Chapter 1
Fundamental Principles of IoT

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ABSTRACT

Internet of things (IoT) is the extension network of the Internet. Internet-enabled objects have the ability to sense and communicate with other objects or humans. Enormous components are used to build the IoT network. IoT begins with the connectivity since IoT is extensively diverse. It is certainly obscure to find a single size fits to all the types of communication. Various solutions have their strengths and weaknesses in different network criteria to best suit different IoT applications. IoT is available in various forms. One of the different types of IoT available for deployment is narrowband IoT (NB-IoT). NB-IoT is famous due to its attractive features of low power wide area (LPWA). Though the challenges such as security, latency, interoperability, policymaking, and resiliency exist for all types of IoT network, it can be improved with careful architectural design. In this chapter, the authors highlight the fundamentals involved in building the network of internet-enabled devices. It describes types of IoT networks, different computing mechanisms in IoT, basic architecture underlying the development, applications in the expansive domain, and finally, the insight of the challenges in IoT.

INTRODUCTION

Internet in this era is not just connecting people, it is connecting the devices to the internet. The Internet of Things (IoT) is nothing but "A network of Internet-connected objects able to collect and exchange data". IoT works by connecting items and then having the ability to sense and communicate. This leads the devices to communicate or interact with other devices and with the human. We humans have five sensors like smell, touch, taste, hearing, and sight. Similarly, things can be built with these abilities to

DOI: 10.4018/978-1-7998-4775-5.ch001

receives input and communicate. Thanks to the increased availability of high-speed internet and its reduced access costs, attention is drawn to the development of devices with Wi-Fi modules. These Wi-Fi activated devices can be connected through the internet. Mobile phones, Coffee machines, refrigerators, washing machines, lamps, speakers, portable devices, and many more can be connected to the internet. IoT is a large network of connected things. These devices with connectivity can be made human life much simpler. It can be better illustrated by examples that simplify our day to day job, such as the vehicle with network connectivity, which can retrieve the information on the best route to reach our destination. Similarly, once the alarm rings it notify the coffee maker to start brewing the coffee, the lights can be turned ON/OFF depending on the presence of someone in the room to minimize power wastage, office equipment knew when it was running low on supplies and automatically re-ordered and many more such applications. IoT is one of the basic aspects of our lives because of many applications such as Healthcare, Smart environment (i.e. Smart city, smart home), Automotive, smart mobility, and Smart energy and smart grid, transportations, surveillance, and so on. Trends of IoT flows through Connectivity, Personal Mobile, and Sustainability to the real world, and here come the drawbacks which may prove to be an obstacle in analyzing its role. Attackers find Internet-connected devices vulnerable to hacking of smart rifles, vehicles, health centers, parking areas. Power, memory and end-point protection software are some of the challenges of IoT systems that need to be synthesized first before implemented. The manufacturers are not paying attention to security as the IoT devices are cheap. But an IoT application developer should always be aware of the security challenges because it is most likely to happen and one should always keep this mind with an alternate plan to overcome the security issues. Through keeping the encryption of data, authentication of data, issues in hardware, and testing hardware in mind, we can increase the benefits in IoT based applications. Potential hurdles stand in the way of significant ramifications typically in the areas of security, privacy, interoperability including legal and regulatory standards with the advancement of technologies. As IoT is the latest trend so there is a need to address its challenges. Cellular networks can be a cost-effective deployment, because of its advanced infrastructure. Non-cellular implementation requires a new base for IoT deployment. In recent advancements in the cellular network have provided support for IoT devices. Release 8 was the beginning of the 4G activity of 3GPP known as Long Term Evolution (LTE). 3GPP developed the latest LTE specifications extending the IMT-2000 guidelines. LTE provides several improved features such as high speed, low latency, higher spectrum performance, Orthogonal Frequency Division Multiplexing (OFDM), air interface, and higher cell capacity. 4G LTE channel is much wider around 10MHz whereas Narrowband IoT (NB-IoT) is 200KHz. LTE implemented Machine type communication (MTC), which facilitates connectivity between the devices. The connected devices may suffer because of small data rates while carrying out handover, whereas static devices such as smart meters need a small data rate for its operation.

The key purpose of this chapter is to include the fundamentals of different types of IoT, its architecture, implementation, features, applications, working principles, limitations, and future research directions. We have discussed different types of IoT in this chapter for understanding its underlying benefits and hindrance. The remainder of the chapter is organized into 8 sections. Section 2 discusses the literature review; Section 3 describes the evolution of IoT. Types of IoT networks are covered in section 4. IoT architecture and the types of computation involved in IoT architecture is explained in section 5. Applications of IoT in various fields are discussed in section 6. Finally, challenges and new research direction in IoT are highlighted in section 7, and chapter conclusion is given in section 8.