International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)
Web Site: www.ijettcs.org Email: editor@ijettcs.org
Volume 6, Issue 2, March - April 2017 ISSN 2278-6856

Integrating the IoT with Cloud

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Abstract: Integrating Internet of things with cloud computing is gaining popularity in the recent trends. The needs of sensor nodes deployed in the IoT environment are fulfilled by the cloud service providers. This paper focused on integration of cloud platform with IoT to fulfil the data requirements of IoT and research issues related to them.

Keywords: Cloud, IoT, gateway, QoS, Sensor nodes.

1. INTRODUCTION

IoT is the term first used by kevin in 1988 [1]. The IoT is defined as the connection made with an object either it is a living thing or non-living thing. For instance, a tree, dustbin, smartphone, anything can be a part of the IoT. The communication between the objects is carried by using the Radio frequency identification tags (RFID). IoT contains not only the things but also smart objects. These objects have the ability to compute the tasks and communicate with the internet and humans.

The IoT is organized with three layers such as perception layer, network layer and application layer [2-4]. In the past decade, the advancement in the field of Internet of things (IoT) grown rapidly. Productive research is still in progress to improve the next generation internet. There is a need of integration of IoT with cloud due to the production of Zetta bytes of data from the IoT devices. In the future, the devices connected to internet will be more than the people connected to the internet. The architecture of IoT is given in Figure 1.

Cloud computing is the new era in the recent years. Cloud computing is a paradigm where it can provide any thing as a service. The major services provided by the cloud are infrastructure as a service, software as a service and platform as a service.

Cloud computing offers the services with pay-as-you-use policy and the users have the flexibility to use any service by renting them [19]. Cloud is the extending platform of parallel and distributed computing [5-7]. The large industries can utilize cloud services without any installations of high computing devices.

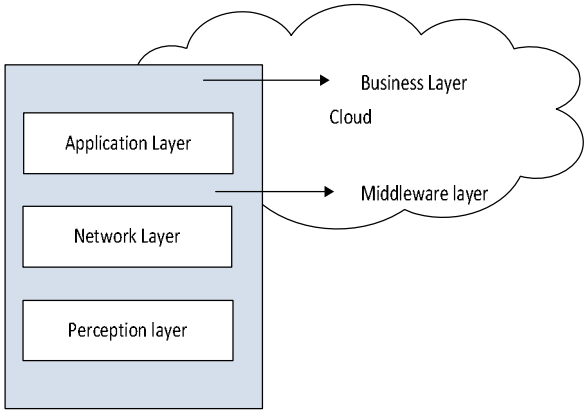

Figure.1 Layered Architecture of IoT

This paper focused on integration of cloud platform with IoT to fulfil the data requirements of IoT. We focused on discussing the issues of cloud IoT integration and proposed a framework for communication between the cloud and IoT which is not there previously.

The rest of the paper is organized as follows. Section 2 deals with the layered architecture of IoT. Section 3 explains about the scenario of integrating IoT with cloud services and finally conclusion is drawn in Section 4.

2. Layered architecture of IoT

In figure 1, the layered architecture of IoT is presented. Perception layer, network layer and application layers are the three general layers considered in the architecture of IoT, but in recent studies, additional two layers are defined such as middleware layer and business layer.

Perception layer: This layer act as the sensing layer for the IoT, the data gathered from the environment is carried through this layer. The sensor devices such as RFID tags, environment monitoring sensors, health monitoring sensors and many more are deployed in this layer. The main functionality of this layer is to sense and gather the data.

Network layer: This layer gathers the data from perception layer and sends the data to the internet. This layer is a combination of both network layer and transport layer and it includes only the gateway which is connected between the internet and the perception layer.

Application layer: This layer receives the data from the network layer and provides the data to the application. The applications might be a health care environment, smart homes, smart city and other [8].
Middleware layer: this layer lies in between network layer and application layer. This layer gathers the information from the network layer and stores or process the information. This layer has the capability to take the decisions automatically whether to forward the information to the application layer or process the information [9].
Business layer: this layer is solely concerned with the business people who make revenue from the application.

3. Integration of IoT with cloud services

According to the study made in [10], the connected devices to the internet are going to reach the number of 24 billion and this leads to the vast data production as well. Therefore, storage space is needed to honour this data. Cloud computing provides the data storage and data processing for the IoT. These services are provided at rental basis and IoT are integrated with small sensor nodes which are limited in their capacity and storage space. Therefore, cloud computing provides all the needs of IoT. Figure 2 shows the communication architecture of IoT and cloud.

Research issues in integration of IoT and Cloud

The integration of IoT with cloud is not a simple issue; the IoT does not allow all the things to integrate and all the resources to avail from the cloud. There are some issues which have to be addressed before the integration. The communication between the IoT and cloud are considered as the major constraint for the integration. Some of the issues are discussed below.
QoS Provisioning: In IoT, the data size produced by the sensor nodes is more, it leads to the unpredictability and quality of service becomes major issue. The sensor nodes produce data at any time and some time it might be an important data. Therefore, cloud should provide prioritization to the data [11]. Quality of service is measured in terms of packet loss ratio, bandwidth, jitter and delay [12].
Protocol Design: In IoT, there are number of devices connected through the internet and the protocol used by these devices is different from one to another. Some devices useZigbee and some other devices use IEEE 802.11. The gateways present in between the sensor nodes and internet supports some protocols. The protocol support is dependent on the sensor devices and the gateway used in the IoT. So, there is no guarantee of protocol support if any new sensor is added in to the network. Therefore protocol support is also one of the issues to be concerned at the time of communication [13-14].
Resource Allocation: resource allocation is the major issue in the cloud platform. In IoT, the sensor nodes are heterogeneous in nature; there is no idea about the capability of the sensor nodes such as bandwidth and computation power. Therefore, it is difficult to provide the resources to the IoT without knowing the exact utilization [15].

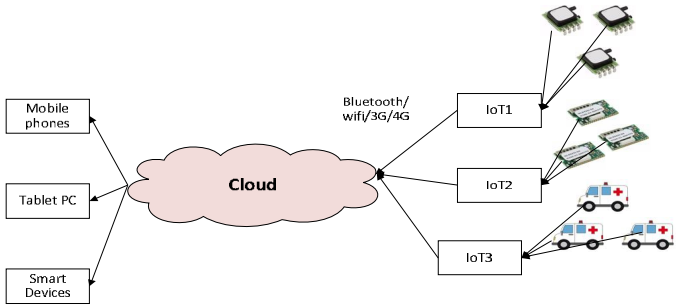

Figure 2: Communication between IoT and cloud

Energy Efficiency: The sensor nodes deployed in the IoT environment must connected to the cloud and it requires lot of data communication and it ultimately leads to the high energy consumption. Allsensor devices are composed of sensing unit, processing unit, transmission unit and power supply unit. Most of the sensor nodes are operated with limited power supply. Therefore, efficient mechanism is needed for efficient utilization of energy for the sensor nodes. Some researchers made contributions to preserve the energy by introducing sleep mode the sensors [16-17].
Service discovery: In the Cloud IoT, the cloud manager takes part of discovering new services to the users. The major issue in the IoT is any node can join in the network or leave the network at any time. Therefore, continuous monitoring is required on the sensor nodes. In larger IoT networks, an IoT manager is also needed to manage the services.
Privacy and Security: In both IoT and cloud, privacy and security is the major research issue. In IoT, the data produced by the sensor nodes might be confidential and it requires some security mechanisms to preserve the data [18].

4. Conclusion

This paper presented the architecture for integration of IoT with cloud services and the research issues which need to be addressed at the time of integration.

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