Chapter 1
Green IoT (G-IoT) Ecosystem for Smart Cities

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ABSTRACT

We are in the era of Industry 4.0 with the world going towards everything, everywhere, and anytime with "things" being enablers of technology. Our world is becoming smarter with everything (mobile phones, cars, TVs) connected to each, having unique addresses and communication mechanisms. It is foreseen that by 2025 every little thing, like pen, paper, food packages, etc., would be operated over the internet by internet of things (IoT) towards a smarter world. However, in order to enable the smart world to be sustainable, IoT should be embarking into energy efficient (green) paradigms. Since IoT is also a key enabler for smart cities, a green-aware design of smart cities could see a potential to create a green IoT ecosystem for smart cities. This ecosystem would comprise the green IoT lifecycle, the six pillars of smart cities, and focusing on the green infrastructure, green applications, and green energy. This conceptual study would motivate researchers embarking into smart city projects and keeping green concepts intact in their design and implementations.

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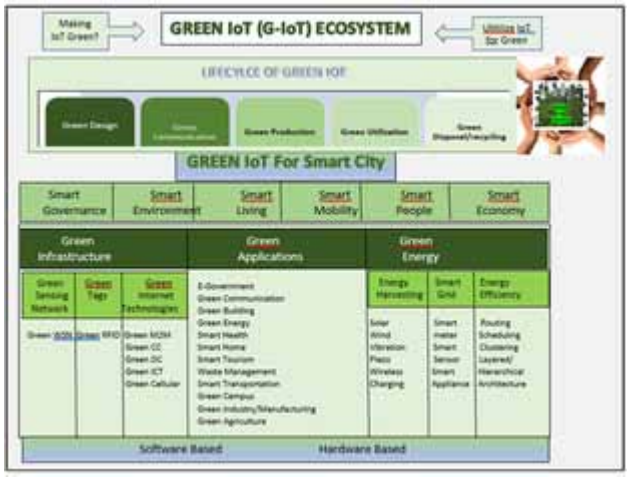
INTRODUCTION

Green IoT would be a moving factor contributing towards energy efficiency by reducing energy utilization either by using software or hardware procedures. When the term Green IoT is stated, there could be two possible ways one could interpret. Are we going to utilize IoT in order to reduce the greenhouse effect or are we looking at the impact of IoT contributing to the greenhouse effect? In the earlier term we should investigate sustainable green applications or infrastructures by incorporating IoT into the design whereas the later focuses more on making the IoT devices more energy efficient. In either case, the entire green IoT lifecycle should focus on green design, green communication, green production, green utilization and green disposal. The design and production of the entire green architecture (device, communication, networking) should be power aware and the utilization and disposal of green devices and technology in order to reduce the greenhouse effects. With this, the global carbon emission reduction and energy consumption savings can be achieved as anticipated by the European Union. A global smart Green IoT Ecosystem (Figure 1) can be foreseen, focusing on the three main IoT domains in the area of application, infrastructure and energy management.

Figure 1. Green IoT Ecosystem



This green IoT ecosystem (Figure 1) is going to be the main contributor in achieving a smarter city with the key focus on sustainability. Smart city framework (Figure 2) consists of smart governance, smart environment, smart living, smart people, smart mobility and smart economy. These six pillars of smart city should be incorporated into the IoT domain (Figure 3)) to create a synergy between Green IoT and Smart City for a generic green ecosystem. While making "THINGS" smart, the green ecosystem should be incorporated to make "THINGS" green (energy aware) as well. To anticipate such vision, research focus should be on the challenges faced by energy hungry IoT devices like Radio Frequency Identification (RFID). RFID devices are very much power hungry and these inter-connected tiny devices are sharing huge amounts of data to the cloud and data centers leading to huge power consumption as well. So innovative ideas are required on how to make these tiny RFID devices green while also making the cloud