A study of the role of Cloud services in the implementation of Internet of Things (IoT)

Karandeep Kaur
Department of Computer Science, Guru Nanak Dev University

Abstract— Changing times have demanded the change in conventional working models. The large-scale use of Internet and its related technologies like Internet of Things has widened the horizons of their applications. However, the actual realization of Internet of Things (IoT) can be made possible only through the readily available location-independent services like the Cloud computing. There are various considerations while adopting Cloud services in IoT. This paper aims to present the role of Cloud computing services in IoT implementation and how they are most suitable for Internet of Things concept. It explicitly defines those parameters from the point of view of IoT implementation and performance.

Keywords—Internet of Things (IoT), Cloud computing, Role of Cloud in IoT, Information and Communication Technology (ICT), Implementation

I. TERMINOLOGY OF CLOUD COMPUTING

According to the official NIST definition, “Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”[1]

To provide the cloud services, the service-providers use three types of service models which are described below. These are Software, Platform and Infrastructure as a Service models.

1. Software as a Service (SaaS): Various software applications are provided to the users on a pay-per-use policy
2. Platform as a Service (PaaS): Different platforms, tools and other services are provided to the users.
3. Infrastructure as a Service (IaaS): Infrastructure like storage, computing power etc. are made available to the users through virtualization [2].

Four types of deployment models are used: Public cloud which is open for access by public; Private cloud which is owned by a private organization; Community cloud which is built for a specific purpose by a community of organizations and Hybrid cloud which is a combination of private and public cloud. The cloud computing models are shown in Fig. 1.

There are many parameters which are under concern when we compare the different types of clouds. Generally, for small organizations that seek cost savings and test their software products before they are out in market, using public clouds is a good option. Private clouds are better suited for organizations that handle sensitive data and are apprehensive about its confidentiality. For organizations which want to reap the benefits of both security as well as cost-effectiveness, hybrid clouds are appropriate.
II. INTERNET OF THINGS AND CLOUD COMPUTING

Internet of Things is the upcoming technology which will completely reform the existing system of technology. According to the definition given by ITU, “The IoT describes a worldwide network of billions or trillions of objects that can be collected from the worldwide physical environment, propagated via the Internet, and transmitted to end-users. Services are available for users to interact with these smart objects over the Internet, query their states, as well as their associated information, and even control their actions” [3]. Its main principle is to create a large network which consists of different smart devices and networks to facilitate the information sharing of global things from any place and at any time [4].

The devices are made smart by using Radio Frequency Identification tags. These devices communicate with the help of networks. The data collected by them are stored and computed on the Cloud services which are location-independent. The cloud service is best suited for this purpose as they provide a convenient way to access resources without having to create expensive infrastructure for it. The services can be availed based on the plans available according to the usage desired. The use of Cloud in IoT is illustrated in Fig. 2.
Cloud computing involves cloud service providers who offer the services to its tenants which in turn use the cloud services through certain contracts with the providers. The cloud providers aim to provide sharing of resources between the tenants to meet the dynamic demands. The tenants benefit as they can pay only for the resources they require, thus removing the start-up expenses and being able to quickly scale up or scale down resources during the demand fluctuations. The end-user of a system can interact with a cloud provider directly or indirectly via the tenants. In this paper, we are focusing on the Internet of Things devices’ interaction with the cloud services.

III. WHY USE CLOUD SERVICES FOR IoT?
There are several aspects which suggest the use of Cloud services for Internet of Things (IoT). The below mentioned reasons describe the suitability of cloud services for IoT.

3.1. Always available
The cloud services are location-independent and always available, which is the prime requirement of Internet of Things technology. The smart devices should be able to interact with each other any time so cloud is the best bet for such necessities.

3.2 Quick scaling up/down
Cloud services can scale up quickly, so adding any number of devices to the system is made quite easy by Cloud service providers. This helps in effective management of devices during peak hours and otherwise as well. For example in a Smart city, the number of vehicles on the roads may increase during the morning office timings, and hence more number of devices will need to connect to the network to find the parking space.
3.3 Better resource management
Cloud services can help manage restraints on resources. For example, due to limited power of the batteries and storage space, the computational jobs on smart phones can be moved on to the cloud. It will help lay off the load from such devices on to the cloud servers.

3.4 Cross device functionality
Cloud services can work across a variety of things or devices. This is one quality of cloud which makes it most appropriate for Internet of Things [5] which has a large number of devices communicating with each other like sensors, cameras, smart phones etc. The use is best exemplified by Smart cities concept where devices work together to bring about the functionalities like heath care, emergency alerts, traffic management etc.

3.5 Different clouds for different needs
Cloud services are available in public, private and hybrid models. These can be used for different needs. For example, in Internet of Things model, the health records of patients can be stored on private cloud for use by the doctors. However the healthcare data like heart-rate, temperature etc. needed for health monitoring can be stored on public clouds.

3.6 Secure data storage
The use of cloud services for storing data is becoming increasingly popular in IoT. This has ensured that the cloud service providers offer the best data storage plans with maximum security levels being promised. This is necessary for the service providers to manage the market competition and rising demands.

3.7 No extra cost of infrastructure
The use of cloud for IoT also provides a cost benefit which is the most lucrative of all its features. There is no extra cost for resources and infrastructure. The cloud infrastructure can be used by paying small costs according to the plans of service providers.

IV. CONCLUSION
The Internet of Things technology is a promising new field in Information and Communications technology (ICT). It can induce the smart factor into the functionalities of diverse fields. The applications of IoT range from Smart cities to Agriculture, Tourism, and Healthcare etc. The implementation of IoT needs the coordination of various technologies like Wireless networks, Cloud computing and networks. This paper presented the role of Cloud services in IoT. A comprehensive reasoning of the various factors was done which suggest the appropriateness of Cloud for IoT. The always-on feature of Cloud services among many others is best suited for the Internet of Things (IoT).

REFERENCES