

Why is Cloud Computing the Future for Smart Cities?

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ABSTRACT

The Distinct Issue “Cloud Computing and Smart Cities” of the Journal of Smart Cities emphasizes smart city solutions that are deployed over various types of the cloud environment and discuss encounters and resolutions related to the use of cloud computing, and mainly the migration of smart city services to the cloud. The papers involved are based on tests that highlight how cities can take advantage of cloud-based solutions in infrastructure, platforms, and application (IaaS, PaaS, SaaS); lessons learned from research with cloud platforms; difficulties and enablers in using cloud technologies; and changes to applications and e-services along their migration to cloud environments. In developing smart city services with cloud computing and making the required internal organizational changes, some contributions offer recommendations and guidelines to public authorities. For the special issue, Six papers and contributions by twenty-two authors are selected. Following an introductory paper on cloud computing and smart cities, two papers discuss platforms and cloud-based environments for the deployment of services; two papers focus on big data and cloud-based applications that can reveal behaviors and trends in smart cities; the final paper looks at the challenging issue of data security in cloud-based environments.

KEYWORDS: Cloud Computing, Smart Cities, Research and Development

INTRODUCTION

Cloud computing, in which access and calculation are collected in cluster server in the applications and network requirement from customers is served by the client browser software, is a kind of new information processing model. In recent years, cloud computing has gradually been a hot topic. From Google Apps to Microsoft, cloud computing has gradually come into our life. As a kind of usage and delivery patterns about service and the infrastructure, cloud computing provides a kind of new way of information resource sharing and service.

In recent years, the integration of physical systems about the development of information represented by the internet of things has become the new goal of city development. To reply to the tendency, International Business Machines Corporation and Cisco Corporation provide the concept of smart city, which advanced city information to the next level. At present, governments around the world published relevant policies to encourage the development of cloud computing and smart city and paid much attention to cloud computing.

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Smart cities can form a kind of new life based on data mining from big data, engender new management models of the information society by using information technology such as cloud computing and the internet of things. Such as the people's living, environmental protection, public security, city services, etc. Smart cities can be speedy and intelligently responsive to all kinds of city needs.

The core purpose of smart cities is to make information infrastructure more perfect, construct the platform of information sharing, and provide automatic services for customers on the application side by using single or multiple data sources and virtualization technology. And then, the public management of public, enterprise and city can receive more convenient services.

The roll of cloud computing in smart city:

With smart cities, people's living standards rise and their living areas become better. People can easily access the information they want and plan accordingly. In this way, they live a better quality and

productive world. They can also remotely control and direct any smart system at home, in his office, or his car, regardless of location and time. Also, thanks to intelligent systems, government agencies can control different parts of the city as well as foresee and take precautionary damages. Health, military, industrial, environmental, agricultural, logistics, transportation systems are realized with social gains and economic. All these smart systems require infrastructure. There are many financial and technical needs such as the servers that the devices that make up the systems can send the data, the servers where these data will be stored,

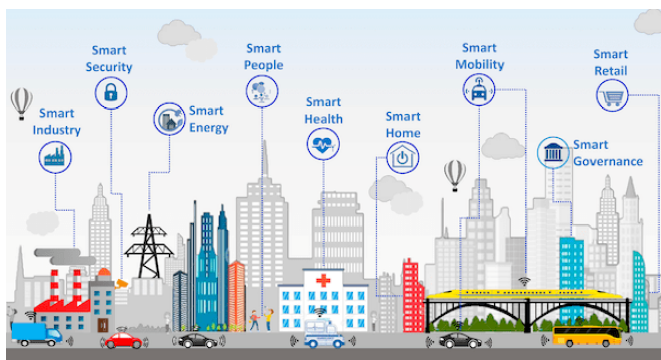


Figure 1 Smart City [Silva et al., 2018]

The security and maintenance of these servers. At this point, Cloud Computing develops. Cloud computing, a new generation of topics, is the general name of Internet-based IT services that can be used by computers and other devices at any time and provides shared resources among users. With Cloud Computing, users can access the system from anywhere on the internet. Cloud Computing is becoming a part of technologies in smart cities with its success in cost, global scale, speed, performance, efficiency, security, and reliability. With cloud computing, servers, storage areas, databases, and numerous application services are easily accessible over the internet, making integration of the systems in smart cities and the exchange of information between them more constructive. In this study, the role of Cloud Computing in smart cities will be explained.

Literature Review:

Indian cities and cities around the world are gradually evolving. It is not a sudden decision with planned infrastructure in advance. The concept of Smart City has been suggested in a planned city, with such impact that each activity carried out in the city is controlled and supervised by technology. A building alone is not enough, but to maintain and sustain their identity. Authenticity and integrity is another task to be processed and implemented. There are several challenges in making a smart city in India, as there are several explicit and implicit obstacles that must be confronted.

-by Prof. Rahul Wantmure and Dr. Murlidhar Dhanawade (2016)

Official statistics are considering larger data for the construction of new statistics because of its potential to produce more timely statistics and relevant than traditional data sources. The author has presented three forms of integration of R and Hadoop to process large-scale data sets: R and Streaming, Rhipe, and RHadoop. Rhipe and RHadoop allows users to define and call their map and reduce functions within R while streaming uses a command-line approach in which the map and reduce functions are passed as arguments.

-by Bogdan Oancea and Raluca Mariana Dragoescu (2014)

As the volume of traffic is increasing day by day, it becomes difficult to process and store such large data sets using traditional software. A set of storage devices for storing such vast amounts of data and also a parallel computing model for the analysis of those huge data entries is needed. Hadoop is one such framework that provides a reliable cluster storage facility, which stores large amounts of data in a distributed manner using a special file system, called system distributed Hadoop files, and provides functions for efficient parallel processing through framework MapReduce. In MapReduce, filtered data traffic can be easily recovered, to provide end-users with traffic analysis and provide useful predictions.

-by KoushalyaBijjaragi, Poonam Tijare (2016)

Advantages of Cloud Computing In Smart Cities:

Cities develop digital infrastructure it, not just aids in producing enormous amounts of vital data for private and public sectors but also creates a safer environment. But beyond that, smart cities also need to improve transparency, operations and create new ways to connect citizens with cities and businesses. Cloud has its applications and benefits in the same direction. So let us look at some of its advantages discussed further.

Well-organized Data:

Data combination and mining are some of the key aspects that smart cities require to develop. Even for a smart city to come into analysing, processing, existence, synthesizing, and managing the mass flow of data is crucial. To ensure such changes happen efficiently and consistently, Cloud is necessary. The advancement in Cloud computing supports swift delivery and consumption of data.

Support to Sustainability Factor:

We know smart cities are nothing without sustainability in their operations, the role of Cloud computing becomes much more relevant. Smart cities

are utilizing resources that have a definite impact on the environment. To overcome this challenge, cities are exploring sustainable solutions such as enhanced decision-making, planning, design, management, and resourcing that work in line with the principles of sustainability.

Increased Economy

When innovative technologies are created to support smart cities, it ultimately results in the boost of the economy. Cooperation between businesses and cities can attract huge profits. Along with the city, even businesses can leverage the data being gathered. They can comprehend their target population better and provide relevant services.

Cost Efficiency

If cities cannot reduce operational costs, the whole idea of developing a smart city goes in vain. To create smart cities it is important that operational costs in the cities are reduced and enhanced level of services are delivered to citizens. In simple words, Cloud-based applications and services can reduce costs for citizens while delivering better service.

Challenges faced by Cloud Computing In Smart Cities:

A smart city achieves these benefits and improves city operations using a network of IoT sensors, big data analytics, smart mobility services, and more. In this article, you will learn about crucial smart city challenges.

The burden of sensor infrastructure:

Smart cities use sensors to collect information, analysing it with big data and AI technologies to improve quality of life. The data can include live traffic information, air quality, health data from across the city, etc.

This sensor infrastructure represents a heavy investment and a major operational burden. Cities must consider how they will be powered – hard-wired, solar, or battery – and which city department and budget will be responsible for their maintenance and installation

How to overcome

Smart city planners should consider the infrastructure challenge from the very beginning. Planning for smart city infrastructure and raising special funding from smart city organizations and government programs can be a great start.

Furthermore, in many cases cities started collecting data using existing infrastructure, such as bus system ticketing, existing CCTV and legacy traffic monitoring systems. This is an alternative for cities where funding or resources are limited.

The connectivity problem:

Smart cities need to provide strong connectivity for residents and visitors to support economic development and enable connected city services. However, even in large Western cities, achieving a good level of connectivity is far from trivial. There are three elements involved:

- Connectivity operators, who need to provide sufficient coverage and capacity for different regions of the city.
- Venue owners and businesses host connectivity equipment or run their private equipment.
- Municipal governments, who need to cooperate with operators and private businesses to ensure there is sufficient coverage across the city.

How to overcome

One technological approach is intelligent digital distributed antenna systems (id DAS). This approach is a network topology that supports multiple connectivity requirements in smart cities.

Digital DAS is cost-effective, energy-efficient, and can provide a good level of coverage in almost any urban environment. DAS is also able to support 5G technologies, for cities preparing for the next generation of mobile connectivity.

Safe use of cloud computing in a smart city:

Smart cities must rely on cloud computing technology to host data and operational services, share data with stakeholders, and provide broad access to residents. At the same time, city services manage large volumes of highly sensitive data, much of it subject to privacy concerns and regulations, which may not be appropriate for storage on a public cloud.

Most cities adopt a hybrid cloud strategy, with some systems hosted on-premises or in a private cloud architecture, and some on the public cloud. But this raises multiple operational and security challenges, which are difficult to handle given the limited IT resources available to cities.

How to overcome

In 2019, the Smart City and Community Challenge group released a blueprint that can help smart cities adopt a secure cloud architecture that supports confidentiality and protect personally identifiable information (PII) based on hybrid cloud concepts.

The blueprint can help smart cities adopt mechanisms to coordinate cloud services, including cloud backups for disaster recovery. Its recommendations are based on the National Institute of Standards and Technology (NIST) Cyber security Framework and contain steps to help cities limit risks to the confidentiality, availability, and integrity of data. Following the blueprint can help cities accept a practical, secure

cloud architecture without needing to “reinvent the wheel”.

The recommendations include a three-level data classification scheme for data risk, which can help build a hybrid cloud or multi-cloud architecture. The three tiers are:

- Red, for highly sensitive data like PII
- Yellow, for data that can be shared more widely
- Green, for low sensitivity data that can be shared openly

Based on data classification, smart city officials can determine legal and regulatory requirements, security policies, and data storage and collection practices to protect privacy and security.

Future Enhancement:

As we move into the future and technology becomes even more advanced, the majority of capital cities will become ‘smart cities’.

A smart city uses cloud computing, data, and technology to streamline services to make a city more connected, manageable, efficient, and cost-effective. Smart cities drive innovation, have connected residents, optimize governance, and make better use of precious resources.

However, several steps need to be implemented before a city can be considered ‘smart’.

The first is infrastructure. This includes wireless and fiber broadband to enable connectivity, and cloud services to monitor, maintain, update, and store data. The cloud enables vital data to be stored off-site with ease of accessibility, meaning fewer and less devastating system failures and the ability to facilitate swift disaster recovery.

Security is also key to a smart city. As smart cities can monitor and deploy fundamental services such as public transport, utilities, and other services, they mustn't be vulnerable to breach physically or virtually. The cloud and new security measures, such as blockchain, help make smart cities impervious to breaches.

Finally, centralized management is key. Using artificial intelligence and machine learning, smart cities can be monitored locally or remotely, to ensure seamless and efficient deployment of services. Using

technology, issues can be identified and rectified before they become problems, disaster recovery becomes a matter of moments rather than days, and utility usage can be monitored and optimized so costs, and carbon footprint, are reduced.

Conclusion:

The purpose of creating a smart city is to apply digital transformation in a way that drives efficiency and operations and centralizes services. However, these efforts could go wrong at any step of the way.

This is why planning is a crucial step for any smart city in the making. Proper planning can help cities avoid unnecessary overhead and delays.

A good smart city plan should not only employ new tech but also leverage existing resources. New tech should be introduced with connectivity to legacy operations in mind. Cybersecurity should be a concern during every step while ensuring the protection of data and privacy of users.

As technologies continually change and mature, smart cities should be planned with flexibility in mind, predicting and allowing for the future evolution of the smart city.

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