

CHALLENGES GENERATED BY THE INTEGRATION OF CLOUD AND IOT

Cloud Challenges

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Abstract—Nowadays Cloud is a growing architecture. It is used in many Organizations which includes Servers. In this paper, Challenges of integrating Cloud with IoT is discussed. Billions of Devices are connected together to communicate with each other and stake the information without delay. There are many issues concerned with cloud and IoT separately. When both are combined, it leads to much benefits. This paper provides the outline of advantages and disadvantages of integration and introduction about Edge Computing.

IndexTerms— *Cloud, IoT, Integration ,Challenges.*

I. BASICS OF CLOUD COMPUTING

Cloud computing is the deliverance of computing services which includes servers, storage, databases, networking, software, analytics, and intelligence which provides much faster innovation , flexible resources and less cost over the Internet[1].

II. CLASSIFICATION OF CLOUD COMPUTING

A. Public Cloud

Public Clouds are owned by a third-party cloud service provider through which it delivers computing services like servers and storage over the Internet. These services are accessed through a web browser.

B. Private Cloud

A private cloud refers to cloud computing resources used exclusively by a single business or organization. A private cloud can be physically located on the company's on-site datacenter

C. Hybrid Cloud

Hybrid clouds combine public and private clouds, bound together by technology that allows data and applications to be shared between them. By allowing data and applications to move between private and public clouds, a hybrid cloud gives your business greater flexibility, more deployment options and helps optimize your existing infrastructure, security and compliance.

D. Internet of Things

It is a technology which connects billions of devices and provides communication between each other to share the information which helps in the betterment of daily life activities.

E. Cloud-Based IoT

Cloud Computing provides necessary tools and services to create IoT Applications. It helps in achieving efficiency, accuracy, speed in implementing IoT applications. Cloud helps IoT application development. IoT is not a cloud computing.

III. CHARACTERISTICS OF CLOUD COMPUTING

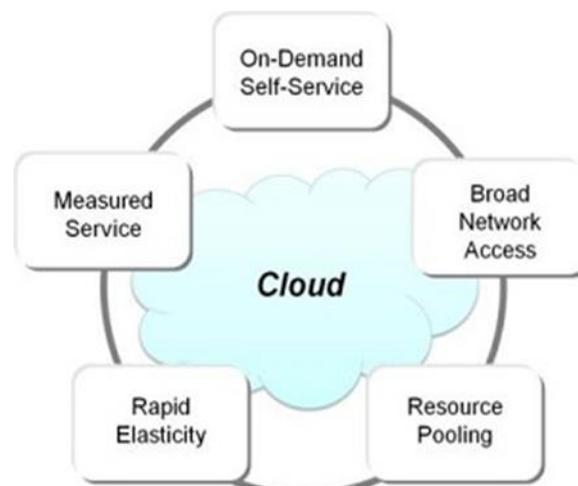


Figure 1 Characteristics of cloud

A. *On-Demand Self Service*

The resources of cloud computing can be attained without communication from the service provider. Computing resources such as storage space or virtual instances can be provided without the concern of cloud service provider[2]. Consumers can access their cloud accounts through web self service which is provided by manufacturing organizations.

B. *Broad Network Access*

Heterogeneous customer platforms access the resources of cloud computing which is available over the Internet. It uses high broadband communication link for providing the services. If the private clouds are used then it uses LAN (Local Area Network). The important aspects are network bandwidth and latency. In addition, broad network access plays a major role since it is in relation with Quality of service (QOS). These aspects are much important when services are provided to the manufacturing applications.

C. *Multi-tenancy and resource pooling*

Multiple customers can share the same physical infrastructure and also preserves the privacy and security of information. The term resource pooling refers to sharing of physical resources by multiple customers. The performance of resource must not be interpreted. The resources must be flexible and large enough to be provided to the customers.

D. *Rapid elasticity and scalability*

Manufacturing organizations can avail the resources as such needed. When the resources are not needed, it can be removed. Based on business demands, the cloud computing resources can either scale up or down in a rapid fashion. This is the important feature of cloud computing. The costs for the resources are purely depended on the usage of the resources. Elasticity refers to the term of provisioning and de provisioning any of the resources from cloud at any point of time. It is applicable to storage and virtual machines and applications of customers.

E. *Measured Service*

Resources are available in the cloud and the users can utilize the resources. For the resource utilization, they have to pay. The manufacturing organization may use the resources and the charges are applicable on how much the resources are used. Usages of cloud computing resources are metered. The cloud service provider monitors the usage of services provided by them and measured and reported.

IV. ADVANTAGES OF INTEGRATING IOT INTO CLOUD USING THE TEMPLATE

The advantages are listed out in the following paragraphs. It has much advantages which are not available in the other networks.

Communication

The key characteristics which are much important in Cloud-based IoT are application and data sharing. Software applications can be transmitted through IoT with less cost of data distribution. Customized portals and built-in-apps can be developed and managed by cloud which is much effective in performance and also less in cost. Cloud helps in communicating data and applications with IoT, but certain restrictions exist when the amount of data to be transferred from the Internet to cloud is much larger[3].

Storage

An enormous amount of data which is semi-structured and as well as non-structured is generated out of IoT technology because it handles billions of devices which is known as big data. There are 5 characteristics for big data which are listed as 1.Variety 2.Velocity 3.volume. When the data to be transferred is much in volume, then Cloud seems to be the best solution when integrated with IoT [7].

Processing Capabilities

In IoT devices, on-site and complex data processing is not possible since it has limited processing capabilities. The processing takes place when gathered data is transferred to nodes whose capabilities are much higher. Its solution remains a thought provoking process without proper infrastructure to accomplish scalability [3]. Virtual processing is provided in an unlimited fashion and usage model by the demand from the customer so that it offers a solution. When predictive algorithms and decisions based on data are both integrated along with IoT, then it can increase the income generated for cloud but the declination of risks is also possible at less cost.

Scope

The communication takes place between thousands of users transferring heterogeneous types of data. When cloud gets integrated IoT, real world objects can be connected which directs to innovation of new services and technologies.

New Abilities

IoT has different types of protocols, devices and technologies. When it gets integrated with many devices, it deals with such protocols and technologies. But factors such as reliability, scalability, security, interoperability, efficiency are difficult to achieve when there are heterogeneous types of devices. When both cloud and IoT are incorporated, these issues are solved through low consumption cost.

New Models

Some of the new models are suggested for smart objects, applications and services as follows
SaaS(Sensing as a Service)- which permits to access sensor data in devices.

EaaS(Ethernet as a Service)-which controls the remote devices in mobility.
 SAaaS(Sensing and Actuation as a Service)- which has the control over the access
 IPaaS(Identity and Policy Management as a Service)- which has the access to policy management
 DBaaS(Database as a Service)- which provides access to the concern database
 SEaaS(Sensor Event as a Service)-which provides service message to the sensor events
 SenaaS(Sensor as a Service)- It manages remote sensors
 DaaS(Data as a Service)- It manages any type of data.

Cloud Based IoT Architecture

In general IoT and Cloud have their own architectures.The comparative study of IoT and Cloud Architecture is shown as follows

Table 1: Comparison of IoT with cloud computing

Items	IoT	Cloud Computing
Characteristics	IoT are real world objects	Virtual resources are there
Processing Capabilities	Computational capabilities are limited	Computational capabilities are unlimited due to virtual components
Storage Capabilities	Limited capacity	Unlimited capacity due to virtual components
Connectivity	Uses internet for connection	Uses internet for delivery of service
Big data	It is a source of big data	It manages big data

Challenges Facing Cloud _ Based IoT Integration

While integration of IoT with Cloud , many challenges arise which are the obstacles between the integration of both the technologies. The challenges are as follows

1. Identification

It is the first process of establishing the connection between the devices and distinguishing among the devices. There are two distinct forms of access controls one is authentication and the other one is authorization which are used to access any kind of information in the system.

2. Security and privacy

When Cloud integrated with IoT, the data from real world gets transferred into cloud. The Cloud has to take care of the data which got transmitted. But it is not that much easier task. Cloud cannot secure the data due to the following tasks

1. Providing access to only authorized users.
2. Multi-tenancy service is provided by the cloud. So there is a possibility of leakage of the secret information to the other customers.
3. Applying public key cryptography to all the layers in the cloud is not possible because of the constraints imposed by IoT objects[6].
4. Session can be hijacked by others.
5. Possibilities of attacks such as SQL injection, session-riding, cross-site scripting and side-channel in cloud.
6. Physical location of data can be trapped easily

3. Heterogeneity

The real time devices that are connected with Cloud need not be of same type. They all belong to different types of devices, platforms, operating systems and services. When they get service from different providers, it also leads to heterogeneous property where it is a difficult time to get connected.

4. Big data

When there is a huge amount of data to be dealt with the cloud and IoT, the storage can be a big problem. This is one of the challenges to be faced during the integration.The data which is outsourced when huge assurance cannot be given to the data which reduces the quality of service.

5. Performance

The type of data that is dealt with cloud-IoT are heterogenous and the amount of data is huge. The performance rate is purely depended on the real time devices . If the coordination is not getting synchronized with Cloud and IoT then there is less performance.

6. Legal aspects

Legal aspects has to be monitored in terms of certain applications. Various service providers are there whom has to obey international regulations.

7. Monitoring

It is one of the important issues in Cloud-IoT since it has to manage the resources, performance, security, and capacity planning. The characteristic of IoT such as velocity, volume and variety has a great impact and challenges.

8. Large Scale

When IoT and Cloud integrated together, there is much real time devices connected to the cloud in large scale. At that time, there comes the issue of storage ability and computational competence. The connection between the devices has to be monitored which are in large number.

9. Latency:

Applications of IoT are novel and hence need immediate response from cloud. But in the traditional cloud computing model, data is transferred from device to the provider and again the response is received which increases the latency time. This is also one of the challenges in Cloud IoT Integration.

10. Availability

Internet services are getting deployed in the cloud which has become the integral part of life. When there is a break in service, which becomes difficult process. It is difficult for the cloud service provider to keep the promise.

11. Energy

Research says that the consumption of cloud is much higher and the data center in United States will increase by 4% by 2020. The development of cloud centers is becoming a restricted access for the cloud environment.

Benefits of Cloud in an IoT Ecosystem

- Accompany to data storage and processing demands of IoT .IoT has a large perspective in the future and all the physical entities are connected to each other. This leads to much computing capacity and the only solution is the cloud [5].

- Advanced analytics

Nowadays things are connected in excess. Hence there is a need for analysis of how to manage with the data and provide uninterrupted experience to the users. Only cloud architecture with advanced level can make sure of the IoT environment with such potentials.

- Smoother inter-device connectivity

The sensors installed in IoT devices communicate with each other to fulfill the proper communication. IoT cloud applications in tie up with IoT gateway, paves the way that variety of sensors and actuators are able to communicate with each other without any hindrance. Advanced Technologies such as Amazon EC2 in combination with EBS (Elastic Block Store) is backed by IoT cloud application. G-Suite from Google and Microsoft Azure are also some examples.

Top 11 Cloud Platforms for Internet of Things (IoT)

1. Thingworx 8 IoT Platform. Thingworx is one of the leading IoT platforms for industrial companies, which provides easy connectivity for devices. ...
2. Microsoft Azure IoT Suite. ...
3. Google Cloud's IoT Platform. ...
4. IBM Watson IoT Platform. ...
5. AWS IoT Platform. ...
6. Cisco IoT Cloud Connect. ...
7. Salesforce IoT Cloud. ...
8. Kaa IoT Platform.

V. Conclusion

We have been focusing on cloud computing and their various issues related to technology and Server. Cloud has its own advantages and disadvantages. This paper has presented the overview of the cloud and its technologies. This paper has focused on the outcome of challenges because of integrating cloud with IoT .

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