Internet of Everything: State of Art – Research Challenges and Directions

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Abstract—Internet of Everything (IoE) stands out in the Digital World of today. IoE magnifies the prospect of Internet of Things (IoT) and leverages people, process, things and data to create new opportunities, capabilities and openings in business, education and numerous massive applications reducing the complexity of the tasks adopting appropriate sensors. This evolving technology of sensors fusion is a boon for the researchers to explore the multifaceted challenges and elucidate possible contribution, making the Internet of Everything a platform of global entirety. Hence, this paper presents the possible impacts on the use of internet of Everything, the challenges and the future directions adopting IP/MPLS.

Keywords—security, internet of everything, sensors, IP/MPLS, IPv4, IPv6, research challenges

I. INTRODUCTION

The Internet of Everything (IoE) is a perception that broadens the frontier of Internet of Things (IoT). The Internet of Everything (IoE) emphasis on machine-to-machine (M2M) communications, machine-to-people (M2P) communications and technology assisted people-to-people (P2P) interactions [1] whereas IoT is limited with M2M communication. Cisco defines IoE as the intelligent connection of people, process, data and things [2]. Internet Business Solutions Group (IBSG) presents the statistics and says that internet growth is occurring in waves where millions of new devices are regularly being connected to the Internet and in 2020 it will be trillion things. Fig. 1 represents this scenario given by IBSG of Cisco, 2012.

IoE interconnects physical objects, converts huge amount of data in to useful information in a very short duration, supplies perfect information to the person concerned at an appropriate time by connecting people more efficiently [3]. Excellent things will happen and bewildering experiences will be envisaged as new people, process, data, and things are networked on the Internet of Everything with the adoption of appropriate sensors.

Sensors play a vital role in Internet of Everything which can be compared with the human activity, the best analogy of IoE. Humans while having meals, the eyes act as visionary sensors, nose smells the food, hands become the actuators, and taste buds tastes the food. Here the brain acts as the CPU, collects the information from the sensors, processes the information and finally decides what action to be performed. If the physical body is not able to sense properly and execute the functions expected, there will be confusions and abnormalities. So to say setting the IoE with proper sensors and computing technology, IoE will be the sole masterpiece to pierce through the lives of all and to reach high by taking into consideration a few concerns and challenges. Because IoE is perceived as a network of networks where billions or even trillions of connections generate surprising opportunities and unexpected risks [4] [5]. Hence this paper provides the impact of IoE with its basic components, the challenges envisaged and the future directions with the integration of IP/MPLS (Internet Protocol / Multi-Protocol Label switching) switch [6].

II. MECHANISMS OF INTERNET OF EVERYTHING

The four important components of IoE are people, data, things and process. In IoE, people could connect to the Internet in many ways. For example, people can take a capsule that senses and reports the health of their internal organ to a physician over a secure Internet connection. Sensors located on the skin or seamed into a dress will supply information about a person’s physical status. According to Gartner, people themselves will become nodes on the Internet, with both static information and a constantly emitting activity system [7].

Things generate massive data. Connected things could transmit higher-level information back to computers and people for evaluation and decision making. This transformation from data to information in IoE is important because it allows people to make intelligent decisions faster and to have the effective control over the environment.

Things comprise physical items such as smart sensors and consumer devices which are connected to both the Internet.
and each other. Things sense data and provide more empirical information to assist persons and machines make appropriate and significant decisions. Process plays a crucial role in making how people, data, and things work with one another to deliver the accurate information to the right person at the appropriate time in the suitable way [8]. Fig. 2 represents the major components of IOE.

III. RESEARCH CHALLENGES IN IOE

The research focus envisaged for enhanced IOE are architectural blockades, false message, sensor interoperability and interconnectivity, data transmission issue, interrupts in communication, prediction and optimisation, power problem with sensors, security and privacy challenges of wireless sensors and data handling.

IV. FUTURE DIRECTIONS

To address the issues of interoperability, interconnectivity, security and privacy threats, IP/MPLS (Internet Protocol / Multi-Protocol Label Switching) switch can be integrated among the connected devices in IoE network. Since the networks of the day comprise both IPv4 and IPv6 components, IPv4 to IPv6 transition and vice versa can be enhanced with IP/MPLS switch. Fig.3 depicts the interoperability mechanism involved among IPv4 and IPv6 devices.

Network performance with regard to data transmission is analyzed by network traffic measurement using IXIA network traffic generator. The data transmission rate is the speed with which data can be transmitted from one device to another. The sample data is tabulated in Table.1 and the graph generated is presented in Fig.4.

<table>
<thead>
<tr>
<th>Data Size (bytes)</th>
<th>IPv4-IPv4 (us)</th>
<th>IPv6-IPv6 (us)</th>
<th>IPv4-IPv6 (us)</th>
<th>IPv6-IPv4 (us)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0009863</td>
<td>0.0009883</td>
<td>0.007</td>
<td>0.010248</td>
</tr>
<tr>
<td>4</td>
<td>0.0009912</td>
<td>0.0009912</td>
<td>0.0071</td>
<td>0.010849</td>
</tr>
<tr>
<td>8</td>
<td>0.0009937</td>
<td>0.0009956</td>
<td>0.0074</td>
<td>0.011683</td>
</tr>
<tr>
<td>16</td>
<td>0.0009958</td>
<td>0.0009961</td>
<td>0.0075</td>
<td>0.012114</td>
</tr>
<tr>
<td>32</td>
<td>0.0009973</td>
<td>0.0009967</td>
<td>0.006999</td>
<td>0.012387</td>
</tr>
<tr>
<td>64</td>
<td>0.0009988</td>
<td>0.0009982</td>
<td>0.006997</td>
<td>0.01249</td>
</tr>
</tbody>
</table>
The traffic generator sends dummy packets, often with a unique identifier. The entire testing process was carried out within the simulation environment using a virtual topology for the four categories of communication namely IPv4 device node to another IPv4 device node in IPv4 network, IPv6 device node to another IPv6 device node in IPv6 intra network, IPv4 device node to another IPv6 device node in the hybrid IPv6-v4 network and IPv6 device node to another IPv4 device node in the hybrid IPv4-v6 inter network communication. The data size is varied in the range (1,2,4,8,16,32,64 in bytes), to measure the data transmission rate among the devices in the network of ‘Internet of Everything’ with all the possible communication defined.

It is observed that the data transmission rate among the devices is significantly faster with the incorporation of IP/MPLS switch without any loss of data.

V. CONCLUSIONS

Internet of Everything creates significant impact in the society and plays a vital role in making everything smart. Yet the challenges hidden in this technology is numerous. Hence it is suggested to integrate IP/MPLS (Internet Protocol / Multiremural Protocol Label switching in Internet of Everything (IoE) platform which will mitigate the possible risks. This integration will stand out in the Digital World of competing and compromising the opportunities, capabilities and openings in business, education and numerous massive applications.

REFERENCES

[1] https://internetofthingsagenda.techtarget.com/definition/Internet-of-Everything-IoE.