IoT Case Study: Smart Cities and IoT

Submitted by:

Vishal Singh Yadav
CS20MTECH01001

1. Introduction

New Internet of Things applications are enabling Smart City initiatives worldwide. Even cities established long before these technologies are now incorporating these systems to provide a better quality of life for their people and efficiently carry out day-to-day tasks without friction from the process. In this case study, we look at the different methods these systems are being incorporated and the effect these systems have on people's lives.

2. Motivation

Recently, many new Smart City initiatives are being undertaken worldwide. With a growing population, there are growing demands from the people. It is now more necessary to improve people's quality of life with optimal usage of resources available. The new Internet of Things applications provides the ability to monitor, manage remotely, and control devices en masse and create new insights and actionable information from massive streams of real-time data[4]. This stream of data offers opportunities to tackle pollution, transportation, planning, etc., in a better and data-driven way than traditional cities[5].

3. System Design

System Architecture:

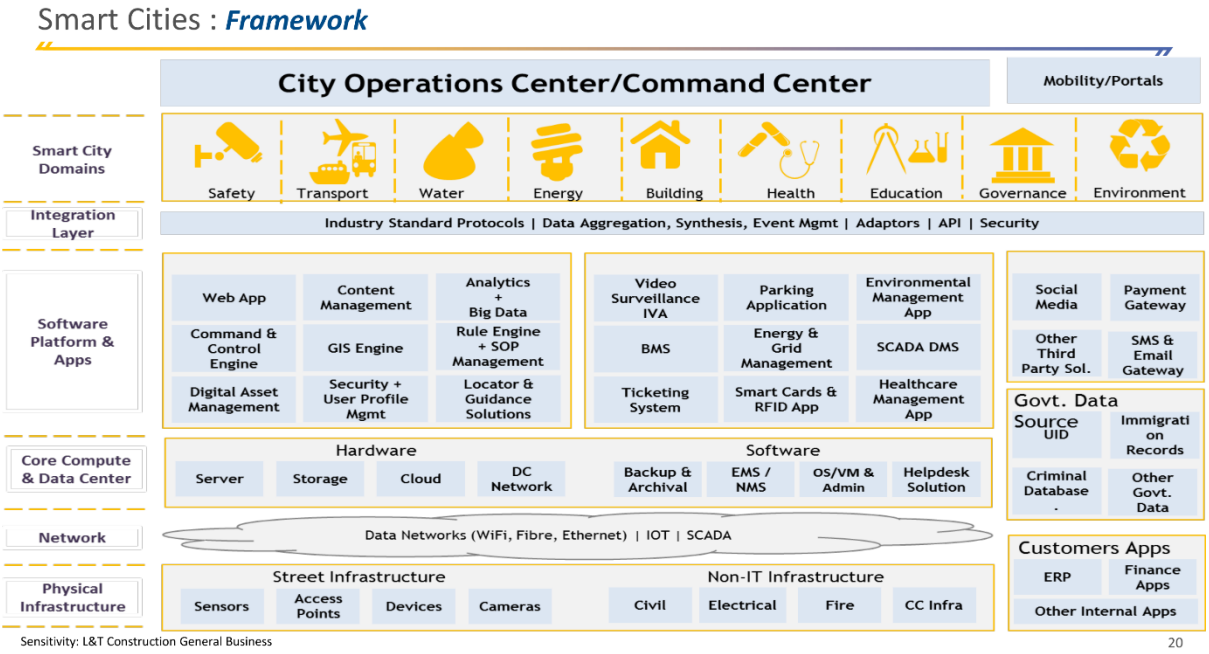

Figure 1 Smart City Architecture [6]

In a smart city architecture, the essential components are smart technology, smart industry, intelligent services, and intelligent management services[1]. To achieve this level of sophistication, we need to install multiple sensors such as RFID, IR, GPS, laser scanners, etc., for everything. These enable intelligent recognition, location, tracking, monitoring, and management.

In addition to these sensors, which work invisible to humans and are focused on information tracking, we also need additional infrastructure such as smart utility meters, intelligent transportation, waste management solutions, air quality monitors, etc.[2]

As shown in the diagram below, a smart city contains multiple components working together. Broadly, the domains of a smart city include:

Safety – This includes installed cameras, location trackers, vehicle identifiers, and other infrastructure necessary for the safety and well-being of the people residing in the city.

Transportation – It refers to the usage of IoT technologies for traffic management and smarter, better public transportation usage. With the integration of these technologies in the transportation system, it is possible to plan routes for people to reduce congestion and reduce travel time even when a lot of people are traveling. Additionally, it also allows the possibility of alerting drivers of potentially hazardous situations in time to avoid crashes, effectively utilizing parking spaces around the city, prioritizing traffic, detect and promptly respond to traffic incidents, reroute traffic in case of any incident, adjust speed limits and signal timings in real-time based on real-world conditions, make public transportation convenient and reliable and also opens the possibility of demand-based transportation. [7]

Smart utilities(electricity and water) – Smart utilities such as smart grids, smart meters provide real-time data to organizations providing these services. Unlike traditional systems, where these companies had to rely on historical data and manual human intervention to keep the demands met, real-time data provide exact details to these organizations of how their services are being utilized, where there is high demand and low demand. This enables them to adjust to requirements of people dynamically. It can be seen in a scenario where many people use electricity and water in the morning hours when they leave for office. The usage is low for an entire day which increases again during the evening. In a traditional method, if there is a deviation from standard procedure, the system may fail, which will not happen if the utilities have real-time data.

Building infrastructure – Since infrastructure is the most crucial part of any human society, such infrastructure must be appropriately maintained and kept in reasonable condition at all times. This includes bridges, flyovers, roads, buildings, etc. Since a failure can be economically costly and to human lives, IoT systems can automate and control building operations such as fire and safety, security, air conditioning, etc., as well as keep a watch on the structural integrity of critical components.

Governance – As all policies should indicate what the people want, many of these policies can now be based on data, thereby making better policies.

All these domains need a lot of data and connectivity to function correctly and make proper decisions. Talking about connectivity, let's discuss protocols and communication standards used in smart city Internet of Things applications.

Connectivity:

In a general sense, applications that require short-range communication can use protocols such as IEEE 802.15.4 (Zigbee), 801.15.1 (Bluetooth). These protocols have low bandwidth and energy requirements.
Applications with more extended range requirements use IEEE 802.11 (Wi-Fi) and IEEE 802.16 (WiMAX).
ANSI C12.18 is an ANSI standard that describes a protocol used for two-way communications mostly used in the North American market. IEC 61107 is a communication protocol published by IEC that is used in European Union. Additionally, Open Smart Grid Protocol(OSGP) is a family of specifications published by ETSI used worldwide[1]. These protocols are used for smart meters and other utilities.
IEEE 802.15.4 and IEEE 802.15.1 are used for smart buildings.
IEEE 802.16 and cellular data are used for smart grid and gas and oil pipeline monitoring.
IEEE 802.15.4, IEEE 802.11, and IEEE 802.16 are used for smart water networks.
IEEE 802.16, IEEE 802.11, IEEE 802.15.4, and cellular data are used for transportation applications.[3]

3. Impact

Due to the considerable importance given to data in Smart Cities, it leads to more effective and economical solutions by reducing losses and wasteful utilization of resources. This is especially necessary as resources are limited, and with an ever-growing population, waste of resources must be minimized. It has also made people more comfortable and increased the quality of life for people living in these cities. This has also led to the removal of low-paying jobs that these automated systems have taken place in. Though it will increase the number of specialized jobs and people's lives in the long term, the short-term impacts are not good. Where the systems have been used as a part of the process instead of replacing the process, we have seen better efficiency and lower costs.

4. Conclusion

In this case study, we have examined the need for smart cities and what some upcoming cities can incorporate from the beginning to make life better for people residing there. Though a small city/town can survive without interconnection, it is an essential system for large cities/ metropolitans. The growing demand for the infrastructure and needs from people cannot be met sufficiently / economically without causing issues or reduced availability. As more cities grow in size, a smart city will be a necessity and not a good to have.

5. References

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