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Overview paper

Transit-based smart parking: An evaluation of the San Francisco Bay area field test

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ABSTRACT

This paper presents an evaluation of the first transit-based smart parking project in the US at the San Francisco Bay Area Rapid Transit (BART) District station in Oakland, California. The paper begins with a review of the smart parking literature; next the smart parking field test is described including its capital, operational, and maintenance costs; and finally the results of the participant survey analysis are presented. Some key user response results are: (1) most participants used the smart parking system 1–3 days a month for commute travel and (2) 37% of respondents had seen the changeable message signs with parking information, but only 32% of those used this information to decide whether to continue driving or take BART. Some key changes in participant travel behavior include: (1) increases in BART mode share, (2) reductions in drive alone modal share, (3) decreased average commute time, and (4) an overall reduction in total vehicle miles of travel.

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1. Introduction

In suburban areas, quick convenient auto access to park-and-ride lots can be essential to making transit competitive with the auto. Most people will only walk about one quarter of a mile to transit stations or stops, and fixed route bus or shuttle feeder services can be expensive and less convenient than the auto. Smart parking management technologies may provide a cost-effective tool to address near-term parking constraints at transit stations. Smart parking can be defined broadly as the use of advanced technologies to help motorists locate, reserve, and pay for parking. Smart parking management systems have been implemented in numerous European, British, and Japanese cities to more efficiently use parking capacity at transit stations. These smart parking systems typically provide real-time information via changeable message signs (CMSs) to motorists about the number of available parking spaces in park-and-ride lots, departure time of the next train, and downstream roadway traffic conditions (e.g., accidents and delays).

Public and private partners jointly launched a field operational test at the Rockridge Bay Area Rapid Transit (BART) District station in Oakland, California, on December 8, 2004. In the San Francisco Bay Area, peak hour parking at most of the 31 suburban BART District stations had recently been at or near capacity. This field test was the first transit-based smart parking system implemented in the US; however, since its launch two other transit-based smart parking systems have been implemented at Metro stations in Montgomery County, Maryland, and at three Chicago Metra stations in Illinois.

This paper presents the results of smart parking participant surveys and evaluates the user response to and travel effects of the field test. The paper begins with a general review of the literature on smart parking. Next, the smart parking field test

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is described, and the capital, operational, and maintenance costs of the field test are outlined. Then, the results of a survey administered to field test participants are analyzed to identify participants' demographic attributes, response to the service, and changes in travel patterns. Finally, conclusions are drawn from the analysis of the results.

2. Literature review

Early examples of smart parking management included parking guidance information (PGI) systems that attempted to minimize parking search traffic in large parking facilities and central cities by dynamically monitoring available parking and directing motorists with CMSs (Griffith, 2000). Lessons learned by evaluating and modeling these systems suggest that awareness and understanding of PGI signs can be relatively high, but in order to be effective, messages must display accurate information that meets travelers' needs. Interestingly, visitors are more likely than resident commuters to use city-center PGI systems (Thompson and Bonsall, 1997). PGI systems were found to reduce parking facility queue lengths; however, system-wide reductions in travel time and vehicle travel and economic benefits may be relatively small (Thompson and Bonsall, 1997; Waterson et al., 2001).

Building upon the objectives of PGI systems, transit-based systems seek to increase transit use and revenues and reduce vehicle travel, fuel use, and air pollution. A review of the literature suggests that parking shortages at suburban rail stations may significantly constrain transit ridership (Merriman, 1998; Ferguson, 2000). In addition, motorists may respond to pre-trip and en-route information on parking availability at transit stations by increasing their transit use (Ferguson, 2000). Finally, regular commuters appear to be more responsive to parking information in conjunction with transit than more basic PGI systems because this type of real-time information has greater relevance to their commute trip (e.g., transit station parking availability, next train information, and/or roadway accident downstream) (Rodier et al., 2004).

In addition to providing real-time information about space availability and transit schedules, smart parking systems can take advantage of new technologies to improve the ease and convenience of parking payment. Contactless smart cards with wireless communication capabilities (e.g., short-distance radio frequency identification) can minimize transaction time by allowing a user to simply wave their card in front of a reader (Communication News, 1996). Mobile communication devices can also be used in smart payment transactions. Smart parking payment systems are now being developed and implemented worldwide by mobile phone developers, credit card companies, and other technology and service providers. Smart payment systems were found to reduce operation, maintenance, and enforcement costs as well as improve collection rates (Communication News, 1996; Glohr, 2002). When transit agencies attempt to induce drivers off of highways to take transit into a city center, time saving technologies may mean the difference between a decision to park and ride transit or to drive the remainder of a trip.

Combining the concepts of its forerunners, e-parking is an innovative business platform that allows drivers to inquire about parking availability, reserve a space, and even pay for parking upon departure—all from inside an individual's car (Halleman, 2003; Hodel and Cong, 2003). Drivers access the central system via cellular phone, personal digital assistant (PDA), and/or Internet. Bluetooth technology recognizes each car at entry and exit points and triggers automatic credit card payment. E-parking promises to reduce search time, facilitate parking payment, guarantee parking at a trip destination, offer customized information, provide parking information before and during a trip, improve use and management of existing spaces, and increase security of payments and total revenues (Hodel and Cong, 2003). One e-parking system has recently become operational at the London Stansted airport (e-parking homepage, 2006).

The parking pricing and cash-out literature demonstrate that charging for parking can result in substantial decreases in single-occupant vehicle modal share (Willson and Shoup, 1990; Willson, 1997). However, officials may be hesitant to implement these innovative solutions for fear of charging for a historically free resource (Kolosvari and Shoup, 2003). However, it is possible that the public may be more amenable to paying for parking if they feel they are getting an advanced benefit from it, which guaranteed parking reservations provide (Kolosvari and Shoup, 2003; Minderhoud and Bovy, 1996).

3. Smart parking field test

To evaluate the feasibility of the smart parking concept in a transit context, the California Department of Transportation, the BART District, California Partners for Advanced Transit and Highways (PATH), ParkingCarma, Inc.'s ParkingCarma™ technology, Quixote Corporation, Intel, and Microsoft jointly launched a smart parking field test at the Rockridge BART station in Oakland, California, on December 8, 2004. BART provided 50 spaces to be used for peak period commuter parking that had previously been reserved exclusively for off-peak parking (i.e., after 10:00 am).

The smart parking field test involved two real-time user interfaces: (1) two CMSs that displayed parking availability information to motorists on an adjacent commute corridor into downtown Oakland and San Francisco (Highway 24) and (2) a centralized intelligent reservation system that permitted commuters to check parking availability and reserve a space via telephone, mobile phone, Internet, or PDA. Those who used the system for en-route reservations called in their license plate number via mobile phone when they parked in the smart parking lot. BART enforcement personnel ensured that those parking in the smart parking lot either had: (1) an advanced reservation parking permit or (2) a license plate number, which matched one of the numbers provided real-time to enforcement personnel via PDA for en-route reservations.