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Introduction to IOT

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Abstract: The phrase Internet of Things (IoT) refers to connecting various physical devices and objects throughout the world via internet. The term IoT was firstly proposed by Kevin Ashton in 1999.The following section illustrates basics of IoT. It deals with various layers used in IoT and some basic terms related to it. It is basically expansion of services provided by Internet. This section also presents the architecture of IoT. For example, when the household devices of our daily life connect with the internet the system can be called a Smart-Home in IoT environment. The IoT is not just deep vision for future. It is already under implementation and is having an impact on more than just technological development.

Keywords: Internet of Things (IoT), Service Oriented Architecture (SoA).

I. INTRODUCTION

The Internet of Things (IoT) is the network of physical objects—devices, instruments, vehicles, buildings and other items embedded with electronics, circuits ,software, sensors and network connectivity that enables these objects to collect and exchange data. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency and accuracy.

The concept of a network of smart devices was discussed as early as 1982, with a modified Coke machine at Carnegie Mellon University becoming the first internet-connected appliance [3], able to report its inventory and whether newly loaded drinks were cold. Kevin Ashton (born 1968) is a British technology pioneer who is known for inventing the term "the Internet of Things" to describe a system where the Internet is connected to the physical world via ubiquitous sensors.

IoT is able to interact without human intervention. Some preliminary IoT applications have been already developed in healthcare, transportation, and automotive industries. IoT technologies are at their infant stages; however, many new developments have occurred in the integration of objects with sensors in the Internet. The development of IoT involves many issues such as infrastructure, communications, interfaces, protocols, and standards.

The objective of this paper is to give general concept of IoT, the architecture and layers in IoT, some basic terms associated with it and the services provided.

II. CONCEPT OF IOT

Kevin Ashton firstly proposed the concept of IoT in 1999, and he referred the IoT as uniquely identifiable connected objects with radio-frequency identification (RFID) technology. However, the exact definition of IoT is still in the forming process that is subject to the perspectives taken. IoT was generally defined as “dynamic global network infrastructure with self-configuring capabilities based on standards and communication protocols”.

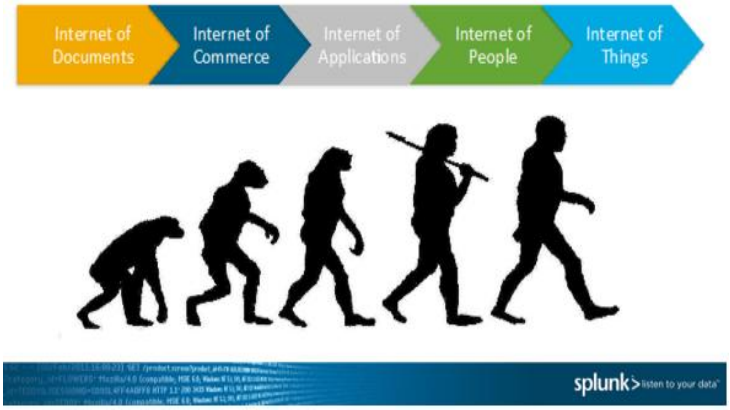

Fig.2.1 Evolution of Internet [1]

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Looking at the evolution of the Internet we can classify it into five eras:

1. The Internet of Documents -- e-libraries, document based webpages.
2. The Internet of Commerce -- e-commerce, e-banking and stock trading websites.
3. The Internet of Applications -- Web 2.0
4. The Internet of People -- Social networks.
5. The Internet of Things -- Connected devices and machines.

Physical and virtual things in an IoT have their own identities and attributes and are capable of using intelligent interfaces and being integrated as an information network. In easy terms IoT can be treated as a set of connected devices that are uniquely identifiable. The words "Internet" and "Things" mean an inter-connected world-wide network based on sensors, communication, networking, and information processing technologies, which might be the new version of information and communications technology (ICT). To date, a number of technologies are involved in IoT, such as wireless sensor networks (WSNs), barcodes, intelligent sensing, RFID, NFCs, low energy wireless communications, cloud computing and so on.

The IoT describes the next generation of Internet, where the physical things could be accessed and identified through the Internet. Depending on various technologies for the implementation, the definition of the IoT varies. However, the fundamental of IoT implies that objects in an IoT can be identified uniquely in the virtual representations. Within an IoT, all things are able to exchange data and if needed, process data according to predefined schemes.

III. ARCHITECTURE OF IOT

A critical requirement of an IoT is that the things in the network must be connected to each other. IoT system architecture must guarantee the operations of IoT, which connects the physical and the virtual worlds. Design of IoT architecture involves many factors such as networking, communication, processes etc. In designing the architecture of IoT, the extensibility, scalability, and operability among devices should be taken into consideration. Due to the fact that things may move and need to interact with others in real-time mode, IoT architecture should be adaptive to make devices interact with other dynamically and support communication amongst them. In addition, IoT should possess the decentralized and heterogeneous nature.

3.1 SERVICE ORIENTED ARCHITECTURE

A critical requirement of an IoT is that the things in the network must be inter-connected. IoT system architecture must guarantee the operations of IoT, which bridges the gap between the physical and the virtual worlds. Design of IoT architecture involves many factors such as networking, communication, business models and processes, and security. In designing the architecture of IoT, the extensibility, scalability, and interoperability among heterogeneous devices and their models should be taken into consideration. Due to the fact that things may move physically and need to interact with each other in real-time mode, IoT architecture should be adaptive to make devices interact with other things dynamically and support unambiguous communication of events.

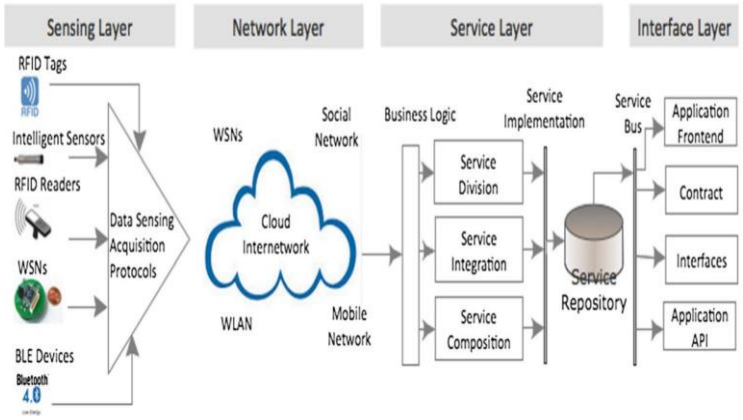

Fig.3.1.1 Architectural Layers of IoT[2]

The SoA treats a complex system as a set of well-defined simple objects or subsystems. Those objects or subsystems can be reused and are maintained individually; therefore, the software and hardware components in an IoT can be reused and upgraded efficiently. Due to these advantages, SoA has been widely applied as a mainstream architecture.

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SoA, which consists of four layers with distinguished functionalities provide the interoperability among the devices in multiple ways .They are:

- Sensing layer is integrated with all available objects (things) to sense their status.
- Network layer is the infrastructure to support the wireless or wired connections among things.
- Service layer is to create and manage services required by users or applications.
- Interfaces layer consists of the interaction methods with users or applications.

3.1.1 SENSING LAYER

IoT is expected to be a wide spread physical inner-connected network, in which things are connected continuously and can be controlled from anywhere .In the sensing layer, the smart systems on tags or sensors are able to automatically sense the environment and exchange data among devices. Things can be uniquely identified and the surrounding environments can be monitored for various purposes and applications. Every object in IoT holds a digital identity and can be easily tracked in the digital domain. The technique of assigned unique identity to an object is called a universal unique identifier (UUID).The identifiers might contain names and addresses. A UUID is a 128-bit number used to uniquely identify some object or entity on the Internet.

In determining the sensing layer of an IoT, the following aspects should be taken into consideration:

- Cost, size, resource, and energy consumption: The things might be equipped with sensing devices such as RFID tags, sensor node. Due to a large number of sensors in applications, intelligent devices should be designed to minimize required resources as well as costs.
- Deployment: The sensing things (RFID tags, sensors etc.) can be deployed one-time, or incrementally, or randomly depending on the requirements.
- Communication. Sensors must be communicable to make things accessible and retrievable.
- Network. The things are organized as multi-hop, mesh or ad hoc networks.

3.1.2 NETWORK LAYER

The network layer in IoT, connects all things and allows them to be aware of their surroundings. Via the network layer, things can share data with the connected things, which is crucial to intelligent event management and processing in IoT.

For the sharing of data and to provide services by a device a strong network is essential.

The network should also automatically discover and map things. Things need to be assigned roles automatically to deploy, manage, and schedule the behavior of things and should be able to switch to any roles at any time as required. This enables devices to perform tasks collaboratively.

In the networking layer, the following issues should be addressed:

- Network management technologies including managing fixed, wireless, mobile networks.
- Requirements of QoS
- Technologies for data searching, data processing.
- Security and privacy

Among these issues, information confidentiality and human privacy are critical since IoT connects many personal things, which brings the potential risk regarding privacy. The existing network security technologies can provide a basis for privacy and security in IoT, but more work still needs to be done.

3.1.3 SERVICE LAYER

Service layer enables the services and applications in IoT. It is a cost effective platform where software and hardware can be reused. The services in the service layer run directly on the network to effectively locate new services for an application and retrieve data dynamically about services. Most of specifications are undertaken by various standards developed by different organizations. A universally accepted service layer is important for IoT. A practical service layer consists of a minimum set of applications, application programming interfaces (APIs), and protocols supporting required applications and services. All of the service-oriented activities, such as information exchanging and storage, management of data, search engines and communication, are performed at the service layer.

The tasks performed by the service layer are:

- Service discovery: Finding objects that can provide the required service and information in an effective way.
- Service composition: It enables the interaction among connected things and describes the relationships among things for enabling the desired service.
- Service APIs: They provide the interface between services required by users.

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3.1.4 INTERFACE LAYER

In IoT, a large number of devices are connected; these devices belong to different people and hence do not always imply with the same standards. The compatibility issue among the things must be solved for the interaction among things. Compatibility involves in information exchanging, communication and events processing. There is a strong need for an effective interface mechanism to simplify the management and interconnection of things. Basically interface layer works in the application frontend or API (Application Program Interface)

IV. CONCLUSION

In the past few years, IoT has been developed rapidly and a large number of enabling technologies have been proposed. The IoT has been the trend of the next Internet. Every available thing is getting smart. There is a wide scope for re-search in IoT. Many new technologies will emerge in the upcoming years taking a us to a whole new level of a smart world. . The future of IoT is very bright. From our bills to vehicles everything would be connected providing a better lifestyle.

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