

Smart Cities

The Cities of the Future Powered by Cloud Computing

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Introduction

City leaders around the world are working to improve the quality of life and increase the number of useful services for their citizens, businesses, and visitors. Smart city initiatives are gaining attention in several countries, as administrators, industry, and citizens are working together to enhance their communities, cities, regions, and nations. After more than ten years of smart city hype, innovative projects have emerged, but few have provided a disruptive impact on the city system itself. Because every city is different, few of the existing models apply universally. An effective response requires leaders to consider a series of prerequisites:

- Consider the local culture and the people
- Prioritize basic needs and requests
- Work at overcoming silos and encourage collaboration across departments
- Consider each “smart” initiative as an integral part of an overall city system

A smart city reflects a number of aspirations: efficiency, resiliency, connectedness, innovation, and sustainability. Although the definition of a smart city varies, we can understand its mission: harmonious, sustainable, and inclusive development of urban areas.

Smart Cities on the Rise

Any city that collects data, transforms it into information, and uses the latest information to make decisions in or near real-time to provide better services to citizens, improve operations, and lower cost can be deemed as a smart city. For example, a smart city might lower congestion on its streets and lower pollution by optimizing transportation infrastructure and assets. It might reduce energy consumption by deploying a range of real-time analysis sensors to optimize the use of luminaires to provide just-in-time or incident-based illumination. It might provide faster responses to public safety incidents via real-time capture and analysis of sensor and surveillance data. The power to transform city operations and services through technology is only limited by imagination and economics.

Smart cities are well placed to take advantage of an increasing range of solutions that promise to deliver improvements in mobility, safety, energy, health, education, logistics, and government services.

The Building Blocks for Smart Cities

Most smart city solutions rely on a combination of core technologies like compute, storage, databases, data warehouses, and advanced technologies like big data analytics, machine learning, Internet of Things (IoT), and Artificial Intelligence (AI).

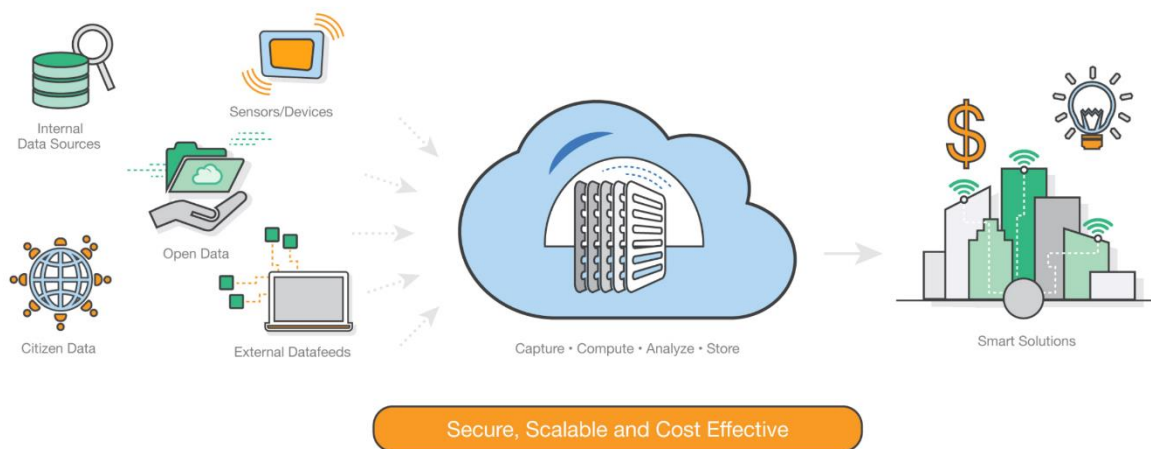
The Rising Importance of Data

The most important aspect of smart city solutions is not the sensors on the ground; rather, it's the data that deployed sensors allow cities to collect.

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Why is data important? Because data, when transformed into information, provide insights into what is working well, what is not working, or what needs to be changed to meet the objectives of the city government.

Data can be gathered using many methods. For instance, data can be collected by deploying sensors, by extracting data from existing systems, and by the collection from external data feeds. Cities can also rely on citizens as sensors and collect data from them as well as through open data sources, such as weather data and mapping data. By gathering, storing, and analyzing data, cities gain insights and can take appropriate actions by using a data-driven decision-making process.



Large-Scale Computing and Data Analytics Infrastructure

To meet the demands of smart city solutions, cities need to plan for scaling IT resources securely, cost effectivity, and as needed. Cloud computing can help by allowing cities to create new services rapidly while also optimizing existing resources. Following are some areas in which cloud computing can help:

1. **Agility:** Cities can move fast on pilots and evaluate multiple solutions at minimal cost. This helps lower risk when projects are scaled beyond pilots and into city-wide implementations.
2. **Lower Total Cost of Ownership:** By leveraging cloud computing, projects can be initiated with zero capital expenditure (for services like computing, storage, and data analytics), and pay for only what you use. According to the International Data Center, AWS delivered a 64.3% savings when compared with deploying the same resources on-premises or in hosted environments. The findings also showed a 560% ROI over five years and 81.7% less downtime.¹
3. **Better Security and Compliance:** Cloud security at AWS is the highest priority. AWS customers benefit from a data center and network architecture built to meet the requirements of the most security-sensitive organizations around the world.
4. **"Ready to Deploy" Solutions:** Cities are able to leverage a wide range of off-the-shelf solutions available on AWS by launching them directly from AWS Marketplace with just a few clicks.

¹: <https://aws.amazon.com/resources/analyst-reports/IDC-business-value-aws/>

5. **Data Integration and Analysis:** The cloud can act as a secure data-hub, allowing the integration of disparate systems and data sources.
6. **Advanced Capabilities:** As solutions get more complex, advanced services like Artificial Intelligence (AI), machine learning (ML), and voice interaction become increasingly useful.
7. **Greener in the Cloud:** Combining the fraction of energy required with a less carbon-intense power mix, customers can reduce carbon emissions by up to 88% by operating on AWS.

The Evolution of Smart City Solutions

Four major trends emerge by examining how cities are moving forward with implementing smart city solutions, especially in the area of data collection, analysis, and citizen interface – IoT, people as mobile sensors, voice assistants, and AI technologies.

Internet of Things (IoT)

By deploying sensors and devices, cities are able to collect, process, and adapt in real-time. Here are a few examples:

The City of Newport in Wales, UK

The [City of Newport in Wales, UK](#), deployed IoT solutions to improve air quality, flood control, and waste management in just a few months, compared to the year or more it would have taken using traditional server infrastructure. Newport is a vibrant city seeking to invigorate its economy and improve quality of life for citizens and visitors using forward-thinking technology.



Philips CityTouch

[Philips CityTouch](#) is a lighting management system for public lighting. CityTouch allows cities to monitor how much energy streetlights are using and which ones need repair. Cities can make better decisions and use of resources by monitoring, managing, and measuring its light management system with CityTouch. More than 600 customers from municipalities up to mega cities, such as Los Angeles and Buenos Aires, in 35 countries manage their street lighting with CityTouch.

Xaqt at Kansas City, Missouri

[Kansas City, Missouri](#), is one of the smartest cities in the United States. Along the two-mile corridor of the Kansas City Streetcar, a \$15 million public-private partnership has supported deployment of 328 Wi-Fi access points, 178 smart streetlights that can detect traffic patterns and open parking spaces, and 25 video kiosks, as well as pavement sensors, video cameras, and other devices. It's all connected by the city's nearly ubiquitous fiber-optic data network. Xaqt, an AWS partner, built a data management platform on AWS to provide urban analytics and intelligence that helps policymakers better innovate on how city functions.



Spectrum by Miovision

[Spectrum by Miovision](#), headquartered in Waterloo Region of Ontario, Canada, provides a turnkey solution that provides the data, connectivity, and tools needed to remotely manage traffic signals. The Spectrum SmartLink and Interface hardware integrate easily and securely with existing traffic cabinet hardware and software. Spectrum includes Miovision Signals, cloud-based software tools to remotely monitor and manage a traffic network. Miovision's data platform is serving 1000 customers in 50 countries.

People as Mobile Sensors

Citizens and visitors are more connected to each other than ever before, and the increased connectivity of devices creates new opportunities for cities to rely on data shared by citizens. Citizen data when augmented with sensor data can help provide better intelligence, understand citizens' needs, and ultimately, provide improved services. Here are a few examples:

PetaJakarta

[PetaJakarta](#) brings together mobile mapping and local flood information for the city of Jakarta, Indonesia. The platform lets the 28 million citizens of Jakarta share real-time flood information in a part of the world increasingly affected by flooding. In addition to the collection and dissemination of information by community members through location-enabled mobile devices, researchers can complement existing manual water gauges with water-level-sensing devices to inexpensively increase monitoring across the waterway network in Jakarta.



Moovit

[Moovit](#), headquartered in Israel, is redefining the transit experience by giving people the real-time information they need to get places on time. With schedules, trip planning, navigation, and crowdsourced reports, Moovit guides transit riders to the best, most efficient routes, and makes it easy for locals and visitors to navigate the world's cities. Moovit's free award-winning app serves nearly 80 million users across 1500+ cities in 78 countries.



Voice Assistants



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As voice-based conversational technology becomes more prevalent, local governments are starting to adopt it as a means of making information about services more readily available to citizens. Here are a few examples:

The City of Las Vegas

Las Vegas, one of the first major city governments to adapt the use of the Amazon Alexa voice assistant technology, has developed a number of Alexa skills, which give citizens the ability to ask about parks, elections, community calendars, and the status of building permits. Las Vegas is also adopting Amazon Echo Show for visual conveyance of information. Users will be able to ask about the status of a building permit and have it appear right on the device's screen.



Grand River Transit in the Region of Waterloo, Ontario, Canada

Grand River Transit (GRT) in the Region of Waterloo, Ontario, Canada, replaced its on-premises legacy interactive voice response (IVR) application for bus riders to access next bus arrival information by deploying an application hosted on AWS. This solution connected to GRT's real-time web service, allows riders to call and enter their bus stop number. Citizens get real-time arrival information for the next buses at their stop to help them plan their travel.



State of Georgia

Digital Services Georgia aims to create a better experience for people looking for state information and services. When voice assistants vocally respond to user's questions, they save users the trouble of navigating content structures, screen readers, and compatibility challenges to get to the needed information. With Ask GeorgiaGov, a new Alexa skill, citizens with a smartphone, tablet, or other Alexa-compatible device can ask several Georgia state service-related questions like how to renew your driver's license or how to get a fishing permit.

Artificial Intelligence, Machine Learning, and Deep Learning

As technologies such as AI, ML, and deep learning become easier to adopt, public sector agencies are starting to embrace them. A few examples include:

Louisville, Kentucky

[Louisville, Kentucky](#), is building a next-generation, adaptive traffic-flow management system. The goal is to sense detrimental systemic changes to the circulatory nature of traffic, and automatically adjust infrastructure to mitigate impact. The city is able to undertake this feat thanks to the use of machine learning, real-time traffic data, IoT infrastructure, and interconnected systems. Once implemented, Louisville will be able to analyze data across many systems, allowing officials to make data-driven decisions that positively impact the citizen.



Washington County, Oregon



In law enforcement, it is important to identify persons of interest quickly. In most cases, this is accomplished by showing a picture of the person to multiple law enforcement officers in hopes that someone knows the person. In [Washington County, Oregon](#), there are nearly 20,000 different bookings (when a person is processed into the jail) every year. As time passes, officers' memories of individual bookings fade. Also, in most cases, investigations move very quickly. Waiting for an officer to come on duty to identify a picture might mean missing the opportunity to solve the case. Amazon Rekognition, a deep learning image analysis service, is used to help automatically identify suspects.

CivicConnect in Los Angeles, CA

[CivicConnect](#), headquartered in Los Angeles, CA, is an Augmented Reality solution for the public sector. It features visual search and scanning of city assets for digital information and directional search allowing users to learn what is around them by simply pointing one's mobile device. Citizens can explore points of interest, facilities, and distant locations with 360-degree views remotely while simultaneously creating a localizing map that reflects the objects therein so they are anchored in the real world, all through a mobile device.



Conclusion

Many cities and communities around the world are starting the journey to leverage data in new and innovative ways to help improve the decision-making process. It is imperative that cities share and learn from each other. While there are differences between how two cities function, there are also many similarities. By sharing lessons learned and best practices, cities can lower risk and increase chances of success.

Cities can start exploring and experimenting with proven smart city solutions right away. There are a number of solutions available on [AWS Marketplace](#). Cities around the world are leveraging the power of cloud computing to bring innovative solutions to their constituents.

Refer to <https://aws.amazon.com/smart-cities/> for more details on how AWS is enabling cities to become connected, smart, and sustainable.

Contributors

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About the AWS Institute



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