Chapter 4
Making Cities Smarter: IoT and SDN Applications, Challenges, and Future Trends

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ABSTRACT

The internet of things (IoT) entails all devices that can get onto the internet. This is mainly because of the technological advancement. This exponential growth of IoT increases on the dense nodes with a huge data volume on the network that affect the collision and network congestion probabilities. This chapter presents a comprehensive description of the central and supporting innovations that are used to make cities smarter, focusing on the fifth generation (5G) IoT paradigm from a software-based network viewpoint. Furthermore, the main initiatives of international significance are discussed. Also, the chapter presents software-defined networking (SDN), IoT, and network function virtualization (NFV) challenges as it relates to the user privacy and security, IoT security, energy consumption, integration of IoT with subsystems, and architecture design. A segment of the top five future trends that are made and will make cities smarter is conclusively included.

INTRODUCTION

The IoT is a concept where electronic devices and components communicate with other through the internet (Al-Turjman et al., 2022). IoT systems employ sensors to perceive and gather data then sent via a specific gateway to the cloud or even a command centers for additional archiving, processing, analytics, and decision-making. The system's actuator then receives a corresponding command in accordance with the decision in reaction to the identified data volumes. IoT addresses some of these issues in energy plant management. Internet-connected devices can detect any operational malfunction or irregular decrease in energy efficiency using IoT sensors, signaling the need for maintenance (Bahalul Haque et al., 2022).

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The research shows that the latest IoT-based energy plant saves approximately 237 million euros over its lifespan, while an existing plant of the same capacity will save fifty million dollars.

Data processing in the factory's structure is a critical component since it enables data in the cloud networks to be evaluated to assist managers in making more effective decisions in real time. The depreciation of machinery and mechanical devices is a major problem in factories about monitoring and sustaining manufacturing properties. The proper system size can be chosen using a suitable IoT platform and tools to minimize corrosion and related protection costs (Parameswaran et al., 2022). The autonomous system certainly not exceeds the threshold limits due to the IoT-based conditional control. In short, this means the system will last longer with fewer failures. Furthermore, errors that result in energy loss are expected to be addressed. In the IoT-based net, energy is always needed for proper execution, like in databases. All assets linked to the grid in such systems can communicate with one another. Furthermore, data on any asset's energy demand is available. This relationship will ensure that energy delivery is perfectly always controlled in all areas. In terms of smart grids' collaborative effect, different parts of the city can be linked together.

A fog node in fog computing is any device capable of computing, storing data, and using the internet. Examples of these machines are personal computers and factory controllers, among others. In this computing model, fog processes and stores IoT data locally on IoT devices rather than sending it to the cloud. Enhanced secure services, including latency and network traffic reduction, are among one of the identifiable benefits of this approach (Zhao et al., 2022). As a result, distinct cloud and fog computing provide processing and computing services that are quicker and more secure. This allows for quicker decision-making and appropriate action. In the IoT domain, among the most urgent issues are security and energy usage (William et al., 2022). IoT devices, for instance, have restrictions owing to heterogeneity in energy resources and computation, which could result in communication bottlenecks and the adoption of security solutions. Figure 1 shows the graphical structure of the chapter.

Temperature-supported sensors are utilized to track cooling and heating fluctuations within the system. Without doubt, temperatures are crucial and widely used various environmental metrics. The approach of converting mechanical to electrical energy is the basic concept of energy. Thermal or temperature conversion are used to achieve these energy conversions, allowing energy to be handled appropriately to conserve energy. The IoT technology application is broad, entailing demand side, services, regulation, and markets, utilities and generation, transmission, and distribution are shown in Figure 2. All these are used to regulate a variety of processes in a smart city.

Humidity sensors differentiate between the volume of moisture and the humidity of the air. The relative humidity is described as the ratio of air moisture to the maximum moisture amount at a specific air temperature. The sensors (for instance, humidity sensors) have a broad range of uses in the energy industry. They're commonly used in the wind energy industry, for example. When wind turbines are located, offshore, humidity sensors are even more important (Yun et al., 2021). For continuous moisture monitoring, these sensors found nacelle mounted and at the bottom of wind turbines. Consequently, operations are more stable, more efficient, and have lower energy costs since operators are better equipped to respond promptly to changes or variations in the operating circumstances of the turbine.

Light sensors: To measure a light's luminance or brightness, light sensors are utilized. They are employed in a variety of commercial and residential appliances, depending on the energy usage. Lighting is the main source of this energy, which we use in houses, which is 15% approximately of the overall electricity use. On a global scale, lighting consumes approximately 20% of all energy (Pandey et al., 2022). This can reduce the amount of energy used for interior illumination. Motion sensors are applied