The Internet of Things

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Nigel McKelvey
Computer Science Department, Letterkenny Institute of Technology, Ireland

Kevin Curran
School of Computing and Intelligent Systems, University of Ulster, Northern Ireland

Nadarajah Subaginy
School of Computing and Intelligent Systems, University of Ulster, Northern Ireland

INTRODUCTION

The Internet of Things (IoT) also known as Web of Things (WoT) is a concept where everyday devices - home appliances, sensors, monitoring devices - can be accessed through the Internet using well known technologies such as URLs and HTTP requests (Gomez et al., 2013). It is estimated that more than 4 billion users of mobile phones already have the ability to access the Internet. Advances in technologies are changing i.e. the way we use the Internet. Intelligent devices found in devices such as fridge's, machine's, factories and even clothes are connecting and interacting automatically on their own without human interaction by use of sensors that transmit data. It is soon expected that there will be more devices or "things" on the Internet than there will be people (Ben-Saied et al., 2014).

IoT has been emerged as one of the most important shifts of thought with regards to the future state of Internet. Its significance is described in terms of providing a different lens on how to link the Internet with real world's objects. In a more comprehensive way, IoT transforms real world objects into smart objects and connect them through Internet. In contrast with the current Internet, IoT depends on a more flexible architecture where physical objects with embedded sensors will communicate with a cloud to send and analyse data using the Internet Protocol. IoT envisions a future in which digital and physical entities can be linked, through their unique identifier and by means of appropriate information and communication technologies (Montavont et al., 2014). There are still open issues regarding 5 IP-WSN (Internet Protocol Wireless Sensor Network) features in an IoT scenario: IPv6 Adaptation, Mobility, WEB Enablement, Time Synchronisation and Security.

Before discussing how the Internet is evolving towards an Internet of Things it is important to understand how the Internet has changed from web 1.0 to web 2.0 and now to the Internet of Things we need to understand the technology and changes in society that have made this happen or even possible. Web 1.0 allowed people to communicate on a global scale by broadcasting their messages (Kalfoglou, 2012). It was focused more towards organizations than individuals. What was on the web or the content of what made up web 1.0 was not seen to be free to all user's like it is today, organizations sought to control or have ownership of this content. Web 1.0 did not allow for personal interaction. User's would have created HTML home pages listing whatever information they wanted about themselves but this information was static or read only. Anyone looking to obtain information over the web would probably have ended up paying a subscription to some on-line encyclopaedia company such as Britannica. Technologies such as JavaScript, XML, Ajax, RSS, Apache, MySQL and infrastructure improvements such as broadband has taken the power away form organizations in terms of content or ownership of information on the web and given it back to the people. Now users could create feature rich dynamic web content, allowing them to become contributors and producers of information. The emphasis was now based on the sharing of information and not ownership. Web 2.0 offers user's and communities a global stage on which they could perform, weather it be posting videos on YouTube showing off there talents or lack of talent, or web forums offering advice or solutions to

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individual worries or problems ranging from diseases and treatments to software fixes and code solutions.

With users now having the ability to generate and post their own content. Social networking sites such as Facebook have been set up to take advantage of this by providing user's a platform on which they can interact. Social networking sites such as Facebook have changed the traditional ways people have communicated, socialised or even became friends it also expected to do the same for organizations in terms of networking and making business connections. This is due partly to the global reach of Facebook. Due to the large number of sensors, an IoT scenario deals with big volumes of data. There are three main problems that must be solved: resolution, sensitivity, and reliability. Compressed Sensing (CS) refers to the method used to reduce the number of samples collected in an IoT WSN (Kyriazis et al., 2013) Thus it is possible to create stand-alone applications that require fewer resources.

BACKGROUND

The following scenario paints a picture of what the Internet of Things is trying to achieve and how it aims to achieve this.

Scenario: *You wake up in the morning and your alarm clock goes off at the right time because it is hooked up to your calendar, which knows that you have a conference to attend that day, it then searches and figures which plane you need to get, therefore knowing what time to wake you up. In your house the heating would have been on for an hour in order to heat the water for you. You get in your car and an audio announcement lets you know that the road to the airport has been closed due to a burst water pipe which has been caused by a blockage in the water supply; your car then identifies another root to take to the airport ensuring that you get there on time.*

In this scenario all this has been taken care of for you on your behalf by sensors or systems linking to each other acting smart because they know about each other. For example your phone was able to communicate or transmit data across a network to a system in your home activating your heating; Sensors in the water supply system were alerted to a blockage which then transmitted this information across a network to the traffic control system; the traffic control system then transmit this data or information across a network to a system in your car along with an alternative route for you to take, making sure you avoid any delays and get to the airport on time.

At present there are systems or sensors in place that can tell when there is a blockage in the water supply, knows if certain roads are blocked and can control the heating in your house all of which transmits data accordingly. But the fact is these systems are isolated systems on their own. Connecting these isolated systems together and creating what is referred to as a system of systems, which allows for all this information to be shared among all relevant systems is one of the major problems facing the Internet of Things in becoming a smarter more intelligent web. Another problem facing the Internet of Things is that if every object e.g. car's, house's, water supplies, clothes, factory's and so on are to be connected to the Internet then surely they will all need to have their own uniquely identifiable IP (Internet Protocol) address, that is a hell of a lot of IP addresses. Currently the Internet works on the network layer standard of IPv4 which is slowly but surely running out of available IP addresses and it is not expected to be able to cater for all the extra IP addresses that will be generated by the Internet of Things.

The Internet Protocol (IP) and IPv6

The Internet Protocol (IP) specifies the format of packets, also called *datagrams,* and the addressing scheme. Most networks combine IP with a higher-level protocol called *Transmission Control Protocol (TCP)*, which establishes a virtual connection between a destination and a source. Today's Internet works on the network layer standard of IPv4. IPv4 is a 32-bit address protocol that was developed in the 70's. IPv4 was thought to offer enough addresses for the future, but with the increased number of Internet user's and the lower cost of "always on" broadband, now with the Internet of Things becoming a reality addresses are beginning to run out. To extend the number of addresses for network devices, a new protocol was required (Dinakaran & Balasubramanie, 2012).

In 1994 the Internet Engineering Task Force (IETF) decided to adopt the new protocol of IPv6. IPv6 is not a new and improved version of IPv4 but rather a totally