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The role of IoT Governance in cloud Computing

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Abstract: - Cloud computing and Internet of Things (IoT) is two different upcoming and growing technologies. The wide application has led to increasing the possibility of the Future. Cloud and IoT deal with the automatic configuration of IoT device in a secure way. In this paper, we focus our attention on the governance of IoT and Cloud, which we call the Cloud IoT governance. Cloud and IoT properties, features, underlying technologies, and open issues. To bridge the gap between Cloud and IoT. The automatic configuration of IoT devices in a secure way through the Cloud, in order to provide new added-value services. The development in the area of Wireless Sensor and Actuator network creates values to the various devices having Internet of Things (IoT), The role of **sensors** and actuators are to establish communication perfectly in the ecosystem in which they are present respectively and also to share and pass on the necessary information through various nodes available in the network independent of the plat form**.** Due to a huge advancement of technological development in Information and technology sector give rise to much wireless technology as stated below**.** The key technologies and application domains in IoT research are discussed with the interrelation of cloud computing and **t**heir joint ventures with Private and public cloud. So we can conclude that IoT and cloud computing has a wide range of growth, development with respect to technology.

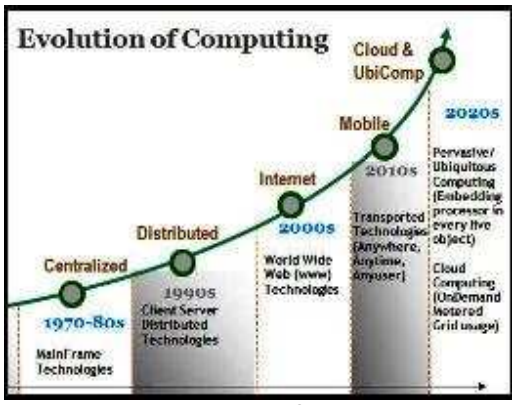
Keyword: - Internet of Things [IoT], Wireless sensor Network [WSN], Cloud Computing, Radio Frequency Identification [RFID].

1. INTRODUCTION

Internet of Things (IoT) is the next step evolution of Internet, where any physical object/thing having/equipped with computation and communication capabilities could be seamlessly integrated, at different levels, into the Internet. The exploitation of Cloud computing technologies is challenging to support the development of IoT systems because it guarantees high scalability and reliability of the available services. Thus, IoT and Cloud computing offer new possibilities for sharing data and services through the Internet, by introducing a dynamic global network system with self-configuring capabilities based on standard and interoperable communication protocols cloud computing acts as a front end to access Internet of Things Nowadays, we can see that the Internet of things gives hopes for human life activity. **E.g.** If a worker needs to finish their report to submit to Manager, suddenly she/he runs out of memory space on the computer. There is no problem if the computer is connected to the Internet. She/he can use cloud computing service to finish their works because the data is controlled by the server. **Ref [3].** IoT is currently applied in many application fields, such as in buildings construction, car traffic monitoring, environments analysis, health-care assistance, weather forecast, and video surveillances. As a consequence, IoT will offer new services for making cities "Smarter" and it will improve the interaction of people and IoT devices/services with the surrounding environments. Security is one of the major factors hampering the rapid and large-scale adoption and deployment of IoT and Cloud computing.

IoT can appear as a natural extension of Cloud computing, in which the Cloud allows us to access IoT-based resources and capabilities, to manage intelligent pervasive environments. In addition, Cloud computing can support the delivery of IoT services. Thus, an IoT service can be considered as an on-demand Sensing and Actuation as a Service (SaaS). One of the main problems in deploying IoT devices is the self-configuration of such devices that is necessary to interconnect them over the Cloud. The Internet of Things (IOT) is a worldwide network of intercommunicating devices. It integrates with various communications and computing devices. IOT is has got "things", which has M-to-M objects, such as all home appliances, furniture, clothes, vehicles, roads and smart materials, etc. are accessible on the basis for many new applications, such as energy monitoring, transport safety systems or building

security**.** Technologies such as Wireless Sensor Networks, Intelligent Devices, and Nanotechnology will enable a number of advanced applications. Innovative use The Internet of Things (IOT) is a worldwide network of intercommunicating devices. Innovative use of technologies such as RFID, NFC,

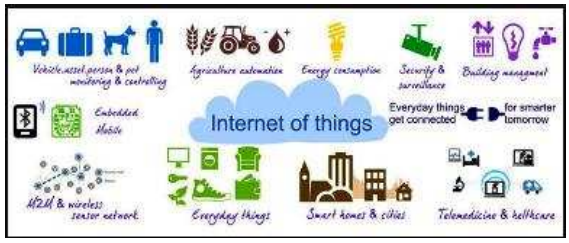


➢ **Fig no. 1. Evolution of Computing.**

and Bluetooth, are contributing to creating a value proposition for stakeholders of IOT.

The following is the Characteristics of IoT and Cloud Computing is as follows:

- ***On-Demand Self Service:*** Cloud Computing resources is web-based service that can be access by the end user without any terms & condition, permissions from other users in the world within the network.
- ***Broad Network Access***: it deals with connectivity. Cloud computing resources can be accessed through a device having the option of internet connection such as tablets, mobile devices and laptops. With the help of IoT, cloud computing can be access with many devices in the network, which help the user easier to access with the devices.
- ***Resource Pooling:*** it deals with sharing Resource with their address. Resource pooling will guide the individuals about their addresses which can be can access anytime and anywhere at a free time interval. In IoT context, humans could easily assign an IP address to communicating device
- ***Rapid Elasticity:*** It deals with meeting the requirement. Cloud computing is liberty for easily and quickly updates in various software and also adds or remove cloud computing. This characteristic will empower IoT by providing elastic computing power, storage and networking.
- ***Measured Service:*** Bill as per usage. Cloud computing will measure your usage about their service such as storage, processing, bandwidth and active user accounts inside your cloud computing. This system is called as Pay Per Use (PPU). IoT has



➢ **Fig no. 2. IoT and cloud computing.**

the network of physical objects featuring IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices. **Ref [1].**

We need an IoT application specific framework for rapid creation of applications and their deployment on Cloud infrastructures. This is achieved by mapping the proposed framework to Cloud APIs offered by platforms such as Aneka Inter-relation between Internet of Things (IoT) and Cloud Computing: The current scenarios about internet traffic from devices such as Mobile phones and Tablets are increasing day by day. So the demand for connectivity of things and Devices in increasing timely. As it could connect to the internet on mobile and monitor the various segment such as home, office, operations etc. The increase in demand is rapidly being supported with the introduction of technologies such as cloud computing, standard protocols, internet enabled intelligent devices, connection friendly sensors. And thus is the growth of required infrastructure such as broad coverage of Mobile networks, affordable mobile network tariffs and high bandwidth internet using 3G, 4G etc.

Due to connected objects in IoT, a huge number of devices are expected to be connected to the Internet. It is, as such clear that the IoT will consist of a very large number of devices being connected to the Internet**. ref [3].** As the number of connected devices is increasing day by day, the IoT applications must be built with scalability, security & reliability as key characteristics. This leads to the adoption of reliable web application frameworks & scalable data stores in the Cloud. Cloud offers resources on demand and thus strikes off the limit on a number of connected devices and its users**.** That makes it the best choice for IoT applications. There are various cloud infrastructures available in the world today from many service providers such as Google, Microsoft, and Amazon etc. And there are various cloud application frameworks being offered, such as Google Cloud Platform, Amazon Elastic Compute

Cloud (EC2), Microsoft Azure to name a few Ref [4].Thus, the IoT application developers are provided with a lot of choices to make depending on their team expertise and application demands.

2. ELEMENT OF IOT AND CLOUD COMPUTING

Basically, it deals with Major 3 components:

(a) ***Hardware or physical layer*** — is made up of sensors, actuators and embedded communication hardware components.

(b) ***Middleware Application layer***—on demand storage and computing tools for data analytics.

(c) ***Presentation layer*** —novel easy to understand visualization and interpretation tools which can be widely accessed on different platforms and which can be designed for different applications. In this section, we discuss a few enabling technologies in these categories which will make up the three components stated above. **Ref [1].** The IoT has potential to connect the world's objects in both a sensory and intelligent manner through combining technological developments in item such as

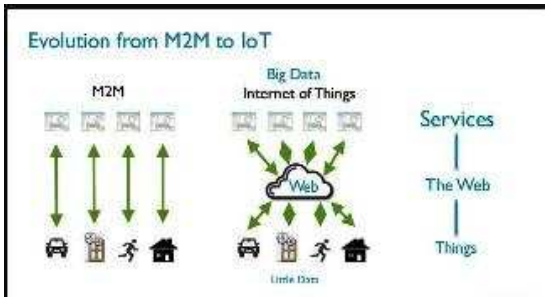
- *Identification ("tagging things").*
- *Sensors and wireless sensor networks ("feeling things").*
- *Embedded systems ("thinking things").*
- *Nanotechnology ("shrinking things").*

The elements are as follows

2.1 Radio Frequency Identification (RFID): RFID technology is a major element in the embedded communication devices which enables the design of microchips for wireless data communication. as it contains E-barcode which help for auto check. This has resulted in many applications particularly in Retail and SCM**.** The applications can be found in transportation and access control applications. E.g. Passive tags as well as Toll Plaza cards are used in Bank card for global

2.2 Wireless Sensor Networks (WSN): The technological Revolution in IC and wireless communications have made easily available low-cost, low power devices for use in remote sensing applications. The sensor network consisting of a large number of intelligent sensors, enabling the collection, processing, analysis and dissemination of valuable information, gathered in a variety of environments. **E.g.** Active RFID. The Sensor data are shared among sensor nodes and sent to a distributed or centralized system for analytics. The components of WSN monitoring network include:

- ***WSN hardware***—A node (WSN core hardware) contains sensor interfaces, processing units, transceiver units and power supply,
- ***WSN communication stack***— the route of topology, routing and MAC layer is critical for the scalability and longevity of the deployed network.
- ***WSN Middleware***—It is based on the idea of isolating resources that can be used by several applications**.**

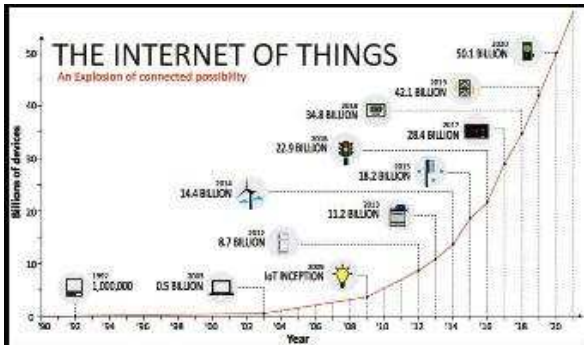


➢ **Fig no. 3. IoT M2M with cloud.**

2.3 Secure Data aggregation—an efficient and secure data aggregation method is required for extending the lifetime of the network as well as ensuring reliable data collected from sensors. The few most critical features of creating a unique address are: uniqueness, reliability, persistence and scalability. (i) Things. (ii) Data (iii) Visualization. **Ref [1].**

3. THE WORKING OF IOT

The Internet of Things is a technological revolution that represents the future of computing and communications, and its development depends on dynamic technical innovation in a number of important fields—from wireless sensors to nanotechnology. Primary stage is connection establishment within networks so that Data is to be collected and processed **E.g.** RFID. The data collection will benefit from the physical status of things, using sensor technologies. . **E.g.** Embedded Technology.



➢ **Fig no. 4. IoT and cloud computing Graph.**

Now the Technology has smaller and smaller things has ability to interact and connect i.e**.** Internet.

4. TECHNOLOGIES & APPLICATIONS IOT

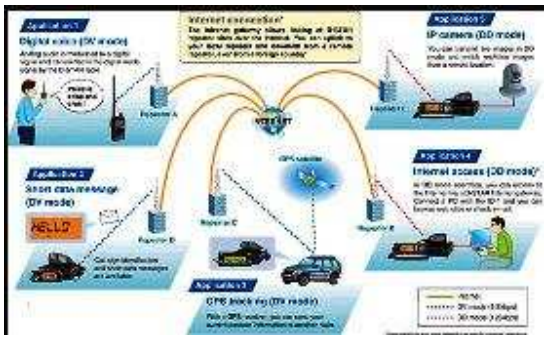
The technologies of the Internet of Things are the following:

4.1.1 ***Enabling Building Blocks:*** The following technologies directly contribute to the development of the IoT: Machine to-machine interfaces and protocols of electronic communication, Microcontrollers, Wireless communication, RFID technology, Energy harvesting technologies, Sensors, Actuators, Location technology (GPS), Software.

4.1.2. ***Synergistic Technologies:*** The following technologies may add value to the IoT: Geo-tagging/geo-caching, Biometrics, Machine vision, Robotics, Augmented reality, Mirror worlds, Telepresence and adjustable autonomy, Life recorders and personal black boxes, Tangible user interfaces, clean technologies.

The entire IoT application should be able to provide supports for the following:

- Read and write Data from the WSN devices or from various sources of data.
- Working with the data is easy and transferable easy on the Cloud**.**
- Further if any instances of activity takes place than it would be traceable easily by the help of



➢ **Fig no. 5. IoT and cloud Application.**

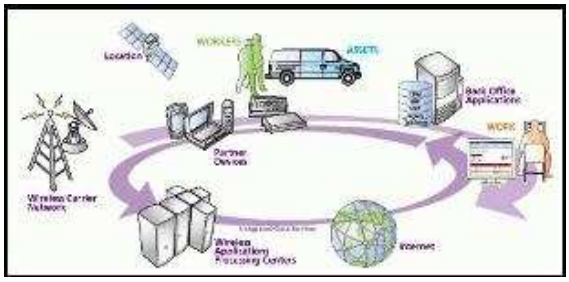
various applications.

There are several applications of IOT in agriculture, healthcare, retail, transport, environment, supply chain management, infrastructure monitoring, etc. Some of them are listed below:

4.2.1 ***Agriculture:*** IOT applications in agriculture include food traceability (RFID), soil and plant monitoring, precision agriculture, greenhouse environment monitoring and control systems, monitoring of food supply chain, monitoring of animals, etc.

4.2.2 ***Retail Management****:* It includes monitoring customer behavior and preferences, shelf stock tracking, context based advertising and product promotions, vending machines, automated checkout, and theft control.

4.2.3 ***Healthcare:*** it includes application areas are personal health monitoring, telemedicine, assisted living, etc.



➢ **Fig no. 6. The Challenges of IoT & Cloud**

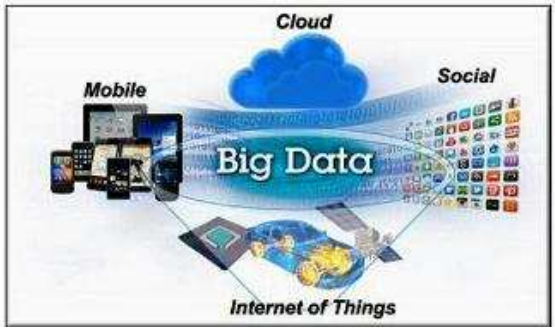
4.2.4 ***Security:*** Detection of counterfeit goods, access control, restricted materials, banknotes, passports Government and public sector: Disaster management, forest monitoring, tourism support, homeland security, pollution monitoring Home: Home security, smart—home (lighting, entertainment, energy management, assistance)

4.2.5 ***Sports:*** Sports equipment, user performance monitoring, safety, etc.

5. OPEN CHALLENGES & FUTURE DIRECTIONS

The Cloud comprises a flexible and open architecture i.e. to user enables to interact in the IoT framework. The step up is made upon the type of requirement of the user and meeting with the different requirement such as healthcare, retail, transport, environment, SCM, Security and infrastructure monitoring**.** Some open challenges are such as privacy, participatory sensing, data analytics, GIS based visualization and Cloud computing apart from the standard WSN challenges including architecture, energy efficiency, security, protocols, and Quality of Service. Standardization of various frequencies of different bandwidth and Internet protocols plays a vital role.

The Integration between IoT and Cloud computing applications enables the creation of smart environments such as Smart Cities need to be able to



- **Fig no. 7 . IoT and cloud computing Future.**

(a) Combine services offered by multiple stakeholders and (b) Scale to support a large number of users in a reliable and decentralized manner.
Ref [1].

6. CONCLUSION

In this paper, we discussed an approach to integrate the IoT with Cloud computing. In particular, a system is presented analyzing the different elements involved and how they interact with each other. Using various examples, we discussed how IoT devices can be extended to support the interaction with the Cloud. In particular, we focused on a system that allows a Cloud provider to deploy the firmware and configure the device and on the one hand to perform sensed data transfer from the device to the Cloud provider. In the end, we discussed how the overall system works, advantages, technology and challenges in IoT devices are at the early stage and, as discussed in this paper, they are not ready yet to support complex Cloud scenarios, even though the roadmap toward innovative Cloud IoT services begins to be tracked.

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