

# Chapter 11

## Cybersecurity and Privacy in Smart Cities for Citizen Welfare

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### ABSTRACT

*In smart cities, technologies and systems of various types, from manual sensors to data collection devices, cooperate to improve citizens' wellbeing. They take advantage of information technologies and the internet of things (IoT) to increase citizens' welfare through the implementation of services with distinct objectives, like reducing energy consumption and improving transport routes and health services. Due to their functionalities and characteristics, IoT devices work interconnectedly and collect large amounts of data. In this context, cybersecurity and privacy arise as topics of central interest, as security breaches can lead to personal data exposure and service interruptions and malfunctions, thus directly affecting citizens' welfare and the implementation of the Sustainable Development Goals. This chapter discusses how cybersecurity risks affect smart cities' operations and citizens' welfare. It presents some current cybersecurity techniques and how to apply them in the smart city context. It also reviews some open issues and future directions.*

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## **1 INTRODUCTION**

In recent years, the implementation of smart cities has attracted the interest of organizations from the most diverse areas, including government and academic institutions and even large industries. The transformation of a city into a smart city brings benefits to citizens and multiple entities. But it also requires new applications and services, which introduce new techniques and technologies that would have a direct role in revolutionizing the city.

In 2050, around 68% of the world's population would live in an urban environment (Nations, 2018), which would lead to a high excess of collected data and high resource utilization due to the immensity of existing services that there will be. On the other hand, climatic problems and over-population would change the population way of life, thus having the opposite effect that one intends with smart cities (Nations, 2018). To overcome such challenges, improving the well-being of the cities' population, city governments should adopt specific measures, like creating sustainable environments and applying intelligent systems. Currently, there are massive investments in the development of smart cities, e.g., there are more than 200 projects in progress only in China (Cui et al., 2018).

The deployment of intelligent services often occurs in a long-term project. For instance, consider the case of Rio de Janeiro, Brazil. Rio de Janeiro has approximately 6.5 million inhabitants and (partially or fully) hosted a series of relevant international events over ten years (between 2007 and 2016), including the 2007 Pan American Games, the Rio+20 United Nations Conference on Sustainable Development, the 2014 FIFA World Cup, and the Olympic Games Rio 2016. Several strategic actions were taken to prepare the city for the events (Gaffney & Robertson, 2018). One of the most relevant was the creation of the Rio Operations Center (COR). The initial motivation for the creation of COR in 2010 was the real-time monitoring of rains and storms. But with the need to prepare the city to host major events, COR was turned into a central operation point, integrating agencies and utilities of several services, including the ones related to areas like incident management and responses to emergencies, transport and mobility, citizen safety, and energy efficiency (Schreiner, 2016). Then, in 2013, the Smart City Expo World Congress awarded the Smart City of the Year award to Rio de Janeiro, with COR being among the long-term initiatives that judges valued (Fira de Barcelona, 2013).

Smart cities are highly dependent on the Internet of Things (IoT). They comprise the use of thousands of interconnected devices, which collect information. Specialized systems and applications apply this data for the interest of the citizens by performing data analysis and predictions. Thus, they help in the decision-making process in various areas such as transport and health services, besides facilitating the management of the city. Although there are several types of applications and systems, a common characteristic is that they need large amounts of data to work adequately. Such data is collected, processed, analyzed, and usually shared between different systems, making it necessary to apply cybersecurity and privacy maintenance techniques in all operations related to the data (Cui et al., 2018).

People often consent to applications and devices to monitor their habits, preferences, and activities. Then, search engines would use such data to present results targeted to the person's location and profile. Social networks would use those data to show relevant information according to each person's interests, and streaming tools would advertise products that suit the person's tastes and needs. Hence, people often give up privacy in exchange for the comfort and supposed well-being that intelligent customizations would offer. If the monitoring of one person and the sharing of collected data with certain service providers (e.g., applications) can promote a supposed increase in well-being and simplification at a personal level, then the broader monitoring of the entire population of a city with data sharing between city services,

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