

Chapter 4

Smart Cities, Smart Grids, and Smart Grid Analytics: How to Solve an Urban Problem

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ABSTRACT

The introduction of the 21st century has experienced a growing trend in the number of people who choose to live within a city. Rapid urbanisation however, comes a variety of issues which are technical, social, physical and organisational in nature because of the complex gathering of large population numbers in such a spatially limited area. This rapid growth in population presents new challenges for the already stretched city services and infrastructure as they are faced with the problems of finding smarter methods to deal with issues including: traffic congestion, waste management and increased energy usage. This chapter examines the phenomenon of smart cities, their many definitions, their ability to alleviate the discomforts cities suffer due to rapid urbanisation and ultimately offer an improved and more sustainable lives for the city's citizens. This chapter also highlights the benefits of smart grids, their bi-directional real-time communication ability, and their other qualities.

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INTRODUCTION

Urbanism has existed for more than 5,000 years witnessing cities being formed according to their landscape, their position from the sea, the ruling of rivers and the transportation networks that connect cities (Anthopoulos & Vakali, 2012). The period between 1950 and 2005 has witnessed a marked annual increase in urbanisation within the developing countries, with a reported growth rate of 3.6% compared to the 1.4% experienced in industrialised countries. By the year 2000 an estimated 45% of the population in developing countries (1.97 billion) and 75% (945 million) of developed countries were already living in cities (Khansari et al., 2014).

Between the years 2009 and 2050 it is predicted that the world's population will increase by 2.3 billion taking it to 9.1 billion people in total and over this same period the population within urban areas is predicted to grow by 2.9 billion to reach 6.3 billion people or 70% of the world's population by 2050. These figures hide a significant difference between the new and emerging markets with the least developed countries witnessing the most dramatic population growth and urbanisation (Bélissent, 2010).

The United Nations (UN) has predicted that by the year 2050 the rapid relocation to cities will have caused the world's urban population to increase by 75% and the result of this migration to the cities will be an increase in the number of densely populated areas (Barrionuevo et al., 2012). This figure differs as a 2007 to 2008 United Nations World Urbanisation Prospects study claims that the population within urban areas is to gain 3.1 billion surpassing the 3.3 billion in 2007 to a figure of 6.4 billion in the year 2050 as shown in Figure 1 (Washburn et al., 2009).

Cities were formed as a natural response to changed life circumstances and have also had a profound and lasting impact on the further development and progress of the human species (Schoorman et al., 2012). Cities are the future of humankind. The 18th century witnessed less than 5% of the World's population living in a city and a huge majority of these were simply engaged in generating enough food to live. The entry into the 21st century however, has been accompanied with a strong worldwide inclination to increase the concentration of the population within fairly few large cities. These large dense cities are attractive and appeal to their citizens as they have the potential to be both highly productive and pioneering and thus very attractive for our futures (Harrison & Donnelly, 2011). Despite only making up 2% of the world's surface cities house half of the world's population, consume 75% of our energy resources, and produce 80% of the carbon which is harming our environment (Aoun, 2013).

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