Narrowband Internet of Things

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INTRODUCTION

Internet of things (IoT) is pervasive extension of the Internet. It uses several sensors based on the application requirements for interconnecting them together in a common framework. These days IoT has several dimensions for numerous applications and it facilitates massive machine type communications. IoT has the ability to reach the territories where there is no Internet available. Internet is normally available where there the human settlements are present. However, there are many scenarios where we need the information without the presence of the Internet. For instance, measurements of under surface soil humidity and fertilizer intensity can be brought in to the Internet through the IoT. This can be done by deploying appropriate sensors under the earth surface. Similarly, there are applications in which micro monitoring is required in the unmanned territories. In those cases, the supervision of the IoT can be done through some remote communication nodes. IoT can provide the information from many unmanned locations using its sensors and the communication infrastructure of the Internet.

Background of NBIoT

IoT is now an integral part of the modern digital ecosystem and leading the changing trends in many sectors. It has several ramifications and can be applied to a number of sensor-based application scenarios. Initially, it was started as a value-added segment for the cellular communication networks. Gradually, they became very popular in many applications. Now they appear in several cellular and non-cellular forms including sensor networks, control networks, and independent networks. Different types of IoTs are available depending on their features. Narrowband IoT (NBIoT) is one of the standardized forms of IoT which is very attractive due to its suitable features. According to the name, NBIoT needs narrow band frequencies for its operations. This narrow band requirement is quite special for NBIoT and thus it has several advantages over other forms of IoTs. NBIoT has ability to cover a large area with a small amount of transmit power (Routray & Sharmila, 2017). This is an energy efficient feature of NBIoT which makes it a popular green technology. These days green and sustainable technologies have high demand due to their energy efficiency and environment friendly features (Zhu et. al., 2015). In these quest, NBIoT like low energy technologies are very popular in different applications in which IoTs and sensor-based technologies are essential. Now green IoTs are well researched areas in which optimization of resources is a prime goal (Routray & Sharmila, 2017). In the resource limited situations, such as the developing countries, they have even more important roles due to the shortage of resources.

In the recent years, several works have been done on different types of IoTs to make them more energy efficient. In Routray & Sharmila (2017), green IoTs have been studied from several technological aspects. In that work NBIoT has been proposed as the inherent green technology for several applications due to its attractive energy and bandwidth saving features. In Zhu et al. (2015), energy efficient and sustainable

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initiatives for IoT based smart world have been addressed. It provides several recent progressive trends on smart initiatives and technologies which are able to make the entire IoT networks energy efficient. It also gives insight for the segment-wise greening processes in the framework of existing information and communication technologies (ICTs) across different application domains. Perera et al. (2014), provided a comprehensive survey of the contemporary IoT marketplace of last few years. That survey explains the recent industrial demands and applications of IoT and its associated technologies in different industrial and other associated processes. They also elaborate through justified logic that manufacturing and automation will have a large share of industrial IoT. Da Xu, He, Li (2014) too provided a similar survey which focuses on the technological prospective of IoT. This survey emphasizes that the wide deployments need to be energy efficient for the practical reasons. In Al-Fuqaha et al. (2015), a comprehensive survey on the practical aspects of IoT such as the enabling technologies, protocols and applications have been presented. At first it deals with the enabling technologies that make IoT a reality and then show the main protocols which are instrumental in the IoT operations. Finally, it provides a long list of applications in which IoT can play significant roles. The authors pointed that the overall success of IoT is very much dependent on the efficiency of the entire IoT networks, their components and end devices. Ramnath et al. (2017) and Yu et al. (2016), provide the hybridization of IoT networks with other types of networks, such as the cellular networks for advanced applications like the localization and tracking of objects and living animals. In the later one the 5G IoT related localization has been emphasized using special algorithms.

The work of Mohanty and Routray (2017) presents the recent trends of consumer electronics driven data communication networks. This paper shows the volume of the resources, such as the bandwidth and power for transmission needed for the global communication networks. The data storage and communication infrastructure required for the current ICT sectors too have been presented in this article. Sustainability aspects of communication networks have been presented in Mohanty & Moreira (2014). In this paper, carbon emission contributions of global communication sector have been presented which shows that more than 2% global carbon emissions are from the ICT sector. Outlooks for overall sustainability in the ICT sector have been proposed in this work. Pirinen (2014), provide the research and development initiatives of 5G and IoT are presented in which energy efficiency and overall network optimizations are emphasized. Hossain et. al. (2012), present the fundamental aspects of green radio communication technologies and the emerging methods used in ICT sectors for energy efficiency. This work also provides insights for emerging networking technologies such as IoT for overall energy efficiency. Cavalcante et al. (2014), present 5G energy efficiency related aspects which mentions general system characteristics for overall effectiveness on the system. Anand & Routray (2017), present the applications scenarios of NBIoT for healthcare. This work analyses several issues and challenges in the healthcare NBIoT. Security aspects of IoT are quite challenging. In Routray et al. (2017) novel cryptographic techniques for IoT have been suggested. Quantum cryptography for IoT is a robust security for the long term. Standardization NBIoT was started in LTE Release 13 (Ratilainen, 2016). Basic specifications of NBIoT were established for the cellular NBIoT. These standards were updated for enhanced performances in Release 14 (Hoglund et al., 2017).

In this article, we provide the main principles, potentials and applications of NBIoT. We present its deployment issues and the commonly encountered challenges in its implementation. These days NBIoT is very popular in several situations due to its attractive features. We show that NBIoT is the right choice for the developing countries at the moment. We also address its main motivating features, deployment options, and applications in different sectors.

The remainder of this article is organized in three sections. In Section 2, we present the energy efficient and green characteristics of NBIoT. We also presented its deployment options and applications of