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**THE COUNCIL OF THE CITY OF NEW YORK**

**BRIEFING PAPER AND COMMITTEE REPORT OF THE**

**INFRASTRUCTURE DIVISION**

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**COMMITTEE ON TECHNOLOGY**

*Hon. Robert Holden, Chairperson*

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**Oversight:**  Smart City

1. **Introduction**

On January 19, 2021 the Committee on Technology, chaired by Council Member Robert Holden, will hold an oversight hearing on Smart City. The Committee expects to receive testimony from the Mayor’s Office of the Chief Technology Officer (“MOCTO”), advocacy groups, academia, and other interested members of the public.

1. **Background and Definitions**

The concept of a “smart city” initially developed out of the idea that cities are “key elements for the future.”[[1]](#footnote-1) There are over twenty distinct definitions of the term smart cities.[[2]](#footnote-2) The most comprehensive definition of smart city covers both physical infrastructure, also known as hard domains, and governmental services and data analysis, also known as soft domains. A smart city is understood to have certain intellectual capability to address innovative aspects of socio-technical and socio-economic growth. These aspects lead to smart city conceptions as “green” in reference to urban infrastructure which protects the environment and reduces CO2 emissions; “interconnected” in reference to the revolution of a broadband economy; “intelligent” in reference to the capacity to produce added value information from a city’s real-time data collection from its sensors; and “innovating” and “knowledge”, used interchangeably in reference to the city’s ability to increase innovation based on human capital.[[3]](#footnote-3)

The term “smart city” has been applied to two different kinds of “domains.”[[4]](#footnote-4) The first domain group is recognized as “hard” domains and includes “[b]uildings, energy grids, natural resources, water management, waste management, mobility, and logistics where ICT [information and communications technology] ... play[s] a decisive role in the functions of systems.”[[5]](#footnote-5) The second domain group is identified as applying to “soft” domains, such as “education, culture, policy innovations, social inclusion, and government.”[[6]](#footnote-6)

##### “A smart city leverages sensors and advanced analytics to improve performance with regard to city services and other aspects of city life, increasing efficiency and improving the quality of life for citizens.”[[7]](#footnote-7) The most common example include Smart Waste Management Systems[[8]](#footnote-8), Gunshot Detection Technology[[9]](#footnote-9), Smart Traffic Control Systems, Smart Air Quality Sensors[[10]](#footnote-10), Smart Street Lighting, Smart grid and water meters,  Public Wi-Fi, as well as City Mobile applications.

* 1. **Benefits and Concerns of Implementing Smart City Technologies**

There are numerous benefits of smart city technologies.[[11]](#footnote-11) By becoming “smart,” a city can deliver more and better services with greater efficiency and economic growth.[[12]](#footnote-12) Generally, smart cities seek to improve city life by gathering more data, analyzing and processing that data, sharing it, and using it to deliver services.[[13]](#footnote-13) Smart city initiatives include the installation of internet-connected sensors in public places, public information kiosks with free Wi-Fi, data analytics of publicly held data, as well as an online portal to share municipal data, or some combination of the above and more.[[14]](#footnote-14) These examples, and more, already exist within the City.

The deployment of internet-connected sensors provides the city with the data it needs to be smart. There are several sensors and other devices installed on city light poles, including cameras.[[15]](#footnote-15) For example, in NYC, smart street lightning enables cost savings, leverages existing streetlight infrastructure to easily connect cameras and third-party sensors, and provides gigabit speed backhaul for public Wi-Fi, surveillance and other high bandwidth applications.[[16]](#footnote-16) Therefore, smart streetlights, now not only generally consume much less electricity than a traditional street light bulb, but have different smart sensors, bluetooth connectivity and beacons that can track street objects and pedestrians. Such system can allow, for example, the city's public transit to adjust to city needs.[[17]](#footnote-17)

Further, more than 1,500 LinkNYC kiosks have been installed throughout the city providing the public with free internet access, free phone calls, maps, device charging and access to 311 and 911.[[18]](#footnote-18) The kiosks also provide real-time information on events, restaurants, or public transit.

Municipal open data initiatives seek to share the data held by the city with the public through an online portal. On March 7, 2012, the City enacted Local Law 11, generally referred to as the ‘Open Data Law.’[[19]](#footnote-19) The law mandated the creation of a single web portal through which agency “public data sets” could be made accessible to the public. According to the 2020 NYC Open Data report, after over a decade of data sharing, there are nearly 3,000 different datasets on NYC Open Data, produced by more than 60 different City agencies, showing how the City collects data, how data powers city operations and how publishing that data benefits New Yorkers throughout the five boroughs.[[20]](#footnote-20) With the proliferated data, it’s possible to find information about many aspects of City life – from healthcare and transportation, to the environment and public safety.[[21]](#footnote-21) These sorts of data sets enable cities to make data driven decisions, and then offer their residents substantial benefits[[22]](#footnote-22) from efficient distribution of resources to safer communities.[[23]](#footnote-23)

The rewards of a smart city can be beneficial, but such rewards also come with risks. These risks are associated with privacy, security and civil liberties. In order to carry out their “smart” functions, smart cities collect a significant amount of data about city residents.[[24]](#footnote-24) Such data often comes from devices like streetlights with sensors and network connectivity.

However, privacy concerns, while important, relate only to a subset of smart city technologies. For example, environmental sensors that measure temperature, air quality, and humidity[[25]](#footnote-25) can probably be regarded as safe from a privacy standpoint.[[26]](#footnote-26) Some public transit optimization, smart sewers and litter baskets are uncontroversial as well.[[27]](#footnote-27) “They raise few, if any, privacy concerns, especially if designed correctly from the outset.”[[28]](#footnote-28)

On the other hand, technologies that “rely on facial recognition, collecting personal data from smartphones, and other sources”[[29]](#footnote-29) raise significant privacy objections. The main three security and privacy challenges faced by smart cities are: (1) a lack of meaningful consent; (2) data collected from public interactions; (3) cyber security and storage of data in the cloud.[[30]](#footnote-30)

Often people are unable to consent to data collection and are not aware of such data collection. The perfect examples are facial recognition cameras, Bluetooth enabled technology, sensors, and network connectivity, or other systems that track cell phones or read license plates.[[31]](#footnote-31) The issues arise predominantly from concern over what public and private companies implementing such technologies will do with the potentially tremendous quantity, and unprecedented quality, of data that smart city infrastructure allows them to collect,[[32]](#footnote-32) and how securely such information is stored and used.

Information security is important as the increased use of technology comes with the potential for hacking.[[33]](#footnote-33) Having vast amount of potentially sensitive information makes cities and companies that have access to such information, attractive targets for cybersecurity attacks.[[34]](#footnote-34) Cyber breaches are increasingly high profile and tend to capture the public's imagination. Many devices and systems could not be cyber resilient, “posing a threat to the safety and security of the citizens they’re designed to help.”[[35]](#footnote-35) For example, in 2014, researchers from the University of Michigan “hacked the traffic lights of 100 of the city’s intersections, proving security flaws existed that had the potential to cause serious accidents.”[[36]](#footnote-36) In 2017, hackers turned on 156 severe weather sirens in Dallas in the middle of the night, causing a surge of 911 calls and distress.[[37]](#footnote-37) Although many experts warn about the vulnerability in connected systems,[[38]](#footnote-38) much progress remains to adequately secure such systems.[[39]](#footnote-39)

While smart city programs have the potential to ease inequity and deliver better services for all city residents, careless adoption of such programs can threaten civil rights and increase or entrench inequity.[[40]](#footnote-40) “Cities run the risk of discrimination and disparate impact that can be entirely unintentional.”[[41]](#footnote-41) For example, many smart city initiatives rely on smartphones as a pre-deployed network of sensors, trackers or mobile applications.[[42]](#footnote-42) However, not everyone has access to this technology. In New York City, eighty percent of residents own smartphones.[[43]](#footnote-43) Therefore, twenty percent of residents would be left without the benefit of any such smart city technology requiring such devices. A similar situation exists with broadband adoption. According to the New York City Internet Master Plan, eighteen percent of New York City households have no internet connection at home at all.[[44]](#footnote-44) Therefore, those with means can purchase a connection in their home while those eighteen percent without may be relegated only to “free” public networks where they exchange personal information for services.[[45]](#footnote-45)

Another aspect that is important to consider are the potentially inequitable effects on older adults. “Many cities are concerned with the impact of aging society on technology diffusion”[[46]](#footnote-46) as many older adults generally may not be as experienced with new technologies.[[47]](#footnote-47) Another concern is that people who are physically or mentally disabled will be at a disadvantage if attempting to use necessary technologies not designed or implemented accessibly. “This leads to the conclusion that younger and healthier people who have grown around newer technology will unfairly benefit from smart cities.”[[48]](#footnote-48)

Another aspect that is important to consider is the discrimination effects caused by the applications being used. Crime detection mechanisms, although useful, also can lead to false accusations or improper categorizations of citizens based on gender, ethnicity, race, or region.[[49]](#footnote-49) The best example is facial recognition technology. Although face recognition algorithms boast high classification accuracy (over 90%), these outcomes are not universal. A number of researchers have exposed divergent error rates across demographic groups, with the poorest accuracy consistently found in subjects who are female, Black, and 18-30 years old.[[50]](#footnote-50) “As a result, the software implemented must be well designed and controlled to avoid possible discriminations.”[[51]](#footnote-51)

1. **Conclusion**

The Committee looks forward to receiving testimony from the Administration, advocacy groups, academia, and other interested members of the public on the efforts and possibilities of implementing smart city technologies in New York City.

1. Vito Albino et al., Smart Cities: Definitions, Dimensions, Performance, and Initiatives, 22 J. URB. TECH. 3, 3 (2015). [↑](#footnote-ref-1)
2. *See id* at 6-8; John Wagner Givens & Debra Lam, *Smarter Cities or Bigger Brother? How the Race for Smart Cities Could Determine the Future of China, Democracy, and Privacy*, 47 Fordham Urb LJ 829, 882 (2020). [↑](#footnote-ref-2)
3. Sotiris Zygiaris, Smart City Reference Model: Assisting Planners to Conceptualize the Building of City Innovation Ecosystems, 4 J. KNOWLEDGE ECON. 217, 218 (2013)). [↑](#footnote-ref-3)
4. Nathalie Vergoulias, *Smart Cities: Is Cutting-Edge Technology the Method to Achieving Global Sustainable Goals?*, 32 J Envtl L & Litig 271, 289 (2017) (quoting Sotiris Zygiaris, *Smart City Reference Model: Assisting Planners to Conceptualize the Building of City Innovation Ecosystems*, 4 J. KNOWLEDGE ECON. 217, 218 (2013)). [↑](#footnote-ref-4)
5. *Id*. [↑](#footnote-ref-5)
6. *Id*. [↑](#footnote-ref-6)
7. Cem Alptekin, *Top 5 Examples of Smart City IoT Solutions*, IOTA, November 1, 2019, <https://www.iotacommunications.com/blog/smart-city-solutions-examples/>. [↑](#footnote-ref-7)
8. *Id (“*With waste production in cities increasing, municipalities are looking for ways to make their collection processes more efficient. Rather than using predefined routes and a fixed collection schedule, waste management workers rely on sensors placed in waste receptacles to measure fill levels and notify them when bins are ready to be emptied.”) [↑](#footnote-ref-8)
9. *Id* (“Acoustic sensors deployed at strategic locales detect a gunshot and send the location information to a local emergency authority. This allows police to arrive on the scene faster than they could have otherwise.”) [↑](#footnote-ref-9)
10. *Id.* (“sensors to collect a variety of air quality data, including levels of particulate matter, carbon monoxide, ozone, nitrogen dioxide, and more, as part of its broader Array of Things (AoT) initiative.”) [↑](#footnote-ref-10)
11. Jesse W. Woo, *Smart Cities Pose Privacy Risks and Other Problems, but That Doesn't Mean We Shouldn't Build Them*, 85 UMKC L Rev 953 (2017). [↑](#footnote-ref-11)
12. *See id*. [↑](#footnote-ref-12)
13. *See* *id* at 955. [↑](#footnote-ref-13)
14. *See* *id.* [↑](#footnote-ref-14)
15. # *See* Catherine Manzo, *Going Beyond Stationary Sensors to Understand Traffic in New York*, March 9, 2017, <https://www.streetlightdata.com/going-beyond-stationary-sensors-to-understand-traffic-in-new-york/> (There are over 600 sensor cameras installed throughout New York City).

    [↑](#footnote-ref-15)
16. # *Ubicquia Announces Ubihub, Industry's First Streetlight Gigabit Switch*, Markets Insider, March 21, 2018, <https://markets.businessinsider.com/news/stocks/ubicquia-announces-ubihub-industry-s-first-streetlight-gigabit-switch-1018992701>; Ubicquia, <https://www.ubicquia.com/applications/advanced-light-controls>.

    [↑](#footnote-ref-16)
17. Jesse W. Woo, *Smart Cities Pose Privacy Risks and Other Problems, but That Doesn't Mean We Shouldn't Build Them*, 85 UMKC L Rev 953, 955 (2017). [↑](#footnote-ref-17)
18. NYC Open Data Portal, <https://data.cityofnewyork.us/Social-Services/LinkNYC-Locations/s4kf-3yrf>. [↑](#footnote-ref-18)
19. NYC Admin. Code §§23-501 - 23-506. [↑](#footnote-ref-19)
20. Open Data for All 2020 Report, <https://opendata.cityofnewyork.us/wp-content/uploads/2020/09/2020_OpenDataForAllReport_Full.pdf>. [↑](#footnote-ref-20)
21. *Id*. [↑](#footnote-ref-21)
22. Jesse W. Woo, *Smart Cities Pose Privacy Risks and Other Problems, but That Doesn't Mean We Shouldn't Build Them*, 85 UMKC L Rev 953, 955 (2017). [↑](#footnote-ref-22)
23. *See* Lily Maxwell, *The 6 Key Benefits of Transforming a Municipality Into a Smart City*, April 2, 2018, <https://hub.beesmart.city/en/strategy/6-key-benefits-of-becoming-a-smart-city>. [↑](#footnote-ref-23)
24. *See* Jesse W. Woo, *Smart Cities Pose Privacy Risks and Other Problems, but That Doesn't Mean We Shouldn't Build Them*, 85 UMKC L Rev 953, 957 (2017). [↑](#footnote-ref-24)
25. *Id* at 960 (citing see Array of Things, ARRAY OF THINGS, <https://arrayofthings.github.io/>). [↑](#footnote-ref-25)
26. *Id*. [↑](#footnote-ref-26)
27. *See* John Wagner Givens & Debra Lam, *Smarter Cities or Bigger Brother? How the Race for Smart Cities Could Determine the Future of China, Democracy, and Privacy*, 47 Fordham Urb LJ 829, 842-43 [2020]. [↑](#footnote-ref-27)
28. *Id*. [↑](#footnote-ref-28)
29. *Id* at 844-45. [↑](#footnote-ref-29)
30. See Lilian Edwards, Privacy, Security and Data Protection in Smart Cities: A Critical EU Law Perspective, 2 EUR. DATA PROT. L. REV. 28, 28 (2016). [↑](#footnote-ref-30)
31. *See* Jesse W. Woo, *Smart Cities Pose Privacy Risks and Other Problems, but That Doesn't Mean We Shouldn't Build Them*, 85 UMKC L Rev 953, 957 (2017). [↑](#footnote-ref-31)
32. John Wagner Givens & Debra Lam, *Smarter Cities or Bigger Brother? How the Race for Smart Cities Could Determine the Future of China, Democracy, and Privacy*, 47 Fordham Urb LJ 829, 882 (2020) (citing Zaheer Allam, *The Emergence of Anti-Privacy and Control at the Nexus between the Concepts of Safe City and Smart City*, 2 SMART CITIES 96 (2019); Ellen P. Goodman & Julia Powles, *Urbanism under Google: Lessons from Sidewalk Toronto*, 88 FORDHAM L. REV. 457 (2019); Rob Walker, *Privacy, Equity, and the Future of the Smart City*, Lincoln Inst. of Land Pol'y: Land Lines Mag., January 2019). [↑](#footnote-ref-32)
33. Nathalie Vergoulias, *Smart Cities: Is Cutting-Edge Technology the Method to Achieving Global Sustainable Goals?*, 32 J Envtl L & Litig 271, 287 (2017). [↑](#footnote-ref-33)
34. *See* Jesse W. Woo, *Smart Cities Pose Privacy Risks and Other Problems, but That Doesn't Mean We Shouldn't Build Them*, 85 UMKC L Rev 953, 960 (2017). [↑](#footnote-ref-34)
35. # *Smart Cities: Is Cyber Security an Issue*?, <https://www.paconsulting.com/insights/smart-cities-is-cyber-security-an-issue/>.

    [↑](#footnote-ref-35)
36. *See* Suzanne Jacobsarchive, *Researchers Hack Into Michigan’s Traffic Lights*, MIT Technology Review, August 19, 2014, <https://www.technologyreview.com/2014/08/19/171586/researchers-hack-into-michigans-traffic-lights/>. [↑](#footnote-ref-36)
37. # *Dallas Warning Sirens 'Set off By Hacker'*, BBC News, April, 2017, <https://www.bbc.com/news/technology-39552471>; Thomas Brewster, *Hackers Turned On 156 Dallas Emergency Sirens And The City Got Noisy*, FORBES, April 10, 2017.

    [↑](#footnote-ref-37)
38. Commission on Enhancing National Cybersecurity: New York Meeting Minutes, NAT'L INST. OF STANDARDS & TECH. 1, 6 (May 16, 2016), <https://www.nist.gov/sites/default/files/may_16_2016_nyc_meeting_minutes.pdf>. [↑](#footnote-ref-38)
39. Jesse W. Woo, *Smart Cities Pose Privacy Risks and Other Problems, but That Doesn't Mean We Shouldn't Build Them*, 85 UMKC L Rev 953, 960 (2017). [↑](#footnote-ref-39)
40. Jesse W. Woo, *Smart Cities Pose Privacy Risks and Other Problems, but That Doesn't Mean We Shouldn't Build Them*, 85 UMKC L Rev 953, 963 (2017). [↑](#footnote-ref-40)
41. *Id* at 956. [↑](#footnote-ref-41)
42. *See id* at 963 *(*For example, transportation schemes that rely solely on smartphone hailed ride sharing services could exclude elderly or homeless populations without access to that technology.) [↑](#footnote-ref-42)
43. New York City Mobile Services Study, RTI, <https://www.rti.org/impact/new-york-city-mobile-services-study>. (The study was commissioned by New York City Office of Financial Empowerment (OFE) to understand the needs of underserved residents). [↑](#footnote-ref-43)
44. The New York City Internet Master Plan, NYC Mayor’s Office of the Chief Technology Officer, January 2020, <https://tech.cityofnewyork.us/wp-content/uploads/2020/01/NYC_IMP_1.7.20_FINAL-2.pdf>, p. 12. [↑](#footnote-ref-44)
45. *See* Jesse W. Woo, *Smart Cities Pose Privacy Risks and Other Problems, but That Doesn't Mean We Shouldn't Build Them*, 85 UMKC L Rev 953, 956 (2017). [↑](#footnote-ref-45)
46. Sawyer Clever, *Ethical Analyses of Smart City Applications*, Urban Science, September 2018, <https://www.mdpi.com/2413-8851/2/4/96> (citing Nam, T.; Pardo, T.A. Conceptualizing smart city with dimensions of technology, people, and institutions. In Proceedings of the 12th Annual International Digital Government Research Conference: Digital Government Innovation in Challenging Times, University of Maryland, College Park, MD, USA, 12–15 June 2011.) [↑](#footnote-ref-46)
47. Pollack, *Intelligent Technology for an Aging Population: The Use Of AI to Assist Elders With Cognitive Impairment*, AI Mag. 2005, 26, 9, <https://ojs.aaai.org//index.php/aimagazine/article/view/1810>. [↑](#footnote-ref-47)
48. Sawyer Clever, *Ethical Analyses of Smart City Applications*, Urban Science, September 2018, <https://www.mdpi.com/2413-8851/2/4/96>. [↑](#footnote-ref-48)
49. Sawyer Clever, *Ethical Analyses of Smart City Applications*, Urban Science, September 2018, <https://www.mdpi.com/2413-8851/2/4/96> (citing Hajian, S.; Domingo-Ferrer, J.; Martinez-Balleste, A. *Discrimination Prevention In Data Mining For Intrusion and Crime Detection*. In Proceedings of the 2011 IEEE Symposium on Computational Intelligence in Cyber Security (CICS), Paris, France, 11–15 April 2011; pp. 47–54.)

    *See* Alex Najibi, *Racial Discrimination in Face Recognition Technology*, HARVARD UNIVERSITY SCIENCE POLICY, SPECIAL EDITION: SCIENCE POLICY AND SOCIAL JUSTICE, October 24, 2020, http://sitn.hms.harvard.edu/flash/2020/racial-discrimination-in-face-recognition-technology/ (citing NicholasFurl, Face recognition algorithms and the other-race effect: computational mechanisms for a developmental contact hypothesis, [Cognitive Science](https://www.sciencedirect.com/science/journal/03640213), [Volume 26, Issue 6](https://www.sciencedirect.com/science/journal/03640213/26/6), November–December 2002, <https://www.sciencedirect.com/science/article/abs/pii/S0364021302000848>; Patrick J. Grother*, Multiple-Biometric Evaluation (MBE) 2010 Report on the Evaluationof 2D Still-Image Face Recognition Algorithms*, NIST Interagency Report 7709, <https://nvlpubs.nist.gov/nistpubs/Legacy/IR/nistir7709.pdf>). [↑](#footnote-ref-49)
50. # *See* Alex Najibi, *Racial Discrimination in Face Recognition Technology*, HARVARD UNIVERSITY [SCIENCE POLICY](http://sitn.hms.harvard.edu/category/flash/science-policy/), SPECIAL EDITION: SCIENCE POLICY AND SOCIAL JUSTICE, October 24, 2020, http://sitn.hms.harvard.edu/flash/2020/racial-discrimination-in-face-recognition-technology/ (citing Nicholas Furl, Face recognition algorithms and the other-race effect: computational mechanisms for a developmental contact hypothesis, [Cognitive Science](https://www.sciencedirect.com/science/journal/03640213), [Volume 26, Issue 6](https://www.sciencedirect.com/science/journal/03640213/26/6), November–December 2002, <https://www.sciencedirect.com/science/article/abs/pii/S0364021302000848>; Patrick J. Grother*, Multiple-Biometric Evaluation (MBE) 2010 Report on the Evaluation of 2D Still-Image Face Recognition Algorithms*, NIST Interagency Report 7709, <https://nvlpubs.nist.gov/nistpubs/Legacy/IR/nistir7709.pdf>; El Khiyari, *Face Verification Subject to Varying (Age, Ethnicity, and Gender) Demographics Using Deep Learning*, BIOM BIOSTAT 2016, <https://www.hilarispublisher.com/open-access/face-verification-subject-to-varying-age-ethnicity-and-genderdemographics-using-deep-learning-2155-6180-1000323.pdf>; Brendan F. Klare, Face Recognition Performance: Role of Demographic Information, IEEE TRANSACTIONSON INFORMATIONFORENSICSAND SECURITY, VOL.7, NO .6, December 2012, <https://assets.documentcloud.org/documents/2850196/Face-Recognition-Performance-Role-of-Demographic.pdf>).

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51. Sawyer Clever, *Ethical Analyses of Smart City Applications*, Urban Science, September 2018, <https://www.mdpi.com/2413-8851/2/4/96> (citing Hajian, S.; Domingo-Ferrer, J.; Martinez-Balleste, A. *Discrimination Prevention In Data Mining For Intrusion and Crime Detection*. In Proceedings of the 2011 IEEE Symposium on Computational Intelligence in Cyber Security (CICS), Paris, France, 11–15 April 2011; pp. 47–54.) [↑](#footnote-ref-51)