DECEMBER 2021

IoT Progress Report

The New York City Internet of Things Strategy Progress Report

Mayor's Office of the Chief Technology Officer

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Introduction

In March of 2021, the Mayor's Office of the Chief Technology Officer (NYC CTO) released the *New York City Internet of Things Strategy*, a holistic, forward-looking effort that describes the landscape of Internet of Things (IoT) utilization today, outlines six key principles for IoT use, and establishes a set of critical near-term actions the City will take toward supporting a healthy, cross-sector IoT ecosystem in New York City – one that is productive, responsible, and fair. [1]

Among the actions outlined in the Strategy is a commitment to "report annually on the City's progress toward reaching its IoT goals."[2] This Progress Report describes steps the City has taken since March, across a range of initiatives outlined in the Strategy. It details, in particular, findings from a set of engagements with stakeholders to solicit feedback on the Strategy itself. It then points to efforts the City will undertake in the coming months, and outlines a set of new commitments based on input received from the community. The City is committed to transparency and accountability in the planning, use, and governance of connected technologies, and will continue to work toward continuous improvement in its efforts to deliver positive impact, build trust, protect New Yorkers' digital rights, and ensure equitable opportunity for all.

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1 The NYC IoT Strategy can be found at: https://www1.nyc.gov/assets/cto/#/project/iot-strategy.

2 Ibid.

NYC IoT Strategy Commitments Tracker

Foster Innovation

COMMITMENT	STATUS
→ Launch a Rapid IoT data collection program	*Complete*
→ Develop a municipal "testbed" and launch a continuous pilot program framework to utilize it, subject to City procurement rules	*Planned*
→ Test new technologies and approaches through pilot or challenge-based programs	*On-going*

Promote Data Sharing and Transparency

COMMITMENT	STATUS
→ Establish scope and resources for citywide IoT data dashboard	*Planned*
→ Launch a Smart City Catalog to publicly share information about City projects	*In progress*
→ Solicit community feedback on the NYC IoT Strategy, and work to incorporate it	*In progress*
→ Report annually on the City's progress toward reaching its IoT goals	*On-going*

Note: Efforts marked "On-going" have begun and are expected to continue indefinitely. Efforts marked "In progress" have begun and are expected to reach a completion point in the future.

Improve Governance and Coordination

COMMITMENT	STATUS
→ Launch a Smart City Collaborative, and a biannual IoT Forum for City agencies	*Complete*
→ Establish an internal City consultancy and office hours program	*Complete*
→ Coordinate wireless IoT communications network deployments across City projects, to support expanded availability for future City deployments	*In progress*
→ Establish a Citywide IoT device inventory	*In progress*
→ Implement a standardized and comprehensive device review process, in coordination with agency stakeholders	*Planned*
→ Develop, in collaboration with the City's Chief Privacy Officer and other partner agencies, new standards, policies, and procedures for City IoT deployments; test implementation of privacy and equity impact assessments and newly developed signage to support IoT transparency in pilot projects already underway	*In progress*

Derive Value from Cross-Sector Partnerships

COMMITMENT	STATUS
→ Establish and promote an online channel for expressions of interest in collaboration – for academic, community, and industry partners, subject to City procurement rules	*In progress*
→ Pursue grants and research partnership opportunities that align with the City's needs and goals	*On-going*

Engage with Industry and Advocate for Communities

COMMITMENT	STATUS
→ Conduct research to better understand the need for IoT skills among local employers	*In progress*
→ Work with City digital literacy and workforce training providers to coordinate IoT-related training, or integrate IoT-related skills into training opportunities, as appropriate	*Planned*
→ Contribute on an ongoing basis to private sector norm-setting by communicating the City's position on industry policy, standards, and best practices	*Planned*
→ Identify opportunities to leverage City procurement or regulatory authority to support the City's positions on industry policies, standards, and best practices, and to support local hiring and local and M/WBE sourcing for City projects	*On-going*
→ Advocate at the state and federal levels legislation aligned with City goals	*Planned*
→ Establish an annual forum for industry and community partners on IoT usage	*Planned*

Progress Updates

The NYC IoT Strategy committed to twenty "next step" actions in 2021-22, organized into five categories: 1) Foster Innovation, 2) Promote Data Sharing and Transparency, 3) Improve Governance and Coordination, 4) Derive Value from Cross-Sector Partnerships, and 5) Engage with Industry and Advocate for Communities. Below is an update on the City's progress on these initiatives since March, 2021. A complete list of commitments, and their status, is included below as Appendix I.

Foster Innovation → Launch a Rapid IoT data insights program

UPDATE:

The IoT Strategy proposes that the City develop a "Rapid IoT" program to allow agencies to deploy short-term, low-cost IoT solutions to gather data for immediate insights, and prove project concepts for larger informational or operational efforts.

In May, 2021, NYC CTO launched a Rapid IoT project with the Mayor's Office of Climate Resiliency (MOCR) and the Department of Transportation (DOT) to deploy temperature and humidity sensors in select locations across the city with high "heat vulnerability" — places where residents are at greater risk of illness or death due to extreme heat.[3] The goal is to shed light on how street design and other interventions impact resident thermal comfort and health. In analyzing the data, a range of factors are to be taken into consideration, including, for example, whether a street is "open" (closed to car traffic), has tree canopy cover, uses impervious surfaces, or includes water features (sprinklers/misters).

Using low-cost sensor devices and Long-Range Wide Area Network ("LoRaWAN-") -based networks, the project team installed sensors in Crown Heights, Hunts Point, and Brownsville. Sensors installed in Boerum Hill were used as a "control group" as the neighborhood has a lower Heat Vulnerability Index (HVI) score. The City partnered with volunteers from the U.S. Digital Response to build a dashboard to visualize the incoming data. Before the end of 2021, the City plans to publish a report detailing findings from this data.

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[3] See the Department of Health and Mental Hygiene's Interactive Heat Vulnerability Index, at https://a816-dohbesp.nyc.gov/IndicatorPublic/HeatHub/hvi.html.

As part of the sensor deployment, NYC CTO needed to establish new LoRaWAN connectivity in the Crown Heights and Brownsville neighborhoods. Working with the Department of Education (DOE), NYC CTO installed a LoRaWAN gateway on the roof of PS 189, a local primary school. The gateway provides public access to The Things Network in the surrounding area and could be used in the future to support educational programming related to IoT in the community.

NYC CTO is working with agencies to develop the next Rapid IoT project, which is scheduled to begin in late 2021.

[FIGURE 01 ◀] Temperature/Humidity sensor installed in.Brownsville, Brooklyn.
Photo: NYC CTO

Foster Innovation → Test new technologies and approaches through pilot or challenge-based programs

UPDATE:

To advance the City's capacity to use connected technologies, and support innovation in its approach, the IoT Strategy recommends the City continue to test new ideas via pilot programs through a range of models.

FloodNet, a collaboration between NYC CTO, the New York City Mayor's Office of Climate Resiliency, the City University of New York (CUNY), and New York University (NYU), has deployed sensors across a range of flood-prone neighborhoods to monitor for stormwater and tidal flooding occurrences. Initially funded with grants from CUNY, NYU Center for Urban Science and Progress (CUSP), and C2Smart, the project aims to source real-time data to inform the City's emergency notification and response, flood mitigation efforts, and to help calibrate future flooding models.

The FloodNet network offered a range of previously unavailable data about flooding caused by Hurricanes Henri and Ida, including precise times, depths, and behavior of flooding events. In addition, the sensor network showed the ability to provide information in real-time. Based on the demonstrated utility of this data, the City announced a commitment to scale the deployment of flood sensors citywide on September 27th, as a part of a broader landmark plan to protect New Yorkers from dangerous storm events.[4] The FloodNet team is working with City agencies to identify additional locations to expand the reach of the flood sensor program.

With additional funding from New York's Empire State Development Corporation (ESD), and in partnership with FieldKit.org, the FloodNet consortium is now developing a data dashboard that will present flood data for use by impacted communities, researchers, and City agencies. Real-time alerts will also be integrated to warn residents of rising waters. In November, the consortium is slated to engage stakeholders to gather feedback on the dashboard. The tool is set to launch in early 2022 and the City will continue to develop and add features to it throughout the year.

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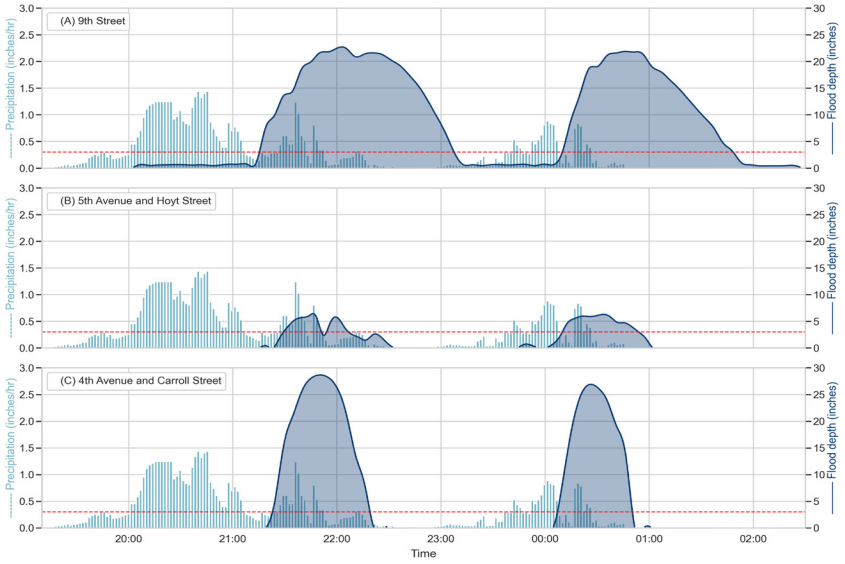
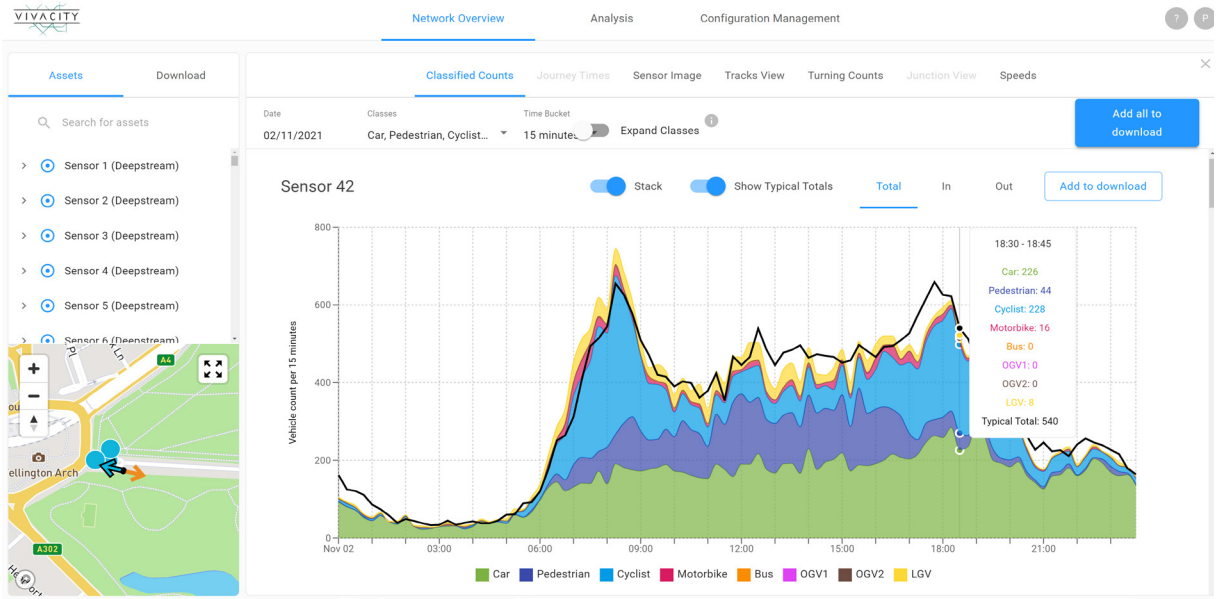
4 See "The New Normal: Combating Storm-Related Extreme Weather in New York City," at https://www1.nyc.gov/assets/orr/pdf/publications/WeatherReport.pdf.



[FIGURE 02 ◀]
FloodNet sensor data graph after Hurricane Henri impacts in Gowanus, Brooklyn, August 2021.
Source: FloodNet

In addition to the FloodNet data dashboard, the City received funding from ESD to pilot a project that uses privacy-protecting computer vision technology to provide automated counts of pedestrians, cyclists, and vehicles as they move through the city.[5] Automated counting can replace labor- and cost-intensive manual counting, and provide new and deeper insights into mobility patterns on city streets. The project team has identified twelve locations across the city where DOT has recently upgraded street infrastructure or is considering new work. The City will work with Vivacity Labs to install sensors before the end of 2021, and with CUNY to verify collected data. The City will use its findings to assess the utility of integrating automated counting more broadly in its street design and safety efforts. Data from this use of computer vision technology could, for example, aid the City's future decisions about the allocation of street space for different modes of transportation or potential needs for traffic calming measures.

5 As noted in the NYC IoT Strategy, this project is being approached with "privacy by design" principles, and the selected sensors will not be transmitting any image or video data from the device, except during a brief calibration period. This approach allows the City to take advantage of the advanced classification and counting capabilities that come from vision, but without the privacy concerns associated with video transmission and recording.



[FIGURE 03 ▲] Mobility data displayed in Vivacity Labs' dashboard from previous deployment.
Source: Vivacity Labs

In September 2021, NYC CTO, the Department of Health and Mental Hygiene (DOHMH), the Department of Citywide Administrative Services (DCAS), the Massachusetts Institute of Technology (MIT), and the Environmental Defense Fund (EDF) launched the third phase of the CityScanner pilot project, which uses solar-powered sensor nodes attached to the roof of City vehicles to collect hundreds of thousands of hyper-local air quality data points in the South Bronx. Following a three-month data collection phase, the MIT team will produce a report on the initiative's findings. Data collected to date indicate that there is potential to validate DOHMH's NYC Community Air Survey (NYCCAS) data that is modelled from stationary air quality monitors, which would strengthen the City's analysis of air quality across the five boroughs. The City believes that these new data can help identify discrete pollution "hot spots" from sources such as industrial sites or motor vehicle emissions, which can be more readily detected with this methodology.

[FIGURE 04 ◀]
CityScanner node on car mounted on NYC fleet vehicle.
Photo: CityScanner

Promote Data Sharing and Transparency → Solicit community feedback on the NYC IoT Strategy, and work to incorporate it

UPDATE:

To support transparency and alignment with community concerns and goals, NYC CTO committed to conducting feedback sessions on the IoT Strategy itself with stakeholders across the city.

Since March, NYC CTO has conducted interviews and roundtable discussions with a wide range of stakeholders. These meetings have included representatives from civil society and community-based organizations, businesses, and academic institutions — in a variety of roles. A complete list of organizations and groups engaged is attached below, as Appendix II.

To date, these sessions have produced a number of key findings, outlined below, which will help inform the City's approach going forward.

Finding 1: Stakeholders found the Strategy informative and helpful, but identified opportunities to reach a broader audience with more summarized, high-level resources.

The Strategy's presentation of basic information on what IoT is, key principles that guide the City in building a healthy ecosystem, and how to think about privacy risk in IoT data were all noted as particularly helpful. The use of an ecosystem approach was also appreciated, as it offered a holistic view of IoT's impacts, and of opportunities for City action. A number of stakeholders noted, however, that it would be helpful to have shorter, higher-level materials available to support communication of the City's approach to a broader audience — and particularly, to facilitate public education and engagement.

Finding 2: Many stakeholders appreciated the emphasis on digital rights and public engagement, and shared ideas to further that work and approach.

There was broad appreciation of the City's focus on digital rights, as well as agreement that public engagement is often critical to planning and implementing responsible IoT initiatives. Stakeholders expressed interest in hearing more about how the City will engage New Yorkers going forward. Here, there was interest in how the City plans to communicate about initiatives that may impact a given community, and how it will identify and pursue opportunities to collaborate with communities and coordinate efforts with local goals and programs. Some stakeholders also expressed a desire for greater transparency about who the City spoke with in developing the Strategy itself, and suggested that the City could more proactively encourage engagement in that process.

Some of the particular ideas stakeholders shared to further the City's work to engage communities included: 1) working with community advisory boards throughout the implementation of IoT projects to ensure local stakeholders can contribute to decision-making about how the costs and benefits of IoT systems are allocated; 2) integrating community residents directly into the implementation of individual IoT projects in order to ensure their local knowledge is included, that projects are rolled out with appropriate sensitivity to local concerns and buy-in, and to offer residents opportunity to learn new skills; 3) partnering with local community schools and other organizations in any IoT "testbed" work, to

support local benefit, and 4) broadly working to integrate qualitative data into the City's IoT-based research to ensure data analysis is appropriately contextualized.

Some stakeholders additionally expressed interest in understanding more about how the City can ensure that government agencies are accountable to digital rights-related goals and principles outlined in the Strategy. In particular, a few stakeholders emphasized that surveillance is a key concern for city residents — and particularly for marginalized populations. These stakeholders expressed interest in more oversight on this issue from city government, and encouraged the City to ensure that there is transparency in the City's development and use of digital rights-related impact assessments.

Finding 3: Both academic and private sector stakeholders have strong interest in fostering partnerships with government, but agree that they face challenges finding appropriate channels to pursue them.

Academic researchers noted that collaborations with the City, given its complex organizational chart and unclear rules, can be difficult to navigate. A great deal of research and effort can be required on their part to identify appropriate partners and projects. Similarly, a range of private sector firms noted difficulty in identifying appropriate ways to engage with City government, and conveyed a lack of clarity on City rules related to public-private engagements. Both groups agreed that clearer pathways, and greater visibility into the City's IoT work would be helpful.

Finding 4: Stakeholders flagged emerging opportunities for the City to look into and expressed interest in better understanding longer-term plans.

These included emerging opportunities to coordinate IoT workforce efforts with broader COVID recovery efforts to reskill and upskill New Yorkers as well as opportunities to use IoT to maximize the impact of any new infrastructure investments made through coming federal funding.

Finally, stakeholders expressed interest in the City's longer-term planning related to IoT, following the initial 2021-22 timeframe outlined in the Strategy.

In response to the feedback received from stakeholders to date, the City will take the following actions:

- → A complete list of organizations engaged in the development of the IoT Strategy is included in this document as Appendix I.
- → Produce a plain language summary of the Strategy to support engagement with a broad audience. This document will prioritize basic educational information about IoT and its applications across society, outline the City's approach, and frame key questions for community input.
- → Continue to test and develop new engagement approaches for IoT projects across City government, beginning with work on the Impact Assessment, and transparency signage.
- → Leverage work outlined in the City's October, 2021 NYC AI Strategy to convene agency stakeholders with experience in establishing productive academic partnerships – toward formulating a Citywide approach to streamlining such partnerships.
- → Explore new opportunities to leverage IoT to maximize the impact of new federally-funded infrastructure investments.

Improve Governance and Coordination → Launch a Smart City Collaborative, and a biannual IoT Forum for City agencies

UPDATE:

The NYC IoT Strategy commits to a number of steps to support coordination of efforts and information across City government.

In May 2021, NYC CTO launched a quarterly[6] IoT Forum, where agency staff from a variety of roles can share information about best practices, technologies, or tools used by the City, as well as information about recent initiatives and developments. Nearly forty civil servants from sixteen agencies participated in the inaugural Forum, which included presentations about upcoming innovative IoT pilots, the City's Cloud Review process, and IoT cybersecurity best practices. A second meeting was held in September and featured

6 The frequency of the Forum has been updated from biannual to quarterly based on the high level of agency engagement seen to date.

presentations about fleet telematics and IoT procurement policies, among other topics. The Forum will continue as a quarterly event in 2022 and beyond.

Additionally, in October, NYC CTO launched a new Opportunity Network email distribution list to support agency coordination on information and opportunities related to IoT. As of November 2021, eighteen agencies have joined the Network. As an initial effort, NYC CTO leveraged the group to disseminate an IoT device inventory survey to better understand the current state of use across City government.

Improve Governance and Coordination → Establish a Citywide IoT device inventory

UPDATE:

In October 2021, NYC CTO worked with NYC Cyber Command to distribute a digital survey to City agencies, requesting information on projects that use connected devices. This effort aims to capture the most comprehensive list to date of connected technology used by City agencies, offering new insight into work happening across City government, and new opportunities for data sharing or collaboration. The inventory will further provide actionable new data toward assessing risk and potential exposure to cyber-attacks.

Improve Governance and Coordination → Establish an internal City consultancy and office hours program

UPDATE:

In September 2021, NYC CTO established an office hours program, through which City workers can sign up for 30-minute time slots to discuss project ideas or get advice on best practices when using IoT. This effort will expand the knowledge-sharing taking place in the IoT Forum with more in-depth, one-on-one conversations about particular projects.

Improve Governance and Coordination → Develop, in collaboration with the City's Chief Privacy Officer and other partner agencies, new standards, policies, and procedures for City IoT deployments; test implementation of privacy and equity impact assessments and newly developed signage to support IoT transparency in pilot projects already underway

UPDATE:

A key component of the City's approach to fostering a healthy local IoT ecosystem is ensuring robust governance of City IoT use, and effective coordination of efforts across agencies. Toward these goals, the IoT Strategy recommended ongoing work to develop a range of new resources for City government use.

NYC CTO is working with agency stakeholders to develop an Impact Assessment framework that can be used for the City's connected technology projects. The framework aims to support agencies to outline a clear statement of the purpose of the proposed technology and how the agency intends to use and deploy it, and to invite public comment. As a starting point, the City has drafted a framework to assess the above-mentioned vehicle, pedestrian, and bicycle-counting pilot. This initial effort will help the City to preview, user-test, and improve impact assessments, and will inform the creation of an IoT Impact Assessment framework for broader City use.

After the City has completed the framework draft, it will launch a community engagement process to gather input and understand the interests and concerns of everyday New Yorkers. NYC CTO is currently working to plan this outreach, which may take the form of surveys, interviews, or focus groups, and will include a diverse set of stakeholders, including groups that are highly knowledgeable in the field as well as residents with minimal knowledge of connected technology and its capabilities.

Finally, NYC CTO has been working in recent months to develop transparent signage to accompany new sensor installations across the City. Implemented for flood monitoring and temperature monitoring pilots, these signs are mounted at sensor locations and provide a range of information, including: which City agency is leading the initiative, what the sensor is doing, why it is being used, whether any identifying information is being

collected, and where a resident can get more information. NYC CTO plans to hold feedback sessions with residents and community groups to assess the effectiveness of these signs, and gather input to improve them.

[FIGURE 05 ▲] Flood sensor transparency signage.
Photo: NYC CTO

[FIGURE 06 ▲] Temperature/Humidity sensor transparency signage.
Photo: NYC CTO

Improve Governance and Coordination → Coordinate wireless IoT communications network deployments across City projects, to support expanded availability for future City deployments

UPDATE:

The IoT Strategy highlighted the opportunity to ensure potential partners in academia, industry, and the community have clear paths to engage with the City, toward demonstrating the efficacy of new technologies, and strengthening alignment with City goals and programs.

In the winter of 2022, NYC CTO will launch a new portal to support expressions of interest in IoT collaborations from academic, industry, and community stakeholders, and will conduct outreach to publicize the portal and encourage use.

Derive Value from Cross-Sector Partnerships → Establish and promote an online channel for expressions of interest in collaboration –for academic, community, and industry partners, subject to City procurement rules

UPDATE:

The IoT Strategy highlighted the opportunity to ensure potential partners in academia, industry, and the community have clear paths to engage with the City, toward demonstrating the efficacy of new technologies, and strengthening alignment with City goals and programs.

In the winter of 2022, NYC CTO will launch a new portal to support expressions of interest in IoT collaborations from academic, industry, and community stakeholders, and will conduct outreach to publicize the portal and encourage use.

Engage with Industry and Advocate for Communities → Conduct research to better understand the need for IoT skills among local employers

UPDATE:

The IoT Strategy noted a need to gather more information to identify local IoT-related workforce needs, and committed to conducting that research in 2021-22.

Since March, NYC CTO has held a range of stakeholder meetings toward developing a research approach to this issue. In September 2021, the Office launched an effort to develop, in collaboration with the NYC Tech Talent Pipeline, and the Columbia University School of Architecture, Planning and Preservation, an ongoing data source on local IoT and related workforce needs.

Engage with Industry and Advocate for Communities → Continue to identify opportunities to leverage City procurement or regulatory authority to support the City's positions on industry policies, standards, and best practices, and to support local hiring and local and M/WBE sourcing for City projects

NYC CTO is currently working with the Department of Small Business Services (SBS) manufacturing industry partnership, the Manufacturing and Industrial Innovation Council (MaiiC), to procure local design-for-manufacturing (DFM) services for the FloodNet sensor project. The goal of the DFM work is to facilitate local contract manufacturers to build the sensor hardware at scale in New York City, supporting local jobs in manufacturing and bridging the industrial design and production sectors. Further work is expected to take place in 2022.

Upcoming Efforts

In addition to the efforts described above, the City will continue to advance the largers set of intiatives outlined in the IoT Strategy in the coming months, including:

Foster Innovation

- Develop a municipal “testbed” and launch a continuous pilot program framework to utilize it, subject to City procurement rules

Promote Data Sharing and Transparency

- Establish scope and resources for citywide IoT data dashboard
- Continue to report annually on the City’s progress toward reaching its IoT goals

Improve Governance and Coordination

- Implement a standardized and comprehensive device review process, in coordination with agency stakeholders *

Derive Value from Cross-Sector Partnerships

- Pursue grants and research partnership opportunities that align with the City's needs and goals

Engage with Industry and Advocate for Communities

- Work with City digital literacy and workforce training providers to coordinate IoT-related training, or integrate IoT-related skills into training opportunities, as appropriate
- Contribute on an ongoing basis to private sector norm-setting by communicating the City's position on policies, standards, and best practices
- Advocate at the state and federal levels legislation aligned with City goals
- Establish an annual forum for industry and community partners on IoT usage

Appendix I: The Voices That Shaped the NYC IoT Strategy

Note: Inclusion of external organizations in this list is purely for the purpose of transparency and does not indicate their endorsement of the Strategy's contents.

- Adafruit
- Berlin Institute for Smart Cities
- Brooklyn Public Library
- City of Melbourne
- Columbia University, School of International and Public Affairs
- Columbia University, Fu Foundation School of Engineering and Applied Science
- Downtown Alliance
- Downtown Brooklyn Partnership
- Gensler
- Google Research
- IoT Privacy Forum
- Itron
- Office of the Manhattan Borough President
- Metropolitan Transit Authority
- New York City Cyber Command
- New York City Department for the Aging
- New York City Department of Citywide Administrative Services
- New York City Department of Education, CS4All Program
- New York City Department of Environmental Protection
- New York City Department of Health and Mental Hygiene
- New York City Department of Information Technology and Telecommunications
- New York City Department of Sanitation
- New York City Department of Small Business Services
- New York City Department of Transportation
- New York City Economic Development Corporation
- New York City Emergency Management

- New York City Mayor's Office of Data Analytics
- New York City Mayor's Office of Information Privacy/Chief Privacy Officer
- New York City Mayor's Office of Climate Resiliency
- New York City Mayor's Office of Climate & Sustainability
- New York Public Library
- New York University, Center for Urban Science and Progress
- Numina
- Older Adults Technology Services
- P.S. 28, Christa McAuliffe School, Jersey City, NJ
- Perceptive Things
- Queens Public Library
- Radiator Labs
- The Things Network NYC
- ThingsCon
- World Economic Forum

Appendix II: Organizations Engaged Following Release of NYC IoT Strategy

NYC CTO requested feedback:

- BetaNYC and community members
- Brownsville Community Justice Center
- City University of New York Advanced Science Research Center
- Cornell Tech
- New Lab and member companies
- New York Civil Liberties Union
- New York University, Center for Urban Science and Progress
- Silicon Harlem
- Youth Design Center

Organizations contacted NYC CTO:

- Co:Census
- DirtSat
- IBM
- Microsoft
- Alchemist Club Studios

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