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Smart Interaction of Object on Internet of Things

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Abstract— The Internet of Things (IOT) is a scenario in which objects, animals or people are provided with unique identifiers and the ability to sense analyses and transfer data over a network without requiring human-to-things interaction. IOT has evolved from the convergence of wireless technologies, micro-electromechanical systems and the Internet. Various scenario in which human-physical objects interaction and physical object-physical object interaction can be predicted with the help of past temporal information. IOT provide flow of information whenever a things are interacting with other things and human as well. A physical thing like RFID is implanted with its unique address using private and public network which is known to the end user. Based on the evaluation of temporal information human behavior is studied for particular thing of interest and things on the other hand could interact with the end user.

Keywords— Internet of Things; Architecture;RFID,Challenges

I. INTRODUCTION

The Internet of Things (IOT), sometimes referred to as the Internet of Objects, will change everything including ourselves. This may seem like a bold statement, but consider the impact the Internet already has had on education, communication, business, science, government, and humanity. Imagine a world where billions of objects can sense, communicate and share information, all interconnected over public or private Internet Protocol (IP) networks. These interconnected objects have data regularly collected, analyzed and used to initiate action, providing a wealth of intelligence for planning, management and decision making. This is the world of the Internet of Things (IOT). The IOT concept was coined by a member of the Radio Frequency Identification (RFID) development community in 1999, and it has recently become more relevant to the practical world largely because of the growth of mobile devices, embedded and ubiquitous communication, cloud computing and data analytics. Since then, many visionaries have seized on the phrase “Internet of Things” to refer to the general idea of things, especially everyday objects that are readable, recognizable, locatable, and addressable and can be controllable via the Internet, irrespective of the communication means whether via RFID, wireless LAN, wide- area networks, or other means. In 2010, the number of everyday physical objects and devices connected to the Internet was around 12.5 billion. Cisco forecasts that this figure is expected to double to 25 billion in 2015 as the number of more smart devices per person increases, and to a further 50 billion by 2020.

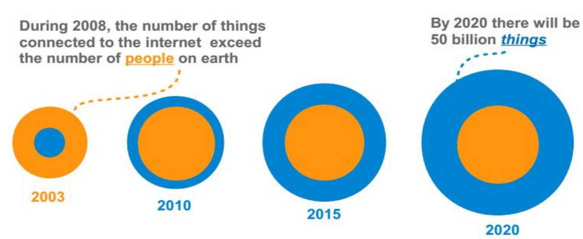

Fig. 1 Accelerated Growth of Internet Connect Devices.
[Source: [1] Evans, D., The Internet of Things. 2011. Cisco Blog. Available online: http://blogs.cisco.com/ news/the-internet-of-things-infographic/ (accessed on 22 September 2014).]

The concept of the Internet as a set of connected computer devices is changed to a set of connected surrounding things of human’s living space, such as home appliances, machines, transportation, business storage, and goods etc. Research is going on how to make these things to communicate with each other like computer devices communicate through Internet. The communication among these things is referred as Internet of Things (IOT). Internet of Things (IOT) connects the world object in both a sensory and intelligent manner through combining technological development in [5]:

- Item identification(“tagging things”)
- Sensors and Wireless Sensor networks (“feeling things”)
- Embedded Systems(“thinking things”)

However, the concept, architecture and key technologies of Internet of Things are still in the initial chaotic phase. From now on, researchers are still unable to give a clear concept and structure.

II. LITERATURE SURVEY

Jian An et al., in the paper [4] they have consider the basic concept of IOT by discussing its view points and defining the key architecture. Five essential factors which the IOT should have which include Application Layer, Information Processing Layer, Resource Management Layer, Network Layer and Sensor Controlled Layer are welly summarized. The architecture is further proposed by its structure and functions are described and the key technologies of IOT are analyzed, including recognition technology, sensing technology, network technology and smart technology. There also exist many problems at same time, which they believe that hinder the development of future IOT will no longer be technical details, but how to realize large-scale application. First is the architecture, protocols and standards. How to coordinate various aspects to formulate a set of standards is urgently. Second is the industry plan, any good technology, if there is no reasonable planning and business model to support the operation, it is difficult to sustainable development.

A. ARCHITECTURE

The IOT is characterized by comprehensive perception, reliable transmission, and intelligent processing [4].

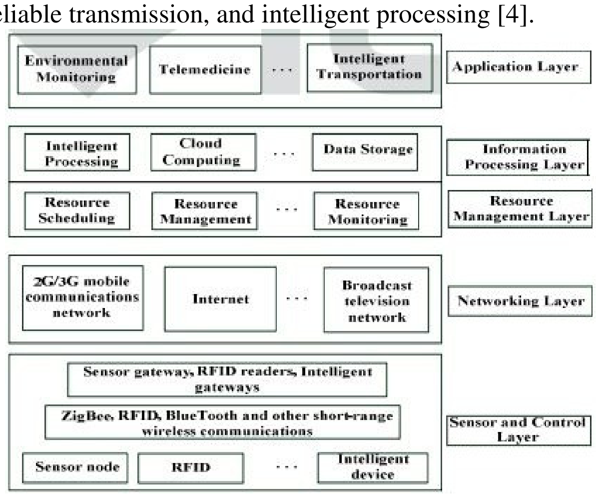

Fig. 2 Architecture of IOT
[Source: [4] Jian An, Xiao-Lin Gui, Xin He, "*Study on the Architecture and Key Technologies for Internet of Things*", International Conference on Electrical and Computer Engineering Advances in Biomedical Engineering, Vol.11, pp 329- 335, 2012]

It correspond to the five-layer architecture: the application layer, information processing layer, resource management layer, the network layer and the sensing layer.

- *Application Layer*

After analyzing and processing the sensing data, application layer using these data to provide users with a variety of different types of services. IOT application can be divided into network monitoring (logistics, pollution control), control type (intelligent transportation, intelligent household), scanning type (mobile purse, highway no parking fees), etc. [4]. In addition, the IOT should also include some support technologies such as network security, fault-tolerant mechanism and quality control which throughout all levels to provide application support.

- *Information Processing Layer*

This layer realized reasoning and semantic understanding of sensing data, it also provide data query, storage, analysis, mining, etc. [4]. Cloud computing could provide a good platform for sensing data storage and analysis. It is an important component of information processing.

- *Resource Management Layer*

It will provide the initialization of resources, monitoring the operation status of resources, coordination of work between various resources and achieve cross domain interactions between resources [4].

- *Networking Layer*

It is mainly responsible for the different types of networks integration, such as Internet, Mobile Communications Network, and Broadcast Television Network [4]. In addition, it will also provide routing, format conversion, address conversion, etc.

- *Sensing and Control Layer*

It is the foundation of the development and application of IOT, including RFID readers, smart sensor nodes and access gateways, etc. [4]. A variety of sensor nodes sensing the relevant information of the target environment and pass it to the nearest gateway, then gateway submit the data which collected via the Internet to background processing platform.

Finally is the trade integration, the application of future IOT will no longer be limited to a specific area, it will be a cross-product which between different industry and different disciplines.

Jayavardhana Gubbi et al., in the paper [3] presented a Cloud centric vision for worldwide implementation of Internet of Things. The key enabling technologies and application domains that are likely to drive IOT research in the near future were discussed. A Cloud implementation using Aneka, which is based on interaction of private and public Clouds is presented. He have conclude IOT vision by expanding on the need for convergence of Wireless

Sensor Network, the Internet and distributed computing directed at technological research community.

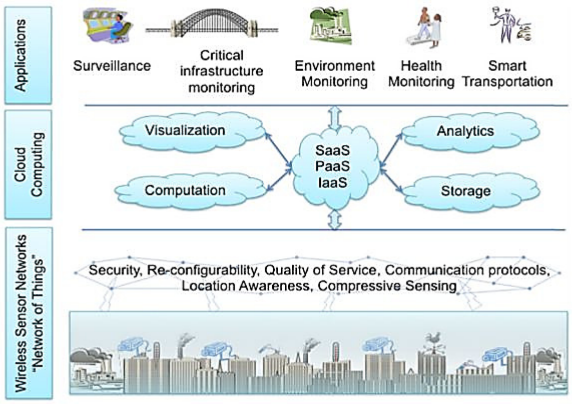

Fig. 3 Architecture of Cloud centric IOT

[Source: [3] Jayavardhana Gubbi, Rajkumar Buyya, Slaven Marusic, Marimuthu Palaniswami, "*Internet of Things (IoT): A vision, architectural elements, and future directions*", Future Generation Computer Systems 29, Elsevier B.V., 2013, pp 1645–1660.]

According to their definition of Internet of Things for smart environments [3] is "*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.*" They have emphasis more user centric and do not restrict it to any standard communication protocol. This will allow long-lasting applications to be developed and deployed using the available state-of-the-art protocols at any given point in time.

Sandra Dominikus et al., in the paper [6] presented establishment of a two-way communication between an RFID tag and a Corresponding Node in a network. Two-way communication means, that the tag can contact a Corresponding Node in the network at any time it is connected to the Internet and vice versa. He think of application scenarios where a Corresponding Node wants to change the tag status (e.g. revocation, call-back), write data on the tag (e.g. guarantee, maintenance), or poll the recent tag status (e.g. sensor data).

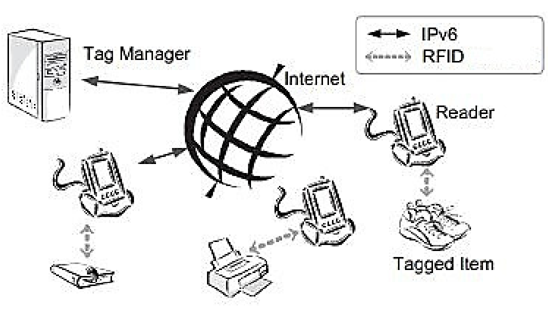

Fig. 4 Communication between things
[Source: [6] Sandra Dominikus and J¨ orn-Marc Schmidt, "*Connecting Passive RFID Tags to the Internet of Things*", IAIK, Graz University of Technology.]

The basic principle of this method is: The Corresponding Node sends a message with the IP address of the tag. The message is delivered to the reader, where the tag is currently present. The RFID reader identifies the tag with the corresponding destination IP address and translates the message into RFID commands, which are sent to the tag. The answers of the tag are re-translated into IPv6 messages which are sent back to the corresponding node.

III. INTERNET OF THINGS ELEMENTS

We present a taxonomy that will aid in defining the components required for the Internet of Things from a high level perspective. There are three IOT components which enables seamless computing: Hardware (made up of sensors and embedded communication hardware), Middleware (on demand storage and computing tools for data analytics) and Presentation (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 components stated above.

A. *Radio Frequency Identification (RFID)*

RFID technology is a major breakthrough in the embedded communication paradigm which enables design of microchips for wireless data communication. They help in the automatic identification of anything they are attached to acting as an electronic barcode. Active RFID readers have their own battery supply and can instantiate the communication. The passive RFID tags are not battery powered and they use the power of the reader's interrogation signal to communicate the ID to the RFID reader. This has resulted in many applications particularly in retail and supply chain management. The applications can be found in transportation and access control applications as well. The passive tags are currently being used in many bank cards and road toll tags which are among the first global deployments.

B. *Wireless Sensor Networks*

The emerging field of wireless sensor networks combines sensing, communication and computation into a single tiny device. The power of wireless sensor networks lies in the ability to deploy large numbers of tiny nodes that assemble and configure themselves. Usage scenarios for these devices range from real-time tracking, to monitoring of environmental conditions to ubiquitous computing environments. While often referred to as wireless sensor networks, they can also control actuators that extend control from cyberspace into the physical world.

C. Addressing Unique Identity

The ability to uniquely identify 'Things' is critical for the success of IOT. This will not only allow us to uniquely identify billions of devices but also to control remote devices through the Internet. The few most critical features of creating a unique address are: uniqueness, reliability, persistence and scalability. Every element that is already connected and those that are going to be connected, must be identified by their unique identification, location and functionalities.

Although, the TCP/IP takes care of this mechanism by routing in a more reliable and efficient way, from source to destination, the IOT faces a bottleneck at the interface between the gateway and wireless sensor devices. Furthermore, the scalability of the device address of the existing network must be sustainable. The addition of networks and devices must not hamper the performance of the network, the functioning of the devices, the reliability of the data over the network or the effective use of the devices from the user interface.

D. Data Storage And Analytics

One of the most important outcomes of this emerging field is the creation of an unknown hype of data. The internet consumes up to 5% of the total energy generated today and with these types of demands, it is sure to go up even further. Hence, data centers that run on harvested energy and are centralized will ensure energy efficiency as well as reliability. The data have to be stored and used intelligently for smart monitoring and actuation. It is important to develop artificial intelligence algorithms which could be centralized or distributed based on the need. State-of-the-art non-linear, temporal machine learning methods based on evolutionary algorithms, genetic algorithms, neural networks, and other artificial intelligence techniques are necessary to achieve automated decision making.

IV. KEY CHALLENGES

Imagine a world where each and every objects are wirelessly connected in a network of communication of heterogeneous node and embedded architecture. As mentioned above IOT consist various stages of architecture defined through cloud as well as its predefined architecture. IOT basically emphasis on different ingredient to make itself spicy for the benefit of end users. Basically it comprised of different sensors working together in an network simulated their behavior and raw data to extract relevant knowledge form the temporal logs to make the interaction much better. So as given in literature survey different researcher has proposed different theory toward IOT in terms of architecture or protocol or platform based which in result lead to an newly opened emerging field of IOT where we gone a play with different types of sensor , wireless network an much more areas needed to be invaded.

The IOT open problems are raised due to two main reasons. These reasons for mass gathering information for each thing in the IOT system and the communication among IOT system hardware.

A. Information Gathering Problems

These problems can be divided to two main classes [4]. The first one is related to the massive information that is gathered by RFID about huge number of things which are found at IOT system. The second is the related to the communication between IOT things components

- *Huge Data's Inflow And Outflow*

  The IOT systems should have millions if not billions of objects. Each object should radiate information to express about itself. This information should be gathered. The quantity of gathered information is massive due to the huge number of IOT objects. So, there are several problems which are raised due to a lot of gathered information. These problems are transmission, storing, and processing.

B. Gaps In Communication

The problem related to the communication between IOT things components, is divided into four classes, Billions of things problem, TCP challenges, Quality of Service and Object detection.

- *Billions Of Things*

  Whenever we think to communicate between large numbers of IOT things, the main problem arise is hardware, addressing, compatibility between hardware, which takes part in IOT system.
- *TCP Challenges*

  TCP should be selected to act as a transport layer for IOT systems. The TCP has more challenges related to the IOT systems such as connection setup, congestion control, and data buffering [4]. The connection setup may not be considered in most cases in the IOT systems due to the need to transmit small amount of data between objects. The congestion control is a challenge in the wireless medium which is the same medium of IOT systems. Also, in case of small transmitted information between IOT objects, the congestion control data is not required. The data buffering in TCP is required at the source for retransmission process and destination for ordering process. The data buffering processes are costly for the battery-less devices such as RFID tags in IOT.
- *Object Detection*

  When we concentrate in IOT system, we find two queries, how we can define each thing and how we can acquire its information. It is natural if we answer by using the RFID. But these technologies have several problems such as radiation, privacy, violation, and inconvenience of information updating.

V. CONCLUSION

As considering today's state of the art technologies, we get a clear indication of how the IOT will be implemented on a universal level in the coming years. In the coming years, technologies necessary to achieve the ubiquitous network society are expected to enter the stage of maturity. As the RFID applications find more acceptability, a vast amount of objects will be addressable, and could be connected to IP-based networks, to constitute the very first wave of the IOT. There will be two major challenges in order to guarantee seamless network access: the first issue relates to the fact that today different networks coexist; the other issue is related to the sheer size of the IOT.

This paper surveyed some of the most important aspects of Internet of Things with particular focus on what is being done and what are the issues that require further research. While the current technologies make the concept of IOT feasible, a large number of challenges lie ahead for making a large-scale real-world deployment of IOT applications.

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Pranay Kujur received his Bachelor's degree in Computer Science and Technology from Government College of Engineering and Textile Technology, Berhampore, West Bengal, India in 2013. He is currently pursuing Master in Computer Science and Technology from Sikkim Manipal Institute of Technology, Sikkim. His research interests include Wireless Sensor Networks, Internet of Things, Security and Web Technology.

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