

# The Need for a Smart City IoT Framework

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POINT OF VIEW



## Executive Summary

The internet of things (IoT) is touted as the fourth Industrial Revolution. This paper discusses how cities can take advantage of the convergence of IoT, big data and ubiquitous communication networks, to improve quality of life for their citizens through the creation of a smart city framework.

## Learn From the Past

It was around 2005 that municipal broadband (Muni Wi-Fi) was thought to be the way forward for cities to bridge the digital divide. While Muni Wi-Fi has its merits, Wireless Philadelphia was an endeavor that exposed the shortcomings for the business model as a whole, and ultimately resulted in negative publicity for the city.

The company I co-founded was busy deploying dedicated wireless to backhaul video for cities across the United States. These systems were mainly purchased by law enforcement and public safety agencies within those cities. We had a bird's-eye view and front-row seat to the downsides of Muni Wi-Fi. I remember having conversations internally with my business partner about jumping on this bandwagon, since we certainly had the expertise to deploy these systems; but further analysis exposed serious deficiencies in the model. Municipalities were basically offering up their infrastructure, such as light poles and electric, for internet service providers (ISPs) to install wireless hotspots throughout the city. The ISP would pay for the wireless infrastructure and operate the network. In turn, it would charge a "subsidized" monthly fee for access to the citizens, often sharing some of the revenue with the city.

After a major ISP won the Wireless Philadelphia contract, the provider began installing its network on a small scale by the summer of 2007. Slow and unreliable connection speeds resulted in just 6,000 people signing up by the following year. The ISP

quickly withdrew from the project, seeing no way to pay for its large infrastructure investment. Needless to say, the project was unsuccessful; but it also had the effect of making some people skeptical of the overall concept of widespread public connectivity in cities. Meanwhile, our company charged forward with building successful deployments of wireless-based video networks across dozens of cities in the United States.

While there were technical reasons most of the Muni Wi-Fi projects failed (for example, trying to maintain a reliable network on unlicensed wireless spectrum), the fact of the matter is that the approach and framework under which these projects were initiated were both seriously flawed. Back in 2007, the main problem for the digital divide wasn't so much the lack of broadband as it was the lack of low-cost devices for accessing the World Wide Web. Had the cities involved the communities from the start, instead of conducting unilateral negotiations between government and large industry, this glaring deficiency may have come to light.

It's important to contrast these two business models as we embark on a new municipal endeavor called smart cities. The model we operated under was one whereby cities used public and often

**70% of the world's population will be urban by year 2050.**

private funds to install cameras in areas where there was high crime. We used licensed spectrum on the 4.9GHz band to get cameras in places where no physical broadband connection existed. In other words, we used proven technology to deliver a solution at a fraction of the cost of running fiber or copper to those locations. On the other hand, the ISP took the majority of the investment risk in Muni Wi-Fi projects, with the cities taking mainly political risk. This "performance-based contracting model," in and of itself, wasn't the problem. While Wi-Fi has improved in some ways since 2007, the fundamental issue wasn't the technology, it was the approach. The problem was that both the ISP and the city failed to involve the citizens and local businesses, and, as a result, the project missed the mark.

Cities today are looking beyond the infrastructure problem (the big telecoms largely have won this battle with the ubiquitous nature of 4G networks) and the digital divide. They are focusing on specific problems they can solve through the adoption of a new technology called the internet of things (IoT). This is the idea that we can

connect real-world things to the internet. And, in doing so, we can glean real-time insights and make more informed decisions, resulting in greater efficiency both in business and government, and even in our daily lives. In essence, IoT moves us beyond smartphones and apps (human contribution of data) and instead assumes we have interconnected sensors and actuators that connect physical objects in the real world. We often refer to these sensors as IoT endpoints. An example of IoT in a city might be placing sensors on all the waste bins that tell the city when they need to be emptied, or a sensor on a light that increases intensity when it detects people nearby. The list of benefits that IoT can provide is virtually limitless.

### **So, What Is a Smart City?**

As is the case with most buzzwords created by technologists, we don't always agree on a common definition of a smart city. However, a smart city is ultimately about improving quality of life for residents. This mission can be generalized to society as a whole, but we like to talk about cities mainly because half the world's population



is living in them, a number that is expected to increase to 70% by 2050. In essence, to solve human challenges we must solve city challenges. To further define the smart city concept, we need to discuss what it means to improve quality of life. In general, people want opportunity and livability from their cities, with safety being an obvious underlying requirement for both of these. In order to achieve these goals, a city must learn from the failures of Muni Wi-Fi projects of the past decade and look to enable the more bottom-up innovations we've seen that are already having a positive impact on cities today. I would put forth that cities need to ultimately strike a balance between the top-down approach of partnering with industry leaders in the space and the bottom-up approach of the entrepreneur who creates the next killer app.

## The Asset-Sharing Society

We can learn a great deal by looking at two companies that have completely disrupted their respective industries: Uber and Airbnb. Uber and other ride-sharing apps have already positively impacted cities through reduction in DUIs and reduced traffic congestion. They have the potential cut greenhouse gas emissions, reduce wear-and-tear on city infrastructure, and so on. Airbnb is another example of a disruptive technology in the sharing economy category that can positively impact cities, especially cities that depend upon tourism dollars or have large universities full of technology-adopting students. Airbnb can increase a city's tax revenue through additional transient occupancy taxes collected, while providing a new source of revenue for its residents.

We can learn from the sharing economy and apply this to the smart city. Ultimately, these apps are about creating more efficiency from existing assets. It's about connecting people and their need for physical objects to achieve some goal and doing it in a more optimal way. Buildings, public transportation, first responders, critical infrastructure and even local businesses are all examples of foundational objects and organizations of people that form a collective and define what it means to live in a city. A city's assets are there to serve the interest of people and businesses. However, in many cities, these



Figure 1. Open IoT platforms like Hitachi's Lumada, in tandem with an inclusive community engagement approach, help produce innovative and effective smart city programs that lead to locally relevant outcomes.

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services are not fully optimized. For example: typically, street cleaning trucks operate on a schedule, regardless of whether certain streets need cleaning or not. Pothole reporting is ad hoc at best, although some bottom-up technologies are starting to address this inefficiency. Community policing is based largely upon where crime has historically taken place.

All of these things operate with little input from the community. However, what if we could think about these problems in a way that is similar to how Uber and Airbnb bring together assets and people today? These companies are among the largest transportation and lodging companies in the world, but own no cars or buildings: They simply provide a marketplace for providers (or prosumers) and consumers to find each other, and set the rules for them to engage. Ideally, we should be performing city operations and management much more

efficiently, bringing down the overall costs to the city or at minimum making them more efficient, so the city can do more with the resources it has. And as we move into an increasingly technological world, cities should provide the open digital platforms that empower residents and businesses to innovate and create opportunity, much as they already do with the physical platforms of municipal infrastructure.

## A Software Framework

In order to achieve this goal, a city needs a software framework that allows consumption of a multitude of sensor and human input in an open way. The true value of the smart city can only be realized through an open software platform that allows people to connect anything and everything. For example, citizens or devices should be able to quickly alert the city to an incident, which goes to a city's computer-aided dispatch

(CAD) system that connects to intelligent traffic systems to help first responders get to the scene faster. An open framework or platform would allow third-party applications and sensors to submit pertinent data, and would provide for both visualization of the information (so humans can understand it) as well as software algorithms that can help make decisions about actions that need to be taken, either by a human or an edge sensor. Hitachi has developed such an open platform, with its recently announced [IoT core platform, Lumada](#) (see Figure 1). An example of the benefits would be to use information from smartphone apps about streets that need to be cleaned, and scheduling the street cleaners to focus only on those areas. Another application would use sensors on street cleaners to detect potholes automatically. Other examples are sensors on bridges that measure vibrations, which could lead to early detection of a structural problem, or water quality sensors, flood sensors, and so forth.

Of course, all of these sensors and the vast amount of data they produce can become overwhelming for us humans to interpret. This is why it's important to also

understand the role that big data plays in the smart city. We can deploy low-cost sensors and develop smartphone apps and the open software platform to collect and store this information, but without computers and software to help us understand and interpret the data in order to make informed decisions it's not very useful. This is why a smart city framework must provide for both visualization and intelligence through software models. Big data is about revealing insights from large data sets that can then be further used to perform specific actions.

## Conclusion

Only by combining IoT with big data and an open software platform, can a city become truly smart. The need to strike that balance between bottom-up (citizen and local business based) and top-down (industry) approaches should not be underestimated when looking for solutions. Urban planners and, more importantly, city IT decision-makers need to shy away from point solutions. While these solutions address a specific problem using IoT, they require closed ecosystems that limit the future choices of the city and its stakeholders.

By implementing a proper framework that embraces the entrepreneur, supports open software interfaces and data between public and private entities, and puts citizens at the center of all decisions, cities can realize the full benefits of IoT. A collaborative effort is required to solve some of the most complex problems we face as a society; and any framework that affects society as a whole must incorporate all of the stakeholders.

Via this smart city framework, we are ultimately striving to increase the city's livability, economic vibrancy and sustainability, all of which make it easier to attract and retain the best talent. In this way, livability is the engine for new business investment and economic development. Livability is also the key to creating an innovative and entrepreneurial culture that provides a positive feedback loop for improving economic opportunity and providing a better quality of life for everyone in the city.

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