

Chapter 7

E–Parking: An Electronic Parking Service Using Wireless Networks

Gongjun Yan

Indiana University, USA

Stephan Olariu

Old Dominion University, USA

Weiming Yang

Old Dominion University, USA

Danda B. Rawat

Old Dominion University, USA

ABSTRACT

Parking is costly and limited in almost every major city in the world. The misparking aggravates the competition of parking slots. Innovative parking systems for meeting near-term parking demand are needed. We propose a novel parking system which adopts the wireless network and sensor technologies to provide an intelligent and automatic parking service. The implementation and a probabilistic analysis of the new parking service are presented as well.

The advantage of this parking system, from the drivers' point of view, is the best quality of service. The drivers will be informed the detailed information, i.e. the vacant parking slots and the route to the slot. The drivers can park without searching slots. The parking process is a non-stop experience. From the investor's view, the electronic parking system proposed in the chapter is an efficient system in utilization of slots and the maintenance cost. More importantly, it is more profitable.

1. INTRODUCTION

Parking is limited and challenging in many big cities. For example, the Manhattan Central Business District (CBD) has 109,222 off-street public

parking spots, for a ratio of approximately one off-street public spot for every 16 CBD workers. Yet, often parking spots are wasted. In large parking lots, a driver may exit the lot without knowing about new spots that have just become vacant. It is a common experience that finding

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a parking slot in a busy airport may take half an hour or even more than one hour of time searing a vacant parking slot.

Parking is a common business in the world since vehicles are invented. In the cybertimes, the parking service can be turned into an electronic parking service (E-Parking) and a wireless network aided intelligent service. It is network based system because the vacancy of the slots can be transmitted thousands miles away from the actual parking lot. It is also an intelligent system because the drivers can be informed the best match of their need, for example, the cheapest slots in the lot or the closest lot to a shopping center. Traditional parking system is basically a blind try to the vacancy of the parking lot because drivers do not know the vacancy of the parking lot. The very first parking model is the Rényi's parking (Finch, 2003) where vehicles can randomly park along the street, no slot no restriction. A more advanced parking system is a slotted parking system where vehicles have to park in a slot. With electronic devices, parking lot can use counters and electronic screen to show passing-by drivers how many vacant slots left in the parking lot.

In this chapter, we will address a novel electronic and intelligent parking system. The advantage of this parking system, from the drivers' point of view, is the best quality of service. The drivers will be informed the detailed information, such as the distribution of vacant parking slots and the route of how to reach the slot. The drivers will save time to straight head the slot. The parking process is a non-stop experience. From the investor's view, the electronic parking system proposed in the chapter is an efficient system in utilization of slots and the maintenance cost. More importantly, it is more profitable.

To illustrate the advantages of the proposed electronic parking system, we will analyze all sorts of parking services. The simplest is a random parking service where vehicles can randomly park along street in Rényi's parking. The slotted parking service, the second parking service, improves

the parking utilization comparing with the Rényi's random parking service. But the parking spots are still wasted because drivers do not know about new spots that have just become vacant. Drivers are frustrated to search for an available spot in a large parking area. Therefore the slotted parking service assigns each spot a unique number. Drivers can reserve the parking spot. Since some drivers will mispark the reserved spot, a chain of misparking may happen. The misparking will greatly affect the parking quality. We address the probability of a driver that cannot find the reserved spot because of misparking of a previous driver. To short the chain of misparking, therefore, intelligent parking services are needed to improve parking space utilization and to improve the drivers' parking experience. With the help of wireless networks and sensor technologies, we proposed an intelligent parking service. The parking spots are embedded with sensors and wireless transceivers. These devices can talk to each other and create a wireless network which can dynamically manage the vacant parking spot and provide the intelligent parking service. The customers will be pleased because they can obtain non-stop, intelligent and customized parking services. The investor will be pleased because the parking services are automatically managed.

2. RELATED WORK

Cassady et al. address strategies for selecting a "good" parking space (Cassady & Kobza, 1998). A "good" parking space is defined in three aspects: the walking time of a driver, the driving time, and the time to reach the front door. A probabilistic approach is used to evaluate the three "good" performance metrics. This method used in this chapter does not help to reduce slot searching time and the slot utilization on a macro-level. Besides, Cassady assumes the drivers' knowledge of space availability. This assumption is strong in a conventional parking system. In our proposal,

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