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Internet of Things: Ecosystem and Applications

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ABSTRACT : The recent upgrade to IPV6 internet protocol which expanded the number of available IP addresses indicates that the Internet is moving into a big expansion in terms of the number of things and objects intended to be connected over the network, enabling it to become an Internet of Things (IoT). This connection shall enable the objects and things to share information among them and thus open the door for new web, mobile and wireless applications. In other words all computers, smart phones, mobile and any other device can be connected to the Internet. This paper shall follow an exploratory approach to outline the use of Internet of Things (IoT) in terms of its applications and the structure and components of its ecosystem.

Introduction

It is fairly easy to define the Internet of Things since it includes everything that can be connected to the internet forming a network of everything composed of objects, sensors, applications, devices and software products and working in harmony to achieve a specific task. Using the Internet as a platform it allows for the exchange of information and data between these things to accomplish its tasks (Ashton, 2009). These things or objects can be controlled from a distance and it can collect its needed information remotely via the internet infrastructure composed of LAN's, MAN's and WAN's. Objects connected to the Internet blend the virtual world with the physical world providing products, services and even information that enhance the effectiveness and comprehensiveness of people's tasks.

These integrated objects are identified on the network through an IP address in order for software applications and controllers to integrate them in the Internet infrastructure and to be accessible throughout the network (Sundmaeker, Guillemin, Friess, Woelfflé, 2010). The outlook for the number of objects connected to the Internet surpasses the 50 billion by the year 2020.

Kevin Ashton a British national came out with the term "Internet of Things" in 1999. It is envision that these connected objects shall provide users with on the spot data, products and services through the collection, processing and integration of data gathered through sensors, devices and applications connected over the Internet compromising the Internet of things ecosystem which includes a wide range of protocols, smart devices and applications in an automated virtual and physical environment forming an intelligent grid and intelligent cities.

Objects and devices connected to the network refers to an extensive range of devices including but not limited to thermo monitoring devices, temperature sensors, bio sensors, electromagnetic devices, location aware devices, RFID's, GPS points and heat sensors to name a few, that can be embedded in cars, airplanes, ships, homes, offices, factories and any other field that can benefit from the collected information they provide (Buckley, 2006).

Information and data collected through devices and sensors can then be processed and the results can be used to perform a user related and automated tasks through Wi-Fi connections.

It is expected that such implementations shall generate a large amount of information generated by the connected objects and devices that shall make users make use of the information that needs to be stored and indexed in a highly professional and efficient manner.

Internet of Things Ecosystem

The Ecosystem of the Internet of Things is composed of integrated and connected objects, sensors, applications, devices and software products has gain a wide spread attention recently. Conference and Journal articles have started to talk about the Internet of Things and its applications (Weiser, Gold, 1999). The Ecosystem of the Internet of things is related to how devices can be connected to the Internet in order to generate added economical value.

The Ecosystem can include broad categories that including everyday things that get connected for an intelligent tomorrow; such as vehicle, asset and pet monitoring and controlling, automating agricultural process, energy consumption, security and surveillance, billing management, embedded mobile applications, wireless sensor networks, everyday things, smart homes and cities, telemedicine and healthcare that are capable of moving and transferring data and information to other parts of the network (Rogers, 2006).

The Ecosystem can be outlined as following

People Internet of Things has a high market value internet enabled personal electronics such as phones and computers (Caceres, Friday, 2012). This section is served by consumer applications that help deliver consumer needs, usually following a new business model such as: wearable technology, home automation, healthcare, fitness assisted living, consumer services and infotainment and vehicles.

Internet of Things with IP address has a mid market value internet that has devices with IP addresses which are categorized as ubiquitous smart objects that sense and communicate over the internet with no human interaction.

Internet of Things without IP address and these are dedicated systems for connected things such as proprietary or standardized RFID, Active RFID, Real Time Location Systems, Mesh Sensor Networks. Both Internets of things with and without IP addresses represent industrial and governmental applications that deliver government and specific niche problems such as: infrastructure monitoring in smart cities, lighting, transportation monitoring, energy monitoring for a smarter grid, process automation, security and agriculture (Akyildiz, Sankarasubramaniam, Cayirci, 2002).

Internet of Things Applications

There are many benefits for the application of Internet of Things in real life scenarios. Real stream of timely data is of utmost importance to business organizations.

Currently almost 99 percent of devices and objects are not connected to the Internet, however, it is expected by Cisco that around 50 billion devices shall be connected through the internet by the year 2020 (Atzori, Iera, Morabito, 2010). This represent a great opportunity for business organizations and people to become connected and receive real time data through objects, sensors and applications connected to the Internet.

The amount of data created and copied through the Internet is expected to grow rapidly throughout the years. Which can led to Enhanced Customer Interaction. The use of the Internet of Things shall provide new venues to organizations to deliver information to its customers and speed up the processing of its tasks and enhancing its performance and become more agile in responding to customer needs (Belissent, 2010).

New Revenue Models shall emerge. Implementing Internet of Things in the business operations shall enable organizations to capture a large amount of data that can be processed and delivered in a timely fashion to their customers that shall improve their efficiency and generate new revenue streams. Information and services provided by organizations employing the Internet of Things concept and technology shall increase customer awareness and loyalty to the organization.

A new Innovative products related to the Internet of Things can help organizations develop and offer new services and products in the market through the connection of devices and sensors between applications (Belissent, 2010). Internet of Things can allow for the exploitation of large amount of intelligent systems providing added value to the organization and its customers.

Internet of things applications shall be focused on building Smart Cities that include services such as smart parking systems that monitors the parking spaces available within the city (Caceres, Friday, 2012).

The number and type of Internet of Things applications is very large to be included in this paper. It shall be used in building smart environments, smart water management systems, smart metering applications, security & emergencies, retail applications, logistics, industrial control, smart agriculture, smart animal farming, home automation and eHealth applications to name a few.

Conclusion

This exploratory paper has reviewed the main pillars of the Internet of Things, its ecosystem and applications. Internet of Things connection shall enable the objects and things to share information among them and thus open the door for new web, mobile and wireless applications. However, this is not as easy as displayed, to achieve this connectivity

between Things or Objects certain conditions must come into effect in order to overcome technical and regulatory and organizations constraints. This paper opens the door for authors to elaborate on how to overcome these constrains and how to turn the Internet of Things into reality and how to solve the interoperability constrains in the future.

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