Integration of Internet of Things and Cloud Computing

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Abstract: Cloud Computing is a remote location technology that has transformed the way of Information Technology. Internet of Things (IoT) is radically changing the way of businesses operate and people interact with the physical world. The combination of Cloud Computing and Internet of Things build a robust, maintainable, end-to-end Internet of Things solution on cloud platform. It creates streams of insight by extending your infrastructure to the physical world. This paper covers the role of cloud computing in IoT and why IoT and cloud computing are inseparable. Cloud computing and the IoT both serve to increase efficiency in everyday tasks and both have a complementary relationship. The IoT generates massive amounts of data, and cloud computing provides a pathway for this data to travel. Storing data in the Cloud, the IoT companies to change directly, quickly and allocate resources in different areas.

Keywords: Internet of Things, Cloud Computing.

I. INTRODUCTION

Internet of Things is nothing but a network of everyday objects tied to the internet. When connected to the internet, all the data that has been generated by the devices has to be stored somewhere for processing and retrieval and this is where cloud devices come into action[1]. The Internet of Things technology would be incomplete without cloud computing and that is exactly why the IoT job market also eyes on cloud computing experts for its projects. Companies into IoT are now increasingly looking for cloud experts, who can blend in the technology as seamless as possible into the IoT devices to eliminate any instance of data loss, distortion, or lag to enable smooth functioning of the connected devices. The arrival of cloud technology, there has been a huge shift towards utilizing it as a method of storage for individuals and organizations. The scalability and data dynamics there is a great deal of stress being given to the utilization of Cloud computing to make information accessible remotely. Today, cloud computing has more or less penetrated mainstream IT and its infrastructure[6]. Many of such as Amazon, Alibaba, Google and Oracle are building machine learning tools with the help of cloud technology to offer a wide range of solutions to businesses worldwide.

II. RELATED WORK

The IOT and the Cloud computing is to increase productivity in the everyday tasks, without disturbing the quality of the data stored or exchanged. The relationship is common, both of them complement each other successfully. The IOT becomes the source of the information, while the Cloud turns into an ultimate destination for it to be stored[6].

The main goal of the interaction and cooperation between things and objects which sent through the wireless networks is to fulfill the objective set to them as a combined entity. In addition, there is a rapid development of both technologies, Cloud Computing and Internet of Things, regard the field of wireless communications[3]. In this paper, we present a survey of IoT and Cloud Computing with a focus on the security issues of both technologies. Specifically, we combine the two technologies i.e Cloud Computing and IoT in order to examine the common features, and in order to discover the benefits of their integration.

A.   How IoT and cloud counter part of each other :

Cloud computing, as well as IoT, work towards increasing the efficiency of everyday tasks and both have a complementary relationship. On one hand, IoT generates lots of data while the cloud computing covers way for this data to travel. There are many cloud providers who take advantage of this to provide a pay-as-you-use model where customers pay for the specific resources used. Also, cloud hosting as a service adds value to IoT startups by providing economies of scale to reduce their overall cost structure[10].
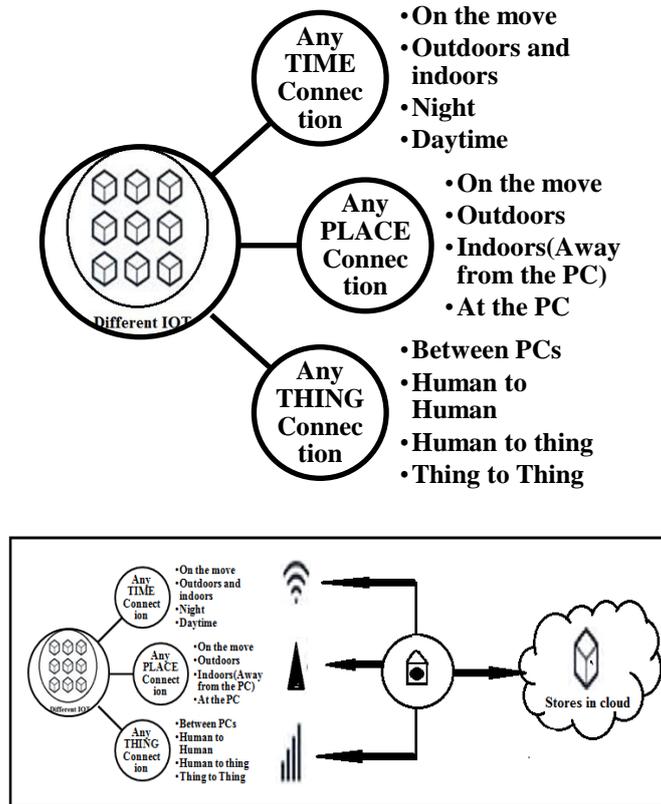
Figure 1: Different IoT integrate & access to Cloud

In addition, cloud computing also enables better collaboration for developers, which is the order of the day in the IoT space. By facilitating developers to store as well as access data remotely, the cloud allows developers to implement projects without delay.

Specification	Internet of things	Cloud computing
Big Data	Acts as a source for big data	Acts as a way or a means to manage big data
Reachability	Very limited	Far spread, wide
Storage	Limited or almost none	Large, virtually never ending
Role of Internet	Acts as a point of convergence	Acts as a means for delivering services
Computing capabilities	Limited	Virtually unlimited
Components	Runs on hardware components	Runs on virtual machines which imitate hardware components

Table 1: Specification of IoT and Cloud computing

Also, by storing data in the cloud, IoT companies can access a huge amount of Big Data. So, in a bid to lay down the relationship between IoT and cloud, here is a table that will let you know how they fit into each other

B.   Cloud is essential to the success of IoT :

cloud computing is built on the tenets of speed and scale, IoT applications are built on the principle of mobility and widespread networking. Hence, it is essential that both cloud and IoT form cloud-based IoT applications in a bid to make the most out of their combination. This alliance has led to the success of IoT[9]. In addition to this, here are a few more pointers as to why the cloud is important from the point of view of IoT's success.

1)   **Provides remote processing power**

Cloud as a technology empowers IoT to move beyond regular appliances such as air conditioners, refrigerators etc. This is because the cloud has such a vast storage that it takes away dependencies on on-premise infrastructure. With the rise of miniaturization and transition of 4G to higher internet speeds, the cloud will allow developers to offload fast computing processes.

2)   **Provides security and privacy**

IoT's role in harnessing mobility is immense. However, its prowess would be incomplete without security. Cloud has made IoT more secure with preventive, detective and corrective controls. It has enabled users with strong security measures by providing effective authentication and encryption protocols. In addition to this, managing and securing the identity of users has been possible for IoT products with the help of biometrics. All of this is possible because of cloud's security.

3)   **Removes entry barrier for hosting providers**

Today, many innovations in the field of IoT are looking at plug-and-play hosting services. Which is why the cloud is a perfect fit for IoT. Hosting providers do not have to depend on massive equipment or even any kind of hardware that will not support the agility IoT devices require. With the cloud, most hosting providers can allow their clients a ready-to-roll model, removing entry barriers for them[10].

4)   **Facilitates inter-device communication**

Cloud acts as a bridge in the form of a mediator or communication facilitator when it comes to IoT. Many powerful APIs like Cloud flare, Cloud Cache and Drop are enabled by cloud communications, allowing easy linking to smart phones. This eases devices to talk to each other and not just us, which essentially is the tenet of IoT cloud[8].

It would be fair to say that cloud can accelerate the growth of IoT. However, deploying cloud technology also has certain challenges and shortcomings. Not because the cloud is flawed as a technology but the combination of IoT cloud can burden users with some obstacles. If you ever go ahead with an IoT cloud solution, it is better if you know the kind of challenges you may face in advance.
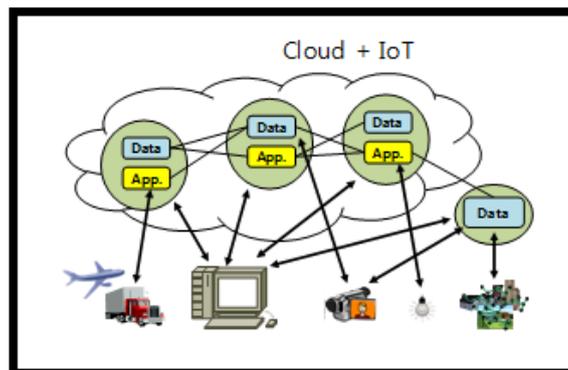

Figure 3: Cloud and IoT

The Figure 3 shows the cloud has several advantages over on-premises storage for IoT data There is typically a more direct connection between the device and the public cloud provider. This direct link means data can be stored off-device faster, resulting in less storage on the device and lower per-device cost. Storage management is now the cloud provider's problem. The provider's job is to provide a service, and the organization just needs to use that service. The cloud makes an ideal storage location if the organization is using cloud compute to process IoT data.

III. CHALLENGES FOR FUTURE

standardization cloud and IoT together :

1)   Handling a large amount of data

Handling a large amount of data can be overwhelming especially when there are millions of devices in the picture. This is because the overall performance of applications is at stake. Hence, following the No SQL movement could be beneficial, but it is not tried and tested for the long run. Which is why there exists no sound or fool-proof method for the cloud to manage big data[11].

2)   Networking and communication protocols

Cloud and IoT involve machine-to-machine communications among many different types of devices having various protocols. Managing this kind of a variation could be tough since a majority of application areas do not involve mobility. As of now WiFi and Bluetooth are used as a stop-gap solution to facilitate mobility to a certain extent[2].

3)   Sensor networks

Sensor networks have amplified the benefits of IoT. These networks have allowed users to measure, infer and understand delicate indicators from the environment. However, timely processing of a large amount of this sensor data has been a major challenge. Though cloud provides a new opportunity in aggregating sensor data it also hinders the progress because of security and privacy issues[10].

4)   Technical consideration for standardization

- ❖   Object naming
- ❖   Virtualization
- ❖   Inter-clouds
- ❖   Distributed clouds (edge clouds)
- ❖   Security
- ❖   Geo-distribution
- ❖   Mobility considering mobile objects
- ❖   Resource provisioning for constraint objects
- ❖   Application-awareness
- ❖   Big Data considering dynamics of traffic pattern
- ❖   Connected objects and interdisciplinary fusion services [4].

IV.CONCLUSION

The IOT and cloud are the future of the world. The integration of cloud computing and IoT is indicative of the next big achievement in the world of internet. New applications developing from this combination known as IoT Cloud which opens new doors for business as well as research. Large protection and data collection and processing of the data is possible using cloud. The secure data transport, less bandwidth utilized faster response . In this paper we covers how IOT and cloud emerged to provide elastic computing recourses provides everything as a service starting from computing infrastructure to the applications in different domains. So cloud computing and the idea of the internet of things with applications in all fields of our daily life as any TIME , any THING will be connect from any PLACE .We present the contribution of Cloud Computing to the IoT technology. Thus, it shows how the Cloud Computing technology improves the function of the IoT. This combination is useful for the future of multi-networking and an open service platform for users.

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