Chapter 51

Big Data Analytics Platforms for Electric Vehicle Integration in Transport Oriented Smart Cities:

Computing Platforms for Platforms for Electric Vehicle Integration in Smart Cities

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ABSTRACT

Electric vehicles (EVs) are key players for transport oriented smart cities (TOSC) powered by smart grids (SG) because they help those cities to become greener by reducing vehicle emissions and carbon footprint. In this article, the authors analyze different use-cases to show how big data analytics (BDA) can play vital role for successful electric vehicle (EV) to smart grid (SG) integration. Followed by this, this article presents an edge computing model and highlights the advantages of employing such distributed edge paradigms towards satisfying the store, compute and networking (SCN) requirements of smart EV applications in TOSCs. This article also highlights the distinguishing features of the edge paradigm, towards supporting BDA activities in EV to SG integration in TOSCs. Finally, the authors provide a detailed overview of opportunities, trends, and challenges of both these computing techniques. In particular, this article discusses the deployment challenges and state-of-the-art solutions in edge privacy and edge forensics.

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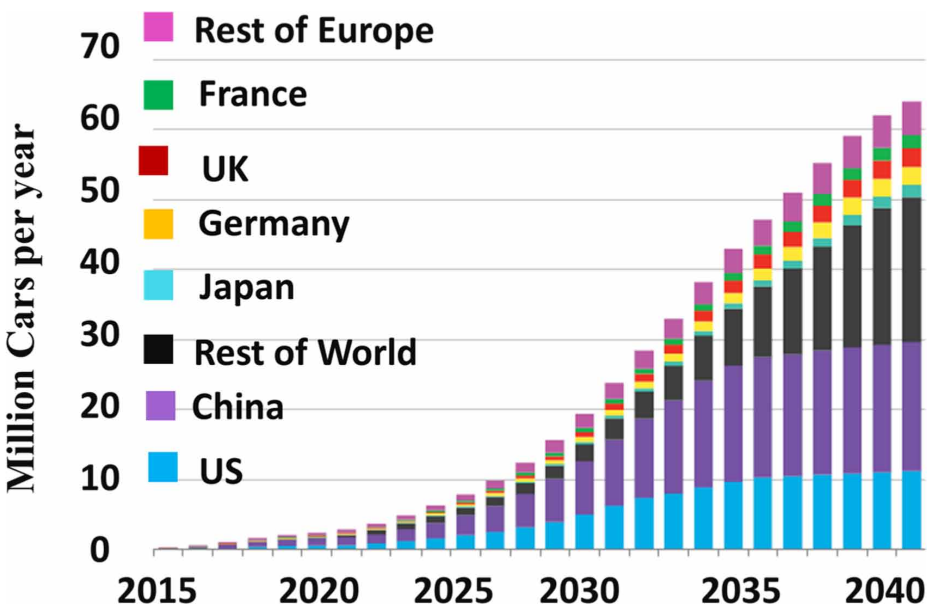
INTRODUCTION

Due to rigorous research and development efforts and stringent protocols related to vehicle emissions (Yang, Zhu, & Wu, 2016), fuel economy, constraints in conventional energy reserves and the innate global warming, the electric vehicles (EVs) have been receiving an utmost attention from automobile industries, policy makers, R&D, as well as consumers (He, Venkatesh, & Guan, 2012). The EV integration programs create potential research thrusts, as they seem to serve as the sustainable and efficient powertrains for the emerging electrified transportation system (Hussain, Alam, & Beg, 2018). The EVs can significantly help emerging transport oriented smart cities (TOSC) to become greener by reducing carbon footprints of the transportation sector (Alam & Beg, 2018). Such characteristic features of EV welcome nations to undertake heavy investments towards EV rollout. According to Bloomberg executive report on global EV forecast (Figure 1), the sale EV will be 41 million per year, which will contribute to 54% of new car sales across the globe (New & Finance, 2017).

Figure 1. Annual global EV sales forecast across different Nations



While executing a fully electrified fleet, the uncoordinated charging of candidate EVs may pose serious impact on reliable and efficient operation of the associated electric utility (Bitam, 2012). Thorough study of literatures reveal that perforation of large scale EVs fleet can pose a huge challenge and will disrupt the operation of underlying Smart Grid (SG) network, unless their operations are monitored and coordinated properly (Kumar, Singh, Zeadally, Rodrigues, & Rho, 2015). The side effects may be in the form of power losses, incremental investment on the pre-existing network, potential violations of statutory voltage limits, degradation in power quality etc (Hussain, Alam, & Beg, 2018). Lack of coordinated charging strategies can also create demand peaks during rush hours which in turn put pressure on the power grids. However, use of proper charging strategies may circumvent significant proportion of burdens from the overall architecture. Indeed, it has been empirically estimated that even if all the

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