

Primer
IoT: Putting the “smart” into smart cities



What’s a smart city?

The Internet of Things (IoT) ushered in a new era of connectivity, information gathering, intelligent decision-making and automation. Nowhere is its impact more profound than in the improvement of urban centers, commonly referred to as “smart cities.”

Smart cities apply IoT devices, applications, cloud computing and, in many cases, artificial intelligence (AI) to automate or augment metropolitan services, improving their quality, efficiency and effectiveness. The application of IoT in smart cities runs the gamut, including transportation, sanitation, public works, communications, public health, policing and security, energy management, environmental protection, and residential services. Essentially, anything that can connect to the internet can be part of the smart city fabric.

Urban planners and city managers see smart cities as a means of improving quality of life and security while reducing costs. With more people living in urban areas, smart city technologies and services are the means of keeping pace with the growing demands of residents and businesses, from keeping traffic flowing and managing parking to improving security, fixing potholes and increasing energy efficiency.

While local governments have lagged behind other industry segments in embracing IoT, that’s starting to change. Globally, the smart city market in 2018 was \$71.3 billion, but will expand 18.9% a year between now and 2025, when it will be worth \$237.6 billion.¹ With myriad ways that IoT can make cities more efficient, more manageable and more livable as their populations swell, IT solution providers have significant opportunities to offer city leaders targeted services to leverage big data, analytics, intelligent and connected devices, artificial intelligence, and machine learning to improve urban living.

Smart cities at home with IoT

About 42% of governments have adopted IoT programs,² putting them behind many other industry segments. Much of it comes down to education—with 35% of IT decision-makers within governments saying their IT leaders have little or no understanding of IoT—making this an opportunity for IT solution providers who can bring their own expertise into the picture.

For those governments using IoT devices, building security systems ranked first (57%) in the way of use cases, followed by streetlights (32%) and vehicles (20%).³ That said, for those city leaders who do have an IoT program underway, the results are impressive. Seven in 10 (70%) said they’ve reduced costs and that their IoT strategies have given them better visibility across their organizations,⁴ which is critical in a smart city scenario, with so many connected devices and systems making up a highly unified infrastructure.

Cities represent a prime space for IoT. With rising populations (by 2040, 65% of the world’s population will live in urban areas), they’re highly complex ecosystems that need to become more sustainable and livable. They encompass a broad range of areas, from governance and buildings to healthcare, transportation, utilities and the environment, with IoT playing a potential role in each to improve efficiencies, streamline operations and reduce costs. Smart traffic lights can be used to improve the flow of vehicles throughout the cities. Buildings can be made more energy efficient and secure. The delivery of services to residents and businesses can be streamlined. The ability to generate, collect, process and analyze data in real time promises to make it all happen.

Ultimately, the use of digital solutions can improve quality-of-life indicators by 10% to 30%. That includes reducing fatalities by as much as 10%, shortening commutes by up to 20% and cutting greenhouse gas emissions 10% to 15%.⁵

1. Grand View Research, “Smart Cities Market Analysis Report By Application,” May 2019, <https://www.grandviewresearch.com/industry-analysis/smart-cities-market>.
 2. HPE, “The Internet of Things: Today and Tomorrow,” January 2017, http://chiefit.me/wp-content/uploads/2017/03/HPE-Aruba_IoT_Research_Report.pdf.
 3. Ibid.
 4. Ibid.
 5. Ibid.



Use cases

As with IoT deployments in all market segments, the key for smart cities is real-time data—the kind and amount of data that’s generated; how it’s processed and stored; how it’s analyzed; and, most important, how it’s used to drive action. There’s a wide array of use cases that solution providers can leverage.



IMPROVE TRAFFIC FLOW

Traffic congestion will only get worse as more people move into already-crowded cities. In response, municipalities are coming up with multiple ways to use sensors to ease the problems. Sensors are being embedded into roads to gather data on traffic patterns, and analytics are being used to optimize the timing of traffic lights and adapt to changing patterns throughout the day. The goal is to ease congestion, make travel times shorter and reduce vehicle idling time. The Surtrac program in Pittsburgh, for example, is credited with reducing aggregate wait times at intersections by 40%, which led to a 21% decrease in vehicle emissions.

To improve air quality, reduce congestion and upgrade an aging infrastructure, a Denver program pushed to increase smart electric vehicle use by city departments, leverage pedestrian detection systems at intersections and create a connected system to enable trucks to communicate with each other to coordinate delivery routes.

Digital signage and mobile apps are also making it easier for residents to take public transportation, adjust their plans when alerted to delays and let officials know when something in the system needs fixing.



ENHANCE SECURITY

IoT technologies are enabling smart cities to increase the security of residents and their property. Connected surveillance cameras on city streets and in buildings, smart traffic lights that let emergency vehicles move faster through congested streets, smart lighting and even connected microphones all enhance public safety. Intelligent streetlights not only light up an area but can also record what they “see.”

Meanwhile, cameras armed with facial recognition can keep a constant eye on streets and buildings, continuously sending data to the cloud for analysis of what they see and who they can identify. Cities also are using smart microphones to analyze sounds they record and providing real-time alerts when gunshots are heard. Technology like smart traffic lights can reduce emergency vehicle response time by 20% to 35% and enable emergency responders to keep in contact with each other.⁶



MAKE UTILITIES MORE EFFICIENT

City leaders are increasingly leaning on smart IoT devices and systems to make their communities more energy efficient and environmentally sound. Smart meters can be used to identify ways to make water, gas and other utility systems more efficient, while automated monitoring devices on commercial and home water heaters, temperature gauges, lighting fixtures and similar systems can reduce power consumption and costs. The savings can be significant.

By relying on IoT data and cloud computing, cities can save 25 to 80 liters of water per person per day. Using sensors and analytics capabilities also can cut water leakage from pipes by up to 25%.⁷ In-office and in-home monitoring devices on power and water systems also can help change the behavior of people occupying those homes and offices, making them more aware of their consumption and the need to reduce it.

Sensors can measure the amount of overflow from all sewers and issue an SMS alert to citizens, who can then reduce or limit their water use in times of overflow and avoid polluting their waterways.

6. McKinsey & Company, “Smart Cities: Digital Solutions for a More Livable Future,” June 2018, <https://www.mckinsey.com/~/media/mckinsey/industries/capital%20projects%20and%20infrastructure/our%20insights/smart%20cities%20digital%20solutions%20for%20a%20more%20livable%20future/mgi-smart-cities-full-report.ashx>.
7. Ibid.



RAMP UP MUNICIPAL SERVICES

How well cities deliver services can have a huge impact on how the residents of those cities view their local government. If they can engage with their government and get positive responses, their relationship with the city and its leaders can only improve. IoT can be seen not only as a collection of technologies and devices but also as a positive force on society, delivering benefits and enhancing social outcomes.

Some cities have implemented programs that allow residents to communicate with officials via social media—contacting their public works departments about a pothole that needs to be filled, for example (and even posting a photo). Through these programs, residents can more easily alert police and fire departments to problems and link their social accounts to municipal applications to find available parking spaces during special events.

Smart waste collection is gaining traction as well. In San Francisco, one such system deploys garbage-bin sensors that take photos of what's inside, analyze the contents and then set routes for trash collectors based on which bins most need to be emptied. Other cities, such as Boston and Baltimore, also use smart trash cans with sensors. In all, the smart waste collection market is expected to grow from \$57.6 million in 2016 to more than \$223.6 million by 2025.⁸



CREATE MORE SUSTAINABLE CITIES

Cities are constantly struggling to find ways to be more environmentally sustainable and livable. Sensors and other IoT technology can be used to improve the situation.

Building-automation systems can reduce carbon emissions by almost 3% if adopted by most commercial buildings, and that can jump another 3% if adopted by most homes.⁹ Applications like dynamic electricity pricing—whereby utilities charge more when demand peaks—can reduce both consumption and emissions. Smart traffic lights can help reduce congestion, which, in turn, cuts down on greenhouse gas emissions.

Air-quality sensors can find sources of pollution and alert municipalities when air pollution reaches certain levels. Digital tracking and charging for waste disposal can lead people to reduce the amount of waste they create.



SENSORS



GATEWAYS



CONNECTIVITY



PLATFORM



8. Ibid.
9. Ibid.



SENSORS



GATEWAYS



CONNECTIVITY



PLATFORM

Today's challenges to the city of tomorrow

While IoT devices and the vast amounts of data they collect hold the promise of creating a much more sustainable and efficient urban environment, there are hurdles that need to be cleared as these solutions are deployed, particularly for city leaders already trying to balance tight budgets. Here are some of the obstacles they face:

Infrastructure

IoT technologies can save a lot of money, but they can be expensive too, as can the complex infrastructure needed to support them. That's no small challenge for cities already putting resources into upgrading and enhancing old legacy infrastructure, from sewers and water pipes to underground wiring. Broadband, particularly 5G as it comes into the picture, will be crucial. Cities must also decide how to power these devices and how best to remotely monitor and maintain them.

Private and public entities—think federal government agencies and non-governmental organizations (NGOs)—can help with funding and form partnerships with service providers, telecommunications companies and other private tech firms, which can pare down some of the costs. Also, device makers are increasingly considering such challenges as they develop new products.

Integration

The ecosystem that needs to be built around a smart city project is extensive and complex: Devices need to be put in place; high-speed connectivity is necessary to create a real-time data environment; cloud computing is crucial for storing and analyzing the data and applications that run on top of it all.

The system also must cross heavily siloed city environments. The sensors embedded in roads and intelligent traffic lights must work not only with a city's transportation and public works departments but also with emergency response systems such as police and fire departments. What's more, these solutions need to tie into legacy back-end systems, particularly in areas such as automated billing.

In addition, devices like sensors and gateways, and the data they create, come in a variety of formats and use different wireless technologies, yet they still must work together as part of a whole, particularly given the multiple technologies needed for any one part of the larger smart city effort.

Security

Cities are highly complex and distributed environments that include residents and their homes, commercial buildings, government agencies, hospitals, public works, vehicles, dozens of services and huge amounts of sensitive personal data. While smart city technologies offer a world of possibilities for improving life for residents and workers, they also broadly expand the attack surface for hackers.

In 2018, IBM X-Force Red, an autonomous group within IBM Security, and Threatcare, an organization that helps technology companies measure the effectiveness of their cybersecurity initiatives, teamed up for an ethical hacking project and found 17 zero-day vulnerabilities in smart city sensors and control devices.¹⁰ Their research highlighted the dangers facing such programs.

Governments and hospitals have been key targets of ransomware, and legacy systems like power grids, which have to be part of an overall IoT strategy, have long been attractive targets for hackers.

Cities need to be diligent when deciding what technologies they'll bring into their IoT environments, and they must carefully scrutinize the vendors behind the technology, as well as their security records. Traditional perimeter defenses no longer work in such highly distributed environments, where data moves freely. Cities must be able to detect and react quickly to attacks and must hold employees accountable for maintaining their own security hygiene.

10. IBM, "The Dangers of Smart City Hacking," 2018, <https://www.ibm.com/downloads/cas/B1JZXZRG>.

Privacy

Smart surveillance street cameras with facial recognition technology can ensure a greater level of public safety, but they come with a trade-off in privacy that still makes many citizens uncomfortable. Ensuring as much privacy as possible will be key to public acceptance of IoT programs.

Smart city IoT solution providers must understand the surveillance technology that's being used in order to help municipal governments ensure that the data they collect can't be linked to any particular person. They can also help clients manage what data to collect and how long it will be retained. In the case of smart city programs that arise from public-private partnerships, specific policies are needed to determine who retains and controls the data when the partnership ends.

Community buy-in regarding privacy is an important consideration when it comes to deploying smart city IoT solutions. Local leaders are increasingly sensitive to their constituents' concerns about surveillance cameras and other smart devices that profile both people and areas of a community. To address those concerns, local leaders need to keep the lines of communication open, engaging in frank conversations through planned forums and town hall meetings about the benefits, challenges and implications of smart city implementations.

Embracing the future with smart cities

Despite the challenges, smart city programs will only proliferate. The promise they hold to make cities more efficient, to reduce costs and, ultimately, to create more sustainable living conditions will continue to drive the trend. As more money becomes available and better technologies emerge, innovative use cases will blossom.

For solution providers, this translates into significant opportunities to help cities plan, design, deploy and manage IoT programs. Smart cities will be complex environments in need of assistance with a range of tasks—from technology partner selection and integration to risk mitigation and deployment—and solution providers can be the trusted advisors providing that guidance.

The discussions will need to be around solutions rather than point products. In the end, it's about making all these devices, systems and applications come together to take advantage of real-time data to improve efficiencies, reduce costs and enhance the lives of residents and businesses alike.



SENSORS



GATEWAYS



CONNECTIVITY



PLATFORM



Next steps

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