

September 2015



# BUILDING A SMART + EQUITABLE CITY

# CONTENTS

## **04** SMART BUILDINGS + INFRASTRUCTURE

Smart Indoor Lighting

Wireless Water Meters

## **08** SMART TRANSPORT + MOBILITY

Responsive Traffic Management

Traffic Signal Prioritization

## **12** SMART ENERGY + ENVIRONMENT

Smart Waste Management

Water Quality Monitoring

## **16** SMART PUBLIC HEALTH + SAFETY

Air Quality Monitoring

Real-time Gunshot Detection

## **20** SMART GOVERNMENT + COMMUNITY

Snow Plow Tracking

24/7 Service Requests



## INTRODUCTION

“Technology is critical to New York’s place as a 21st Century city. Not just because tech brings lots of investment and jobs—but because successful cities have always thrived on the disruption new technology brings.”

— Mayor Bill de Blasio, Internet Week New York, May 2014



In April 2015, Mayor de Blasio announced the release of “One New York: The Plan for a Strong and Just City,” a comprehensive plan for a sustainable and resilient city for all New Yorkers that addresses the profound social, economic, and environmental challenges ahead.

The plan — available online at [nyc.gov/onenyc](http://nyc.gov/onenyc) — sets out a comprehensive blueprint for preparing New York City for the future. We envision a city with a dynamic, thriving economy that is also a responsible steward of the environment and is resilient against shocks both natural and manmade.

Equity is an explicit guiding principle in our work—a lens through which we view all of our planning, policymaking, and governing. Equity means we ensure that every New Yorker has equal access to opportunities to reach his or her full potential and to succeed.

Now more than ever, digital technology and the exponential growth of data are transforming every aspect of the economy, communications, politics, and individual and family life. The implications are profound for every sector of society—including government. The City must respond to these changes and use new digital tools to improve services and create more opportunities for all New Yorkers.

This publication from the Mayor’s Office of Technology and Innovation represents the first in a series of informational resources about New York City’s efforts to leverage new technologies to build a smart and equitable city. It includes ten case studies of current initiatives from a total of seven City agencies.

These efforts demonstrate the diversity of ways that connected technologies can help improve government services and better the lives of all New Yorkers and communities across the five boroughs.

## SMART BUILDINGS + INFRASTRUCTURE

Infrastructure connects people, neighborhoods, and businesses, and provides essential services—the water we drink, the gas we need to cook, the electricity that lights homes and businesses, and the Internet access to communicate and learn. New York City is committed to developing and maintaining world-class buildings and infrastructure that enhances the delivery of public services and supports the City's economic growth, sustainability, and resiliency.

## New York City Department of Citywide Administrative Services

# SMART INDOOR LIGHTING

The introduction of smart lighting solutions into New York City's buildings is saving the City millions of dollars in energy expenses while reducing greenhouse gas emissions.

The introduction of smart lighting solutions into New York City's buildings is saving the City millions of dollars in energy expenses while reducing greenhouse gas emissions.

New York City spends roughly \$600 million per year on electricity for its agencies and public institutions. In order to help decrease New York City's energy bill and reduce greenhouse gas emissions, the Department of Citywide Administrative Services (DCAS) initiated an innovative program to identify and fund cost-effective energy saving projects in City agencies. To date, the Accelerated Conservation and Efficiency (ACE) program has led to over 110 energy saving projects across 18 city agencies, valued at nearly \$291 million.

As part of the ACE program, a number of agencies have installed smart lighting solutions in their buildings, including LED upgrades and advanced lighting controls. For instance, the New York City Fire Department (FDNY) secured ACE funding to install LED lighting in 86 firehouses and FDNY offices across the five boroughs. FDNY facilities have the potential for significant

energy savings because of their 24/7 operations. LED lighting offers a number of benefits including low maintenance costs, high longevity as well as higher quality lighting.

To date, FDNY has completed LED lighting retrofits in 37 facilities; reducing energy use by an estimated 3 million kilowatt-hours (kWh) and eliminating greenhouse gas emissions by approximately 520 metric tons of carbon dioxide equivalent annually. These completed projects are estimated to yield avoided electricity costs of over \$400,000 per year. By 2017, FDNY will complete the remaining lighting projects, which are expected to save the city an additional \$480,000 per year and eliminate greenhouse gas emissions by over 600 metric tons of carbon dioxide equivalent annually.

The DCAS ACE program, in partnership with City agencies, has catalyzed energy efficiency improvement projects in over 600 buildings. All ACE projects combined are estimated to save the City \$43 million every year moving forward, while reducing greenhouse gas emissions by approximately 107,750 metric tons of carbon dioxide equivalent.

## New York City Department of Environmental Protection

# WIRELESS WATER METERS

New York City's automated water meter reading system is one of the largest IoT deployments in the City. Since 2009, it has saved residents tens of millions of dollars by connecting them to water usage data online.

Each day, over 1 billion gallons of clean, fresh water is distributed to the city's 8.5 million residents. In order to efficiently manage this level of water consumption, New York City's Department of Environmental Protection (DEP) has installed the world's largest advanced Automated Meter Reading (AMR) system.

New York City's AMR system consists of 817,000 individual water meters distributed throughout the five boroughs. Each meter is connected to a low-power radio transmitter that sends regular water readings to rooftop receivers over a dedicated frequency. The receivers then transmit that data to a Network Operations Center (NOC) using a secure citywide telecommunications network. In order to provide the most accurate and up-to-date information, the readings are sent four times daily for small account holders and on an hourly basis for large account holders.

All the data received by the NOC is automatically analyzed and used for billing and presentation to customers. The customers, ranging from individual homeowners

to large apartment complex managers, can then view their water usage data and pay their bills online.

New York City's AMR system has precipitated a range of direct and indirect benefits to the City and its water users. The City saved over \$3 million per year simply by eliminating the need for manual meter readings. The initiative has also vastly improved the level of customer service provided to residents. Previously, inadequate meter readings required DEP to estimate up to 17% of bills. The new AMR technology reduced that rate to 3% within three years of the system's installation. Furthermore, due to more accurate water consumption data, customer billing disputes have dropped by 56%.

In 2011, DEP introduced the Leak Notification program, which notifies registered customers of possible water leaks. This program has already saved 88,000 registrants an estimated \$73 million dollars.

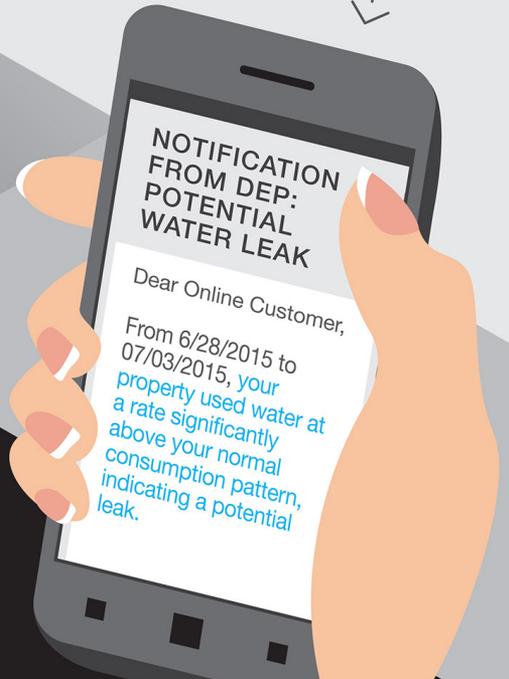
1

Individual water meters are connected to radio transmitters that send automated water readings to DEP.



2

DEP sends leak detection email alerts to customers to help them save money.



## SMART TRANSPORT + MOBILITY

Every day, New York City's public transit, roadways and bike paths enable millions of New Yorkers to get to work and school, access services, and enjoy city life. New York City is committed to maintaining a reliable, safe, sustainable, and accessible transportation network that meets the needs of all New Yorkers and supports the city's growing economy. To this end, New York City is working to expand and improve transport and mobility options to ensure 90 percent of New Yorkers can reach at least 200,000 jobs by transit within 45 minutes

New York City Department of Transportation

## RESPONSIVE TRAFFIC MANAGEMENT

Through its Midtown in Motion program, New York City is using real-time traffic information to reduce congestion, improve the flow of traffic, and decrease carbon emissions.

New York City has 6,000 miles of streets which are used by more than 5,000 public buses, 13,000 yellow taxis, 60,000 for-hire vehicles, and millions of commuters daily. In order to ease the congestion created by these vehicles, the Department of Transportation (DOT) established Midtown in Motion, a smart city approach to traffic management.

Midtown in Motion is a technology-enabled traffic management system that uses real-time traffic information from a variety of sources to monitor and respond to various traffic conditions. The system incorporates microwave sensors, traffic video cameras and EZPass readers to gather traffic flow information.

All of this information is transmitted wirelessly to DOT's Traffic Management Center (TMC) over a secure City-operated network. Engineers at the TMC use that information to quickly identify congestion issues as they arise and adjust signal timing. This enables DOT to unplug bottlenecks in real-time, easing the flow of traffic through the City.

Initially encompassing a 110-square block area in Manhattan, Midtown

in Motion was able to improve travel times by 10% within its first year of operation. That success led DOT officials to increase the program's service area to 270 blocks in 2012, and they are now replicating the Midtown in Motion concept in Flushing, Queens.

In addition to improving the movement of vehicles through the City, responsive traffic management also helps the environment. As vehicles idle in traffic, they emit a range of greenhouse gases and particulate matter associated with air pollution. Midtown in Motion mitigates this effect by reducing vehicle idle times, helping to keep New York City's air clean.

## New York City Department of Transportation + Metropolitan Transportation Authority

# TRAFFIC SIGNAL PRIORITY

New York City has improved the daily bus commute for millions of New Yorkers by equipping City buses and traffic lights with real-time sensors that prioritize bus transit through signalized intersections.

New York City operates more than 5,700 public buses that carry around 2.5 million passengers every weekday on a network with 12,860 signalized intersections. In order to keep those passengers moving, the City's Department of Transportation (DOT) and the Metropolitan Transportation Authority (MTA) introduced Transit Signal Priority (TSP), an urban traffic management system that improves the efficiency and dependability of bus mass transit.

A bus equipped with the in-vehicle TSP system requests priority service as it approaches an intersection and can change the normal signal operation to improve the flow of bus traffic. TSP will provide the equipped bus with either an "early green" (red truncation) or a "green extension" (extends the green time), ensuring the bus's expeditious passage through the intersection.

The TSP system currently uses GPS and location-based traffic control software built into the buses and traffic controllers which communicate with each other via DOT's Traffic Management Center (TMC) using the City's secure wireless network (NYCWIN).

After successful pilot tests in 2008 along bus routes in Staten Island and the Bronx, the program was extended to Manhattan along a corridor used by the Select Bus Service. Technological advances in the ensuing years reduced the cost of the system's adoption, prompting further expansion of the technology to more of the City's bus routes.

Since the introduction of TSP, transit bus delays have been reduced by nearly 20%. Reduced delays and speedy passage through intersections assist in making the bus an attractive alternative to single-occupancy vehicle commuting. The improved reliability of the City's bus service has particularly positive impact on the millions of New Yorkers who rely on the bus network for their daily commutes.

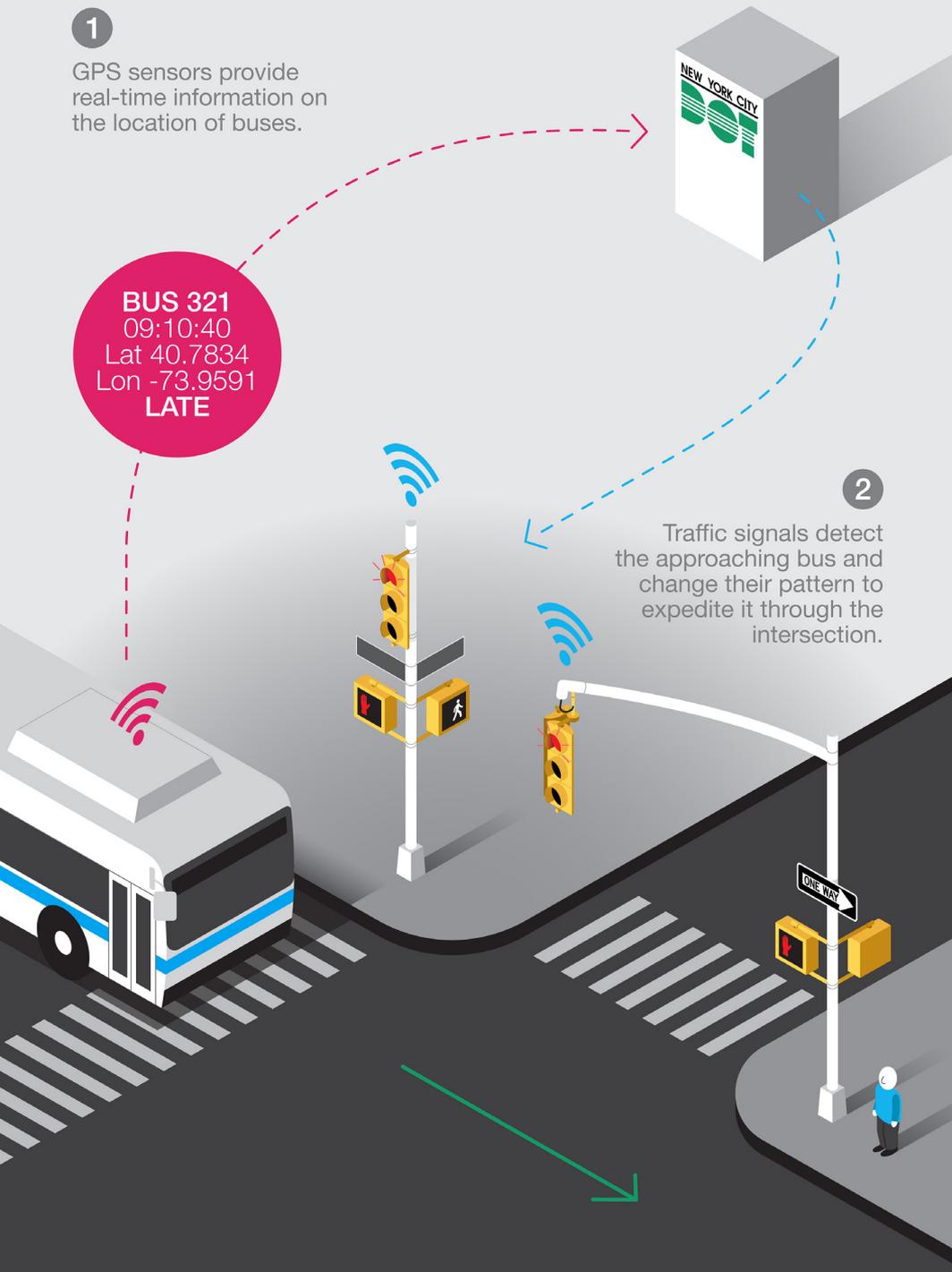
1

GPS sensors provide real-time information on the location of buses.

**BUS 321**  
09:10:40  
Lat 40.7834  
Lon -73.9591  
**LATE**

2

Traffic signals detect the approaching bus and change their pattern to expedite it through the intersection.



## SMART ENERGY + ENVIRONMENT

New York City is committed to being the most sustainable big city in the world and a global leader in the fight against climate change. Towards this goal, New York City will reduce greenhouse gas emissions by 80 percent by 2050 relative to 2005 levels and reduce risks of storm water flooding in affected communities.

## NYC Department of Small Business Services + Department of Sanitation

# SMART WASTE MANAGEMENT

New York City is improving the collection of garbage and recyclables and reducing the city's carbon footprint with the introduction of new smart waste and recycling systems with integrated real-time sensors and compaction.

New York City is home to the world's largest sanitation department, collecting more than 10,500 tons of residential and institutional garbage and 1,760 tons of recyclables every day. NYC businesses generate another 13,000 tons of garbage daily, which is collected by private carting companies. This garbage — particularly in commercial districts — makes its way through public trash and recycling receptacles. The amount of garbage in these receptacles can vary dramatically from hour-to-hour or day-to-day depending on a variety of factors including pedestrian traffic, special events and weather, so it can be challenging to define an efficient pick-up schedule that can prevent overflowing trash bins. In partnership with the city's Department of Small Business Services and Business Improvement Districts (BIDs), New York City is changing this equation with the introduction of smart trash cans.

A number of waste management companies have developed and piloted smart trashcans on public and private property across the five boroughs. The BigBelly, the most widely deployed smart waste and recycling system in New York,

uses integrated wireless sensors to detect trash level, alerting sanitation services to empty the bin at the appropriate time. The unit can also store five times more waste than the ordinary public garbage bin thanks to solar-powered compaction. Successful pilots with BigBelly in New York City precipitated a partnership with the Downtown Alliance to install nearly 200 units in lower Manhattan. In total, BigBelly has now deployed nearly 700 smart waste and recycling systems citywide.

Smart waste and recycling systems provide multiple benefits. Sanitation service providers can plan their routes according to what bins need emptying, rather than simply sticking to a preset schedule, saving time. BigBelly estimates that their solution improves waste collection efficiency by 50% to 80%. More efficient garbage collection also means trucks cover shorter distances and idle less, greatly reducing the amount of greenhouse gases and air pollution they produce.

## New York City Department of Environmental Protection

# WATER QUALITY MONITORING

New York City has some of the best water in the country, and the quality of that water is maintained through constant real-time monitoring at its source.

New York City's water supply is the largest unfiltered water supply system in the country. The city's water comes from 19 reservoirs and three controlled lakes in a watershed extending up to 125 miles away, with a combined storage capacity of 580 billion gallons of water. New York City uses over 1 billion gallons of fresh water every day which flows into the city via almost 7,000 miles of pipes and aqueducts. In order to monitor all this water, the Department of Environmental Protection (DEP) has deployed an extensive network of remote monitoring sensors.

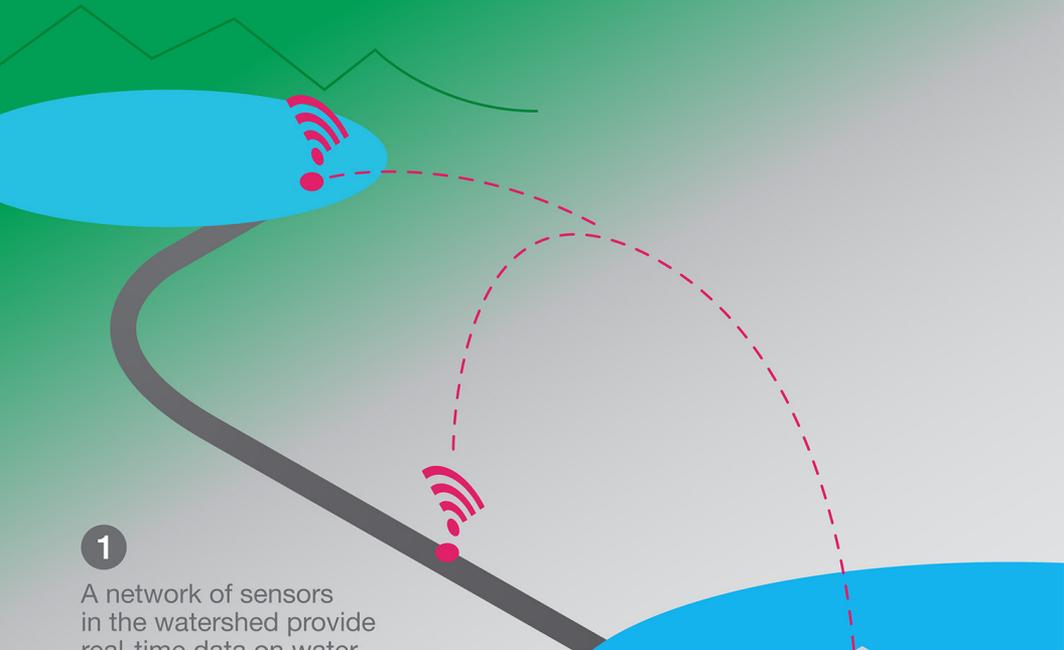
First initiated in 1995, DEP's Water Quality Early Warning Remote Monitoring System is comprised of over 40 active monitoring stations placed throughout the city and watershed. In 2011, the program was expanded to include a Robotic Monitoring Network in the watershed, providing an additional 20 monitoring stations. The sensor units are each equipped with cellular connectivity and they autonomously transmit water data to the DEP operations centers, providing real-time data on water quality and supply. The data from

all of the units is automatically amalgamated and analyzed, alerting operations staff to any anomalies.

The sensors provide real-time, 24/7 information about the city's water supply, alerting DEP to possible water quality issues before water reaches a tap in New York. To further support water quality in NYC, DEP also collects and analyzes over 2,500 water samples every month from 967 water sampling stations spread throughout the City. DEP's water monitoring system is a critical aspect of the city's operations.

Some of DEP's water quality monitoring sensors are also set up to automatically notify the City Health Department and 311 service in the event of a contamination, allowing multiple agencies to swiftly coordinate a response. Connecting New York City to real-time information about its watershed ensures that New Yorkers can continue to enjoy clean and safe water enjoy clean and safe water.

1



A network of sensors in the watershed provide real-time data on water quality and supply.

The diagram shows a blue lake at the top left with a red wireless signal icon. A dashed red line connects it to a second red wireless signal icon on a grey pipe. Another dashed red line connects this second icon to a white control box on the right. The control box has a red arrow pointing down to it and is labeled 'NYC Environmental Protection'. A worker in a yellow vest stands next to the box. The pipe continues from the box to a tap in the foreground, which is dripping a blue drop of water. A person in a green shirt stands below the tap, looking at a smartphone. In the background, there are grey 3D blocks representing buildings.

2

Operations staff are alerted to any anomalies.

3

The city can remedy the situation long before the water reaches a tap.

## SMART PUBLIC HEALTH + SAFETY

New York City is committed to being the safest large U.S. city and ensuring every New Yorker has the opportunity to live a long and healthy life. This means accepting no traffic fatalities on New York City streets, providing residents with access to the physical and mental healthcare services that they need, promoting an active and healthy lifestyle, and having a criminal justice system that leads the nation in fairness and efficiency.

## New York City Department of Health and Mental Hygiene

# AIR QUALITY MONITORING

New York City's air quality is improving faster than that of most other big U.S. cities thanks the City's data-driven air quality management practices.

Air pollution is a major cause of illness and death in the urban environment, especially among the elderly, very young, and other vulnerable residents. To inform New York City's effort to reduce the pollutants in its air, the Department of Health and Mental Hygiene (DOHMH) conducts regular air quality surveys measuring fine particulates, nitrogen oxides, sulfur dioxide, elemental carbon, and ozone levels.

DOHMH has been conducting The New York City Community Air Survey since 2008. This survey, done in conjunction with the City University of New York's Queens College, is the largest urban air monitoring program in the US. Surveyors place sophisticated air monitoring equipment at 75 sites around the city for a period of two weeks in each season. They then collect, analyze, and publish this data on DOHMH's website.

To complement the annual air quality survey, DOHMH is field testing eight air quality monitors throughout the city that can report data in real-time. Each monitor will be able to measure the concentration of fine particulate

matter in its vicinity and report that reading every 15 minutes.

NYC has used data from the Community Air Survey to introduce regulations targeting major local pollution sources. For example, building heating systems often burned less expensive types of heating oil which release large amounts of sulfur dioxide and soot particles. In 2010, 10,000 buildings using this oil, just 1% of all buildings in the city, created more air pollution than all of the vehicles using the city's streets and highways. The effects on air quality were quantified by the Community Air Survey, prompting City regulations to reduce and eventually ban the use of the most polluting heating oils.

Sulfur dioxide levels have now fallen 69% since the surveys were first initiated. DOHMH makes this and other community environmental data available in a user-friendly Environment and Health Data Portal on their website.

## New York City Police Department

# REAL-TIME GUNSHOT DETECTION

New York City's urban public safety data collection system, the largest in the country, has been further enhanced with state-of-the-art real-time acoustic gunshot monitoring equipment.

The New York City Police Department (NYPD) operates the largest urban public safety and security data collection and processing system in the United States. The Domain Awareness System (DAS) incorporates thousands of NYPD video feeds, license plate readers, radiation and chemical sensors and 911 reports into a centralized clearinghouse. It also integrates data feeds from various City agencies and from some private and commercial buildings.

In order to enhance the DAS and improve gunshot incident response times, NYPD introduced technology that provides the agency with real-time acoustic gunshot detection. First tested as a demonstration project in the Bronx and Brooklyn in the spring of 2015, a gunshot detection system called ShotSpotter has now been integrated into the City's DAS.

The system consists of hundreds of rooftop mounted sensors, each programmed to detect the acoustic fingerprint of a gunshot. Three sensors must identify the gunshot, and using

these recordings, the shot can be located to within 25 meters of its location. The signals are routed to ShotSpotter's headquarters for validation before sending an alert through the DAS that notifies NYPD within a minute of the shot's firing.

It is estimated that 75% of the shots captured by ShotSpotter nationwide are not otherwise reported to the police. Automated gunshot detection monitoring is therefore a valuable tool for deterring and responding to crime when witnesses fail to dial 911. DAS operators that receive gunshot alerts are able to view that information alongside concurrent 911 reports and video feeds from the incident area, providing them with a clearer picture of the situation on the ground.

NYPD is currently working with the DAS software developer to allow police officers to access the application on their smartphones while in the field which will provide them with a full suite of valuable situational awareness information in real-time.

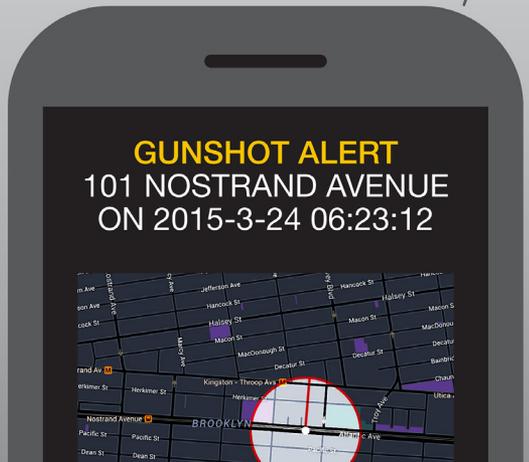
1

Sensors detect and triangulate the location of gunshots, immediately alerting the NYPD.



2

Officers will be able to view the alert – along with video feeds, the location, and 911 reports – and respond.



## SMART GOVERNMENT + COMMUNITY

Technology plays a critical role in improving service delivery and increasing civic engagement. New York City is committed to expanding two-way digital communication and engagement with the public using tools like [nyc.gov](http://nyc.gov), as well as non-government platforms and products. Every New Yorker should have access to high quality, community-based City resources that enable residents to thrive.

## New York City Department of Sanitation

# SNOW PLOW TRACKING

New York City uses high-tech GPS equipment and geographic information software to provide its residents with real-time web-based snow plow tracking information during the winter months.

New York City receives around two feet of snow every winter. In 2010, however, a major snowstorm dropped over two feet of snow across the city in a single day, the sixth largest snowfall on record. The snow brought public transportation to a halt, stranding subway and bus passengers for hours and blocking many roads across the city. While the Department of Sanitation (DSNY) continued to operate throughout the storm, many people wondered if or when their streets would be plowed.

In response, DSNY developed a new tool called PlowNYC, a public-facing web app that allows city residents to monitor snow removal progress in real time. To quickly operationalize PlowNYC, DSNY installed GPS-enabled flip-phones into the agency's hundreds of snow removal vehicles — a low tech but high impact solution. The phones' GPS data was fed into the PlowNYC web app, revealing snow plow progress down to the City block level.

In 2014 the system got an upgrade with a new hardware and software package that was optimized for fleet management, allowing supervisors at DSNY to monitor vehicle progress and vital statistics in greater detail. The new system wirelessly sends GPS signals to a data center every

12 seconds, where the information is processed for use on the PlowNYC website and in DSNY's management tool.

PlowNYC has resulted in a number of direct and indirect benefits for New York City's residents and DSNY. The primary function of the program — giving people a tool to watch snow removal progress on their streets in real time — is particularly useful for New Yorkers who rely on cars or buses for transportation or those whose businesses depend on trucks to deliver goods. This information also reduces the number of calls about snow removal to the City's 311 call center, freeing up valuable resources during storms.

The tool also benefits planners at DSNY who can now more efficiently map out routes based on the GPS data. Since 2010, DSNY has expanded the use of the tool to non-snow removal vehicles, extending these efficiencies to other sanitation services.

## New York City 311

# 24/7 SERVICE REQUESTS

New York City's 311 is a mobile-friendly, user-oriented service that facilitates and improves the interaction between the City's government and its residents.

New York City's 311 system is the largest in the country. Since 2003, the City has handled more than 232 million contacts. As the city's main source of government information and non-emergency services, residents can access 311 via phone, web, text, social, and mobile to submit service requests or obtain community information.

The popularity of the app has grown exponentially over the last few years — downloads per month now average 13,000, and the share of requests made through the app has grown from around 8% to more than 15% of total requests within the last year.

The 311 app allows New Yorkers to directly submit requests in many of the most frequently used categories via a user-friendly interface, from reporting a pothole to recording heating complaints in the winter. When a user enters a request or complaint, it is tagged with their GPS location, any additional information about the request, and a photo if desired. This information is then transmitted to the 311 database and subsequently forwarded to the appropriate agency for action.

311 also supports the submission of requests and complaints via text, Twitter and Facebook.

While the model is still relatively new, the 311 app is already generating benefits for both the community and the City. Thanks to the app's user-friendly interface and its ability to record GPS locations, photos, and details when people first encounter the issue, people are submitting more timely and accurate service requests and agencies can more efficiently remedy the problems. In essence, the 311 app and social media channels allow community members to operate as real-time sensors themselves, creating a positive feedback loop between the City and its residents.

1

With the 311 app and social media, residents and visitors can report a variety of complaints, such as potholes.

2

GPS location, photo upload, and text inputs are transmitted to the 311 database.

3

DOT or other agencies receive this information and can take action.





# NYC

Mayor's Office of  
Tech + Innovation

[nyc.gov/forward](https://nyc.gov/forward)