Chapter 16
Role of Big Data in Internet of Things Networks

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ABSTRACT

With recent advancement in cyber-physical systems and technological revolutions, internet of things is the focus of research in industry as well as in academia. IoT is not only a research and technological revolution but in fact a revolution in our daily life. It is considered a new era of smart lifestyle and has a deep impact on everyday errands. Its applications include but are not limited to smart home, smart transportation, smart health, smart security, and smart surveillance. A large number of devices connected in all these application networks generates an enormous amount of data. This leads to problems in data storage, efficient data processing, and intelligent data analytics. In this chapter, the authors discuss the role of big data and related challenges in IoT networks and various data analytics platforms, used for the IoT domain. In addition to this, they present and discuss the architectural model of big data in IoT along with various future research challenges. Afterward, they discuss smart health and smart transportation as a case study to supplement the presented architectural model.

1. INTRODUCTION

The Internet-of-Things (IoT) concept traces its origins the back to late 90s and it referred to the interoperability of devices using RFID technology. With the explosion of cheap mobile devices with a wide array of sensors, IoT has transformed into a large-scale network of heterogeneous devices that are connected via wired or wireless internet. Today, a widely accepted definition of the modern IoT is "a network

DOI: 10.4018/978-1-6684-3662-2.ch016

infrastructure comprised of interconnected "smart things" having self-healing and self-configuring characteristics. These smart things refer to physical and virtual entities capable of sensing and gathering information, having smart interfaces with interoperability capability using standard communication technologies." (Xu, He and Li, 2014) & (van Kranenburg, 2007)).

This new revolution in terms of IoT has led to a generation of huge volumes of data contributed by billions of devices connected to the internet (Bloem et al., 2013; Tannahill & Jamshidi, 2014; Zikopoulos, Eaton, Deroos, Deutsch, & Lapis, 2012). Recent estimates suggest that several zettabytes (ZB) of data have been created and processed today, a quantity that vastly exceeds the data created and stored since the dawn of human civilization until 2003 (Chen, Mao and Liu, 2014). Naturally, such an explosion in generated data has mandated that Big Data storage, processing, and analytics technologies go hand-n-hand with the IoT, with Big Data tools today being an indispensable backbone for the operation of the IoT.

The creation of the new IoT has opened up new vistas in exploiting the power of information in ways never seen before. Efficient utilization of the massive volume of data generated by industrial sensors can help increase the efficiency of industrial manufacturing processes, while data from smart devices can enhance a wide variety of human experiences ranging from home environmental control to tailored social media content. Further, big data analytics can help governments and businesses make critical decisions and improve policy-making towards economic growth (Cebr, 2016).

The objective of this chapter is to present an overview of big data, its storage and processing which serve as key enablers for IoT applications. We discuss the concept of Big Data along with its importance in IoT, in section 2, followed by the architectural framework of the IoT in section 3. Section 4 covers state of the art techniques used in IoT applications. Afterward, we present two applications of IoT in intelligent transportation networks and healthcare services, as a case study in section 5. These case studies are used to illustrate the power of Big Data technologies coupled with the IoT framework. In section 6, we highlight challenges in the adaptation of Big Data in IoT, along with some future directions. We conclude the chapter in section 7.

2. IMPORTANCE OF BIG DATA INTERNET OF THINGS

This section provides a general overview of Big Data and its usability in the IoT domain. The notion of Big Data trails back to the realization of engines such as; Yahoo and Google and large-scale experiments performed by European Organization for Nuclear Research (CERN) supercollider (Arkady, Perera and Georgakopoulos, 2013). Today, with Cloud technologies, smartphones and massive social media networks, Big Data is a ubiquitous industry worth nearly 125 billion USD.

2.1. Big Data: The Definition

Big Data is usually characterized by five properties, referred to as the 5V's in Figure 1.

2.1.1 Volume

Typically, Big Data means massive volumes of data, usually in terabytes (TB), petabytes (PB), zettabytes (ZB) or more.