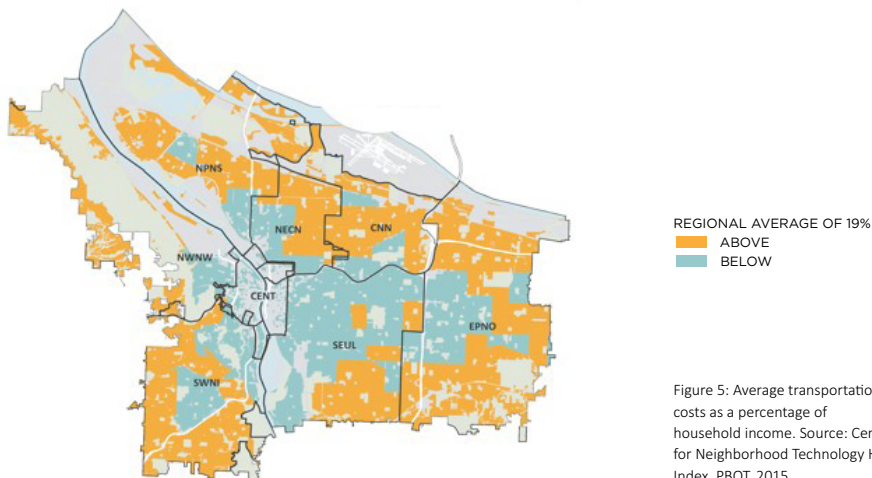


Figure 5: Average transportation costs as a percentage of household income. Source: Center for Neighborhood Technology H-T Index, PBOT, 2015

In April of 2017, the Portland Bureau of Transportation launched a Smart Autonomous Vehicles Initiative (SAVI) through City of Portland Resolution No. 372964. The purpose of SAVI is to develop best practices for the testing of AVs, and to create AV policies that spur innovation, advance the City’s Vision Zero goals to eliminate traffic deaths by 2025, reduce congestion, significantly decrease CO2 and other transportation pollutants, and make travel more affordable for Portland’s low and moderate-income residents. The ultimate goal of SAVI is to maximize the public benefits of AVs to Portland residents and businesses, and to minimize the risks and potentially negative outcomes of this new technology.

There are three main components to SAVI. The first component is an adopted Autonomous Vehicle Policy. With SAVI, the City introduced the concept of “FAVES” – fleet-owned fully-autonomous vehicles that are electric and shared. Prioritizing FAVES will be the foundation of the City’s draft policy. Tools such as congestion pricing and road use fees are also being considered as part of the AV policy.

The second component is a Request for Information (RFI) to gather information from AV and other technology providers regarding a potential pilot of AVs in the City of Portland. The pilot would be informed by and operate within the framework of our draft Autonomous Vehicle Policy.

The third component of SAVI is community outreach and engagement around AVs to identify where and what type of potential pilot systems would deliver the most benefits to the community. A goal from the outset is to focus on underserved communities in Portland and to use AVs to address the issue of mobility choice inequity, which has resulted from a focus on the private vehicle as the primary means of transportation. AVs are likely to be a disruptive technology that could give cities the opportunity to correct past mistakes, to move away from privately-owned, single-occupancy vehicles, and

to develop a system of mobility that better meets the needs of all Portlanders, including the most vulnerable. The City of Portland seeks to fully engage our community in shaping the next generation of our transportation system.

Portland recognizes that AVs alone are not a Smart City technology. It is the opportunity that AVs present for cities to change and improve our transportation systems and to better meet the mobility needs of our residents – to help us meet our transportation, land use, equity and other city goals – that makes AVs a Smart Cities technology. The critical need is for proactive policies to steer this coming technology to address our City goals and the needs of our residents.

LIVING LABORATORY

The City of Portland is currently developing a portfolio of projects with diverse partners to pilot new technology applications and Internet of Things (IoT) systems. To truly create a living laboratory, we will need to create understanding and trust with the public to enable some technologies to be tested out through responsible pilots. The overall goal of these projects is to improve the available data for informed decision making by City engineers, planners, and the public. The uses for such collected data are currently focused on informing traffic safety, improving emergency management and communication, enabling assessments of public health and equity, advancing Portland’s Climate Action Plan goals, and creating economic and civic engagement opportunities.

OPEN DATA CLOUD

Using new data sets from distributed sensors to meet City goals will require



Figure 6: The pillars of data management, documented and standardized data access, and urban analytics for the City of Portland and Portland State University Open Data Cloud and Analytics Pilot

efficient data integration, analysis, and improved management. A collaboration between the Bureau of Planning and Sustainability and Portland State University has produced the concept of an “Open Data Cloud”, which recently received funding for an initial pilot.

The Open Data Cloud Pilot project will collect, store, and integrate Smart Cities related data from a variety of sources including new sensor deployments, autonomous and connected vehicle pilots, and existing City internal

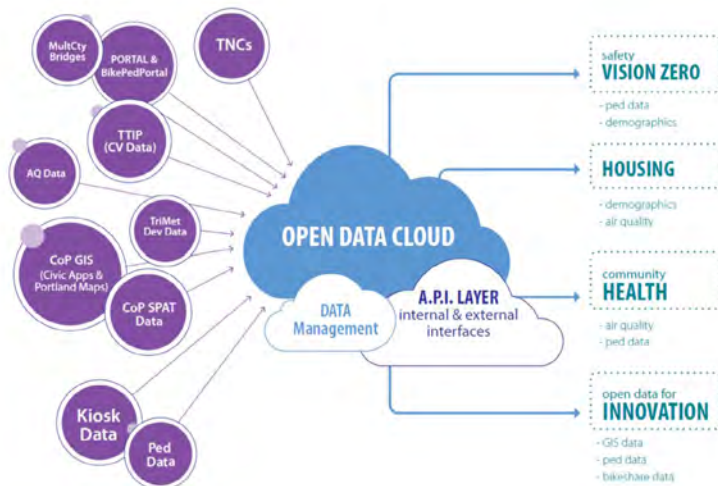


Figure 7: Conceptual Open Data Cloud architecture

data sets and regional data sources. The integrated data platform will provide standardized access to these data sources for public sector agencies and local innovators, while respecting privacy and security needs and developing data user agreements. A key step in this process is documentation of the metadata for each data set including quality control/quality assurance methods, any other data cleaning methods, other notes about aggregation, etc. The documentation step combined with standardized access is key to helping make the data useable by a variety of end users. Additionally, the pilot will focus on developing data standards and an automated data integration process.

ROADWAY URBAN INSTRUMENTATION

Two urban instrumentation projects will begin deployment in the next 6 months. The first is a multi-vendor, low-cost, climate and air quality sensor pilot funded by a Replicable Smart Cities Technologies Cooperative (RSCT) grant from the National Institute of Standards and Technology (NIST). This project will deploy 9 sensors total: 3 Argonne National Laboratory/University of Chicago Array of Things nodes; 3 SenSevere RAMP devices; and, 3 Apis SensorCell nodes. Each device will take 5-minute mean measurements of carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO₂), and ozone (O₃) gas concentrations, temperature, and relative humidity. The RAMP devices will also measure carbon dioxide (CO₂) and the Array of Things nodes will also measure particulate matter with diameters < 2.5µm (PM_{2.5}).

Figure 8: Images of the three climate and air quality sensor devices to be deployed in the City of Portland. From left to right, Argonne National Laboratory/ University of Chicago's Array of Things node, Apis SensorCell node, SenSevere RAMP device



The air quality devices will be deployed in three phases beginning with a laboratory deployment at PSU to compare the sensor measurements with known concentrations of pollutants. Next, the devices will be deployed at the Oregon's Department of Environmental Quality (DEQ) urban background monitoring site to co-locate the sensors with each other, and with reference instruments used for regulatory purposes, to assess their accuracy. During the final deployment, the validated sensors will be placed on the roadway at three different signalized intersections where one sensor device from each vendor will be deployed (3 unique sensors per intersection) and co-located with City operated Curbside Labs for Emissions and Atmospheric Research (CLEAR) cabinets for two of the intersections. The CLEAR cabinets house some reference air quality instruments in repurposed traffic signal cabinets with special air sampling inlets and reference meteorological instruments deployed to the traffic signal pole and mast. This sensor project also involves the development of sensor recycling guidelines with the Green Electronics Council (GEC). We are working to draft guidelines for how to improve the ability to recycle IoT electronics, minimize electronics waste and maximize the ability to repurpose



Figure 9: The City of Portland Curbside Lab for Emissions and Atmospheric Research cabinet on the right at the intersection of SE 122nd Ave and SE Division St. The traffic signal cabinet operating the signals and decorated with community art is on the left



Figure 10: The traffic signal pole and mast arm equipped with a 3D sonic anemometer for wind speed and direction, temperature and relative humidity probe, and cameras and radar for traffic counts on the SW corner of the intersection of SE 122nd Ave and SE Division St.

or upgrade electronics through city and community procurement guidelines.

The second potential sensor deployment, coming online over the next year, is a pilot collaboration with AT&T, GE, and Intel to install approximately 200 CityIQ Nodes on street light fixtures along high crash corridors. This pilot will test computer vision algorithms in the nodes to collect pedestrian counts and direction as well as traffic counts, speed, direction, and lane use. Pedestrian counts are rarely collected in real-time or across the length of major corridors. Such data have been identified by planners, engineers, and researchers as key to addressing both the City of Portland's Vision Zero traffic safety goals and to identify locations of where pedestrian infrastructure investments are needed. This project will also rely on collaborations with PSU and cross-bureau partnerships between PBOT and BPS to help design node orientations and deployment setups, validate data collected, manage data collected and develop methods to aggregate and query data across the corridors. Research partnerships will allow for further use case exploration, such as building pedestrian activity models, so that we can potentially apply what we learn in this pilot to other non-instrumented intersections.

SMART RESILIENCY

BPS and the Portland Bureau of Emergency Management (PBEM) are also partnering with the Massachusetts Institute of Technology (MIT), Portland State University and Portland General Electric (PGE) to pilot an innovative kiosk-based infrastructure designed to increase disaster resilience. PREPHub, the name for this technology, was developed by the Urban Risk Lab at MIT as part of an ongoing research project exploring ways to integrate disaster preparedness and response technologies into public infrastructure to facilitate community resilience. PREPHubs, which are able to operate without power for several days during and after a disaster, are strategically placed in visible, public gathering spaces, and will include free public WiFi. Because of their locations they both serve a function during a disaster and act as a reminder for the Portland community to build preparedness into their everyday lives. PREPHubs are designed to engage the community during normal times, so residents are familiar with the PREPHub and its location if there is a disaster.



Figure 11: An example of the PREPHub disaster resiliency kiosk

This pilot project will deploy PREPHubs in several designated post-disaster gathering sites^{vii} that exist in Portland. Community engagement is core to the PREPHub project, so various Portland communities will be involved with the development and design of the pilot units, including what functionality and information is provided. PREPHub is still a research project, so we are helping develop and pilot the prototypes.

WHERE TO NEXT

Smart Cities projects provide a framework to help the City of Portland implement technology and data-related projects on our continued pathway to enhance Portland's livability and be a sustainable, equitable, and resilient City. Organizing and managing our data is key to looking at the city as an integrated system as well as being transparent. Comprehensive, coordinated policies and projects will be necessary to meet our goals to provide public benefits and leverage resources efficiently. Data analysis and analytics will help us continually evaluate our policies and projects to help us make better decisions and thus maximize public benefits.

Broadening the scope of Smart City projects beyond transportation is an important need identified by the City and region. The collaborative smart cities governance structure will be key in coordinating new projects and conducting a use case inventory across all City Bureaus. Access to affordable housing, emergency management infrastructure and communications, energy efficiency, and green infrastructure are future Smart City project topic areas identified from initial meetings. For any type of project, improved community engagement such as using online tools or technology in the roadway to submit public feedback or learn about City services is an important direction as we move forward. Bridging the digital divide with increased access to technology is also another target area we hope to transform with future Smart Cities projects.

Taking the time to assess the achievements and the challenges related to our recent Smart Cities efforts allowed us to re-focus and formalize a centralized approach that is applicable for Portland. Sharing with our community and making sure Portland's Smart Cities project are understandable by our public and incorporating feedback are essential next steps as we move forward and aim for our planned trajectories on City goals around digital equity, improved mobility, greater affordability, sustainability, community health and safety, workforce development and resiliency.

^{vii} A post-disaster gathering place, also called BEECN sites, are designated locations in Portland to go to after a major earthquake to seek emergency assistance and report severe damage or injuries if phone services are down. BEECN sites will be staffed with pre-designated City employees, Neighborhood Emergency Team (NET) members or other volunteers trained to operate emergency radio equipment and provide information on food, water, shelter and other supplies. To learn more about the BEECN program run by the Portland Bureau of Emergency Management, see: <https://www.portlandoregon.gov/pbem/59630?>

References

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