Chapter 5
Deployment of Narrowband Internet of Things

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ABSTRACT

Internet of things (IoT) is an integral part of modern digital ecosystem. It is available in different forms. Narrowband IoT (NBIoT) is one of the special forms of the IoTs available for deployment. It is popular due to its low power wide area (LPWA) characteristics. For new initiatives such as smart grids and smart cities, a large number of sensors will be deployed and the demand for power is expected to be high for such IoT deployments. NBIoT has the potential to reduce the power and bandwidth required for large IoT projects. In this chapter, different practical aspects of NBIoT deployment have been addressed. The LPWA features of NBIoT can be realized effectively if and only if its deployment is done properly. Due to its large demand, it has been standardized in a very short span of time. However, the 5G deployment of NBIoT will have some new provisions.

INTRODUCTION

Internet of things (IoT) is a pervasive application of the Internet connected through several sensors and actuators. Initially, it was started as a value added service over the cellular communication networks. Over the time, it has evolved as a new dimension of the cellular networks. Now, it can be applied for several applications which are very attractive in the new initiatives such as smart cities and smart grids. The modern day cellular networks are in a very suitable position to provide the IoT deployment over their infrastructure. However, it can be deployed both in the cellular and non-cellular frameworks. Cellular networks provide cost effective deployment as their infrastructure is already mature. Non-cellular deployment needs a new infrastructure for the IoT deployment.

Right now, there are several types of IoT networks. One of them is narrowband IoT (NBIoT). This is a new type of radio access technology which needs a very few resources for its deployment when compared with other forms of IoTs. Therefore, it is considered as a low power wide area (LPWA) technol-

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ogy. That means it needs a very low power levels for its operations while covering a large area. LPWA features are essential for large scale deployment of IoTs for long term sustainability. In the modern digital ecosystem, wide spread deployment of sensors and actuators for all the essential facilities of the cities would be very expensive and energy consuming. Therefore, energy and other resource saving technologies are essential for modern projects such as smart cities, smart retail, smart transport systems, smart grids and smart policing.

The term "narrowband" is due to the use of 200 kHz bands for NBIoT. In Long Term Evolution (LTE), bands are comparatively much wider than 200 kHz. The time when NBIoT was standardized by the Third Generation Partnership Project (3GPP) in 2016, the typical 4G LTE channels used to be of around 10 MHz. Therefore, 200 kHz bands are much narrower than the LTE bands. Of course, when compared with the GSM and UMTS bands, the 200 kHz may not be that narrow. However, the name (i.e., NBIoT) was given based on the comparisons with the 4G LTE bands. In 5G, the bands will be even wider and the 5G associated NBIoT will be really very narrowband application over it.

The main objective of this chapter is to provide the deployment techniques of NBIoT. We provide a detailed study and analysis of NBIoT features, principles, potentials and some typical applications. We also present the bandwidth and other essential requirements of NBIoT for practical deployment. We show the typical models for NBIoT and their utilities for practical deployment. We also considered the energy efficiency and other related aspects which are important considerations for its long term sustainability.

The reminder of the chapter is organized in five sections. In Section 2, the literature review of NBIoT deployment has been presented. In Section 3, the bandwidth and band selection related issues of NBIoT deployment have been presented. It is shown that in three different ways it can be deployed effectively, and even hybrid deployments are also available. In section 4, the methods and techniques for the deployment of sensors, actuators and servers of NBIoT have been shown. The roles of edge computing facilities have been presented in this section. In Section 5, the future research directions of NBIoT and its deployment techniques have been presented. Finally, in Section 6, the chapter has been concluded with the main points.

LITERATURE REVIEW

Due to its importance for the modern digital ecosystem, a lot of research is going on different types of IoTs. Every year new outcomes of research change the IoT landscape to a large extent. Overall, the IoT research is quite mature now. Almost all aspects of IoTs are being investigated for better performances. In comparison to the other forms of IoTs, NBIoT is relatively new. NBIoT was proposed as an alternative solution for massive machine type communications (Li et al., 2018). Due to its suitability for large coverage using a small amount of power, it became popular for several applications in the cellular communication framework. In Ratasuk et al. (2016a), the basic ideas behind NBIoT are presented. Its deployment issues too have been addressed in this paper. The deployment of NBIoT can be done over three different types of bandwidth allocation: standalone deployment using dedicated carriers for NBIoT; in-band deployment using the LTE bands when they are not used for LTE communication; and guard band deployment using the band gaps provided between the LTE bands. Depending on the situation, two or more hybrid of the above methods can also be used. In the standalone mode, NBIoT normally uses one GSM or LTE equivalent channel of 200 kHz known as a physical resource block (PRB). In the two other modes, it normally uses a GSM or LTE band of 180 kHz. NBIoT normally uses low cost systems and can provide enhanced coverage. The coverage can be 20 dB more above the existing GPRS coverage (Ratasuk et al.,

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