

A Review of IOT Architecture, Challenges, Applications, Future Trends

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Abstract

The Internet of Things is emerging as the third wave in the development of the internet. Internet of things (IOT) is expected to have a massive impact on consumer products, business and wider culture, but these are still early days. Given its potential for very wide applicability to almost all verticals and aspects of business, industries, manufacturing, consumer goods, supply chains, etc.. IOT as a whole is very broad area. This paper introduces IOT with emphasis on its driver technologies and system architecture. In addition to application layer protocols, we focus on identifying various issues and application areas of IOT as well as future research trends in the field of IOT.

Keywords: Applications, Architecture, Big Data, IOT (Internet of Things)

Introduction

Internet of Things- A prominent paradigm in the field of IT has a nominal intervention of humans, it is a network where miscellaneous things like animals, plants vehicles, appliances, buildings dialogue information via the internet. IOT makes our surroundings smart by exploiting RFID tags, sensors, mobile phones, internet protocols, and wired or wireless communication technologies. IOT has been included in first six “Disruptive Civil technologies” list by US National Intelligence Council(NIC) . NIC also envisions IOT to be present in everything be it furniture, paper, food packages or anything by 2025. By 2020, CISCO gauge to approximately 50 billion IoT objects. In 1999, Kevin Ashton first coined the term “Internet of Things”.

Gubbi et al. define IOT as:

“Interconnection of sensing and actuating devices providing the ability to share information across platforms through a unified framework, developing a common operating picture for enabling innovative applications. This is achieved by seamless

ubiquitous sensing, data analytics and information representation with Cloud computing as the unifying framework”

IOT sensors enable things (real/physical) to anticipate, sight, perceive and conduct jobs as living things do. For example, a wrist band with embedded sensors monitor your sleeping and waking time and set an alarm accordingly, this wristband can then convey a message to the bath tub to start warming water and can even communicate to the coffee maker to repair coffee. Thus, IOT cannot only sense things but it can also control and actuate things, Deploying IOT in our daily activities can the increase quality of life and can even help in the growth of the economy. By 2025, approximately 2-3 billion people will access the internet also economic growth caused by IOT is estimated to be in the range of \$2.7 trillion to \$6.2 trillion.

IOT Forum Architecture According to this, IOT architecture is divided into many layers; each layer has its own functionality. Perception layer is responsible for identifying smart objects in the environment. Network layer as the name indicates is used for routing and processing of data. And the application layer is used for providing services to the users through various applications.

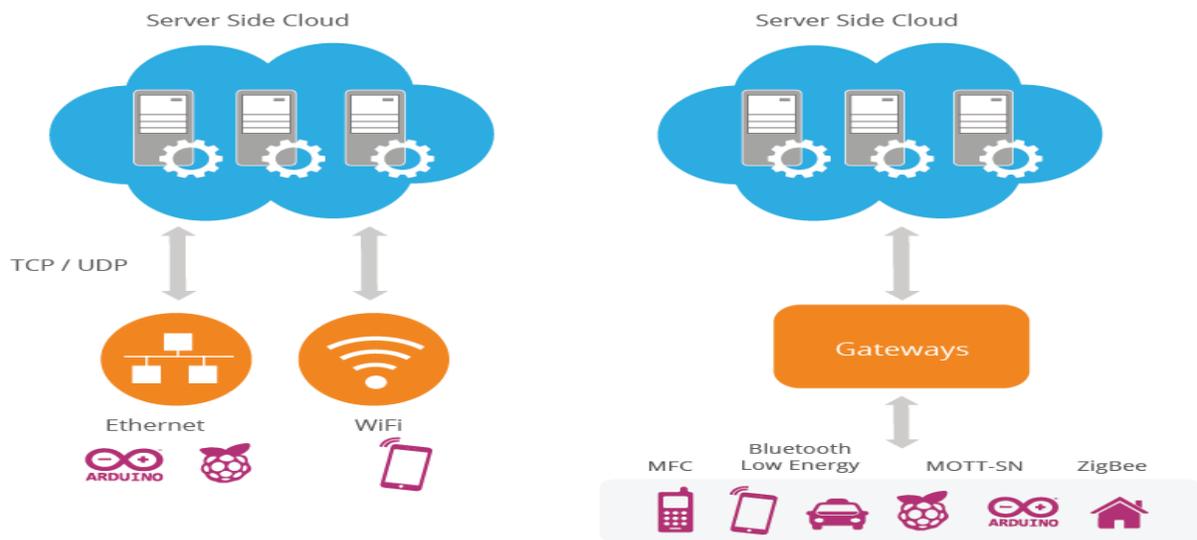


Figure1. IOT Forum Architecture

ITU Architecture

According to ITU, the IOT architecture is divided into five layers:

- Perception layer
- Business layer
- Middleware layer
- Application layer
- Network layer

To further enhance security aspect, new six layer architecture was proposed. It has hierarchical structure as shown in Fig. 4 and is described below:

- Perception layer: It is also known as physical layer. It consists of data and network sensors, which would sense various attributes of objects. It collects useful data about the object and converts it into digital signals .These signals act as input for network layer.
- Network layer: The output of the perception layer becomes the input for the network layer and it is further transmitted to the middle layer via various transmission media.
- Middle layer: It is used for processing the information that is received from various sensor devices. After processing, further actions are taken based on the results.

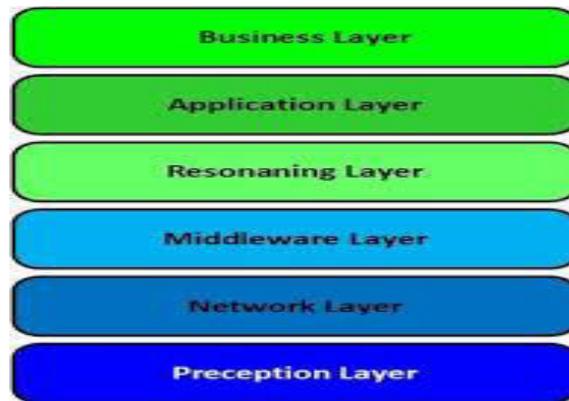


Figure2. IOT Six Layer Architecture

- Application layer: It allows user to access various applications IOT provide. IOT found its applications in vast areas like health care, transportation, government, retail etc.
- Business layer: It is also known as management layer, as it manages all the applications and services of IOT.

IOT Technologies

IOT consist of multiple connected “smart” devices which includes various technologies in them. The technologies included in IOT are Radio Frequency Identification (RFID), the sensor technology, and intelligent embedded technology.

- **Radio Frequency Identification (RFID):** It refers to small device having a small chip and an antenna. It is used to identify an object using radio waves. It consists of readers and tags which identify objects and generates appropriate signals. These signals are further transmitted to readers using RFID frequency and are analyzed by the processors.
- **Wireless Sensor Network (WSN):** Wireless Sensor Network consists of independent devices having sensing capabilities that monitors physical or environmental conditions, such as temperature, pressure. It consists of two main components – sensor nodes and base station. It consists of numerous amounts of sensor nodes and the nodes communicate with each other using radio signals. Data is passed from one node to another and a base station act as an interface between users and the network.

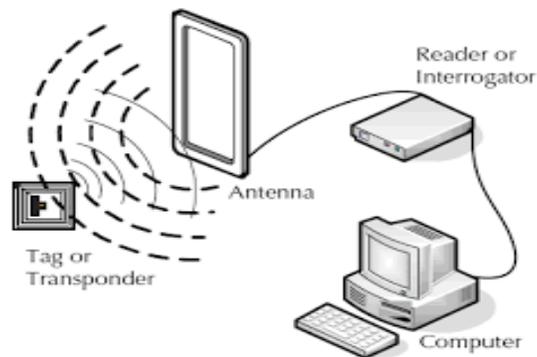


Figure3. RFID

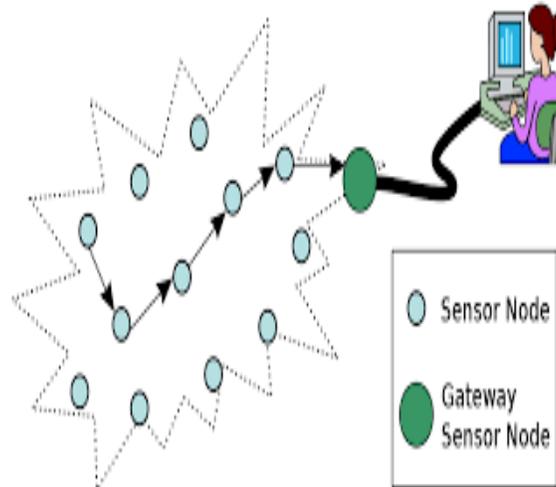


Figure 4.WSN

IOT Applications

IOT being a “smart system” found application in many domains. Some of them are listed below:

- **Smart Home:** IOT found its application in smart home, as it is improving the living standard with home automation. We can control various systems according to our requirements such as lighting system, water supply etc. and it helps in saving resources as well.
- **Smart Environment:** Smart environment is that where everything comprises of “smart system” such as smart government, smart utilities, smart buildings .With the help of this we can monitor traffic in city, pollution level, waste management and also with modern technologies of IOT we can predict natural disasters as well such as earthquake, landslide etc.
- **Smart City:** A smart city aims to provide IOT solutions so that it becomes easy to manage city assets. The goal is to improve traffic control system, education system, transportation system, hospitals system and many more to make a city a smart city.
- **Hospitals:** The IOT found its application in health care also. It aims to improve the hospital service by adding smart features like some hospital has “smart bed”, that will detect when the bed is reserved and when it will be free.
- **Shopping:** It found its application in shopping also. While shopping in a market, the goods will automatically introduce about them and when you buy a good it will give indication to staff to put a new one there. So in this way it is making shopping scenario so smart.

IOT-Future Applications

Nowadays, technology is expanding at a fast rate and everyone either directly or indirectly accessing these technologies. Just like Internet has expanded in the whole world, in the same way IOT is going to expand. It will be just like new internet. As IOT found its application in various fields, one can predict that the future of IOT is going to very bright.

Some of the future predictions about IOT are:

- **Information:** One will be able to access information at a very fast rate, which means that the query of user will get solved just by thinking of it. It will save a lot of time as well.
- **Food Production:** It will help in developing many new technologies in food production such as pre planned analysis of plants and crops can be done. In advance we get to know what are the requirements of the plants and crops such as water requirement, fertilizer etc.

IOT Challenges

As IOT has come up with many new opportunities and applications in various fields, but it faces some challenges as well. Some of them are:

- **Security:** Security is one of the biggest challenges in IOT. As the IOT devices such as sensors, actuators and they are directly accessible, so they are prone to various security attacks such as spoofing, denial of service, altering attack. So there is need to deploy against these attacks.
- **Data Storage:** As the amount of data is increasing with a very high pace, so the storage of data becomes a major problem. Data storage also effects data protection. As the stored data crash, it is difficult to backup all the stored data. So it is also major problem in IOT.
- **Standard and interoperability challenge:** Set of standard has a huge impact on IOT. Each sort of objects in Internet of Things has diverse data, preparing and correspondence abilities. Diverse objects would likewise be subjected to various conditions, for example, the vitality accessibility and the correspondences data transfer capacity necessities. To encourage correspondence and participation of these items, basic benchmarks are required.
- **Architecture challenge:** IOT consist of couple of devices connected, sensors and many more. Different device uses different set of protocols and standards to communicate. And there is no well defined standard and rules for communication, so it becomes a major problem in IOT.
- **Privacy:** It is one of the other challenges to IOT. As it comprises of number of devices connected and allows anyone to access anything from any place. But with this feature it affects

the privacy of sensitive data. So some norms or rules must be set to avoid the violation of privacy.

Conclusion

In this paper we had examined what IOT is, how fast it is evolving, its architecture, technologies, applications, various challenges it faces and its future prospect. So in nutshell we can conclude that the whole future of global information depends on IOT and it will bring inevitable changes in technology. It will go to be a boon for many upcoming technologies.

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