

The Tolls of Privacy: An Underestimated Roadblock for Electronic Toll Collection Usage*

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Abstract

Despite continuing population and economic growth in the Bay Area, the rate of adoption of FasTrak, the electronic toll collection system employed in California, has been significantly lower than similar systems in comparable urban areas of the United States. Prior economic research suggests drivers in California's urban areas have a revealed willingness to pay for the convenience of FasTrak that exceeds their current cost of FasTrak. Using survey results and other research, we find the slower progress of FasTrak is partially related to consumers' value of perceived privacy outweighing the implicit value of convenience. Similarly, our research suggests that either a change in consumers' perception of privacy in the FasTrak system, or a fiduciary compensation must be offered to Bay Area drivers' in exchange for their perceived reduction of privacy, if any significant increase of FasTrak usage is to be achieved.

Overview of the Electronic Toll Collection System in the San Francisco Bay Area

1. Bay Area Overview

Demography experts estimate that the San Francisco Bay area will gain over two million new residents by 2030, most likely populating significantly in suburban areas, and surrounding outside counties such as San Joaquin, Stanislaus, and Merced.¹ Despite healthy use of public transit infrastructures such as the Bay Area Rapid Transit (BART), carpool programs, and county and city bus systems, Bay Area Transit studies demonstrate that traffic has dramatically increased in the Bay Area, likely attributed to a shortage of affordable housing in urban areas and strong economic expansion of the Bay Area.^{2,3} One salient attribute of the traffic increase can be seen on and around toll bridges, with a noticeable average vehicle increase of 12% since 2000 on the Bay Area's eight toll bridges.⁴

The eight toll bridges in the Bay Area are the only toll bridges in the state of California, and are the subject of this study. The contingent value of these bridges has been estimated in the billions of dollars a year, as they provide essential transportation links

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¹ Dyett and Bhatai, 2004.

² Bay Area Toll Authority, 2000-2005.

³ Dyett and Bhatai, 2004.

⁴ Bay Area Toll Authority, 2000-2007.

and connections among some of California's most prosperous cities spread out over the 7,000 square miles of the Bay Area. Considering that these significant increases in traffic could affect the sustainability of economic growth in California, the California Senate passed Bill 1523, instructing California's Department of Transportation (CalTrans) to compose a state wide electronic toll system, effectively creating the first state in the nation to require all of its toll roads and bridges to use the same technical specifications.^{5,6}

2. The FasTrak System Overview

The electronic toll collection system went online in 1993, and named the FasTrak system. FasTrak allows vehicles with a portable FasTrak electronic RFID transponder to cross toll roads and bridges, which have been updated with large FasTrak readers, without necessitating a driver to stop and pay the toll collector with cash. Instead, the FasTrak system reads the respective driver's FasTrak transponder and charges each respective driver's prepaid FasTrak account as the driver makes their way through the toll area. From a security and privacy prospective, development of the FasTrak transponder went through several iterations of threat modeling and usability testing to incorporate drivers' potential concerns. For example, as the FasTrak-equipped driver passes through the toll booth, the user is given feedback that the transponder has been read, with both an electronic screen displayed in the end of the toll booth, and by emitting a confirmation noise from the transponder, allowing the user to have both FasTrak system status and acknowledgement of when their transponder was read (important in alerting the user to potentially unauthorized interrogation of their transponder).

While all of the eight Bay Area bridges are equipped with FasTrak readers, most toll booth lanes allow either cash or FasTrak payments. There are also some FasTrak-only lanes where no cash payments are allowed. In all lanes, there are cameras designed to take photographs of license plates of cars in the event of non-payment, robbery, or a failed wireless connection between the FasTrak responder and reader. To sign up for FasTrak, a user must deposit at least \$20 towards their prepaid account, but are not required to pay for a deposit for the FasTrak transponders, nor have to pay a startup fee. One FasTrak account may have up to three transponders for no cost, and additional transponders require a deposit. Until recently, distribution and sign-up procedures has been limited to FasTrak's office sign-ups, and online at FasTrak's website, which seem to be utilized by mostly early adapter users. Since 2003, FasTrak has also started to provide sign-ups at local retailers like Costco and Best Buy, in an effort to recruit casual toll bridge users.

Social Utility of the FasTrak system

A. Benefits of Electronic Toll Collection

⁵ Halloran, 1992.

⁶ Although CalTrans was required to design the FasTrak system stipulated by the legislators, the Metropolitan Transportation Commission (MTC) and the Bay Area Transit Authority (BATA) run seven of the eight toll bridges in the Bay Area, while the Golden Gate Transit (GGBHTD) controls the Golden Gate Bridge.

The FasTrak system has many direct benefits to the Bay Area, providing a decreased duration of time per FasTrak-equipped vehicle, reduced labor and health coverage costs, a reduction in fuel consumption, and a reduced level of air pollution around toll both areas. According to studies by the BATA, a FasTrak exclusive lane can handle three times more vehicles than the Cash and FasTrak” dual purpose lanes (we will refer to these as “cash lanes”).⁷ The Golden Gate Bridge reduced the number of required toll collectors by thirty-five percent since installing FasTrak.⁸ Another benefit of FasTrak is additional revenue for BATA and the GGBHTD based on the interest gained from the prepaid user accounts. In addition to the supply chain optimizations, high quality information about traffic conditions is also another asset of the FasTrak system, which has been leveraged by transportation planners, mobile phone service providers, local radio and tv broadcasts, and internet companies. As FasTrak-equipped-vehicles travel throughout the Bay Area, there are a number of interspersed, high-speed FasTrak readers that measure traffic and make this information available publicly. Some innovative companies have started to analyze and leverage this accurate information and started incorporating this information into their online Map products. Some GPS and mobile phone companies have also utilized information given from FasTrak to provide accident or traffic warnings, and more accurately estimating the time of arrival for their users. Additional indirect benefits have also been suggested to be derived from the FasTrak system, such as reduction of stress and anxiety in people, and a reduction in accidents on or around bridges.⁹

B. Challenges of Electronic Toll Collection

However, many of the benefits potentially provided by the FasTrak system are contingent on a high usage of vehicles equipped with FasTrak. If there are not enough FasTrak users, traffic in Cash lanes could potentially suffer from longer delays that without a FasTrak system in place, as some of the former Cash lanes have been allocated to FasTrak-only lanes. Likewise, some FasTrak-only lanes are currently used by non-FasTrak vehicles until these non-FasTrak vehicles arrive at the toll booth, where they attempt to merge into an adjacent cash-FasTrak lane, causing “cross traffic” interference for FasTrak users¹⁰. For example, if a toll booth has a ten minute traffic queue before the transaction occurs, and enough non-FasTrak users occupy the FasTrak-only lane and effectively bring to a halt the FasTrak-only lane due to their mergers, the flow of traffic in both FasTrak and Cash lanes will suffer. Similarly, if traffic before the toll booths is backed up beyond the separation of FasTrak-only and Cash lanes, FasTrak users will be stuck in the same queue until the lanes diverge.

The FasTrak system and the FasTrak-only lanes actually cause longer traffic delays on weekends. FasTrak-only lanes are effective in optimizing traffic for the weekday commute vehicles, but these lanes are underutilized on weekend hours, due to a higher percentage of the traffic being non-FasTrak users. Due to low penetration rates of the non-commute, occasional user, traffic in toll booth plazas and bridges has increased

⁷ Bay Area Toll Authority, 2005.

⁸ Golden Gate Bridge, Highway and Transportation District, 2006.

⁹ Bedolla, Sengupta, Bollapragada, 2007.

¹⁰ Bay Area Toll Authority, 2006.

dramatically since the introduction of the FasTrak system, as the reduction of Cashlanes provides an imbalance of non-FasTrak users to FasTrak-only lanes.¹¹ Similarly, the problem outlined previously of “cross traffic” interference is a more serious problem on weekends, as more non-FasTrak users will take advantage of the FasTrak-only lane, and merge into a Cash lane upon arriving at the toll booth, effectively clogging the FasTrak-only lane for FasTrak users.¹²

C. California Drivers’ Revealed Willingness to Pay for Travel Time Reduction

Much like many public infrastructure projects, there exists an inherent difficulty in determining exactly what fiduciary value the FasTrak system provides users. However, previous studies of California traffic and residents have provided defensible, willingness-to-pay valuations for reducing travel time.^{13, 14} These studies utilize revealed preference data involving real drivers in their normal driving patterns, using their own respective funds, and real purchases of travel time reduction. These studies conclude that a California urban area drivers’ willingness to pay to reduce travel time is on average \$30 per hour. Considering this, a ten minute reduction in waiting in line at a toll plaza, for example, would be valued on average \$5.00, with some users valuing the ten minutes as a higher value, and some lower.¹⁵ Given that FasTrak does not charge any membership or additional fee per usage, any meaningful reduction in time would be a net gain in utility to a FasTrak user per use, being valuable to both commuters and casual drivers alike.

Our FasTrak Research and Survey Results

A. Research and survey overview

Research on toll roads and applicable toll collection systems in the United States was conducting in 2007. A Bay Area survey was conducted with 558 participants, and offered in either paper or online formats. Solicitations for participants were made online, in randomly chosen retail chains, and in street locations chosen randomly throughout the Bay Area. No compensation was given to participants for taking the survey, which consisted of seven to eight questions, depending on the type of participant (either a current FasTrak user or a non-FasTrak user.) No personal information was requested, and the survey required about two to three minutes.

B. Bay Area Usage Significantly Lower Than Similar Urban Areas

¹¹ Bedolla, Sengupta, Bollapragada, 2007.

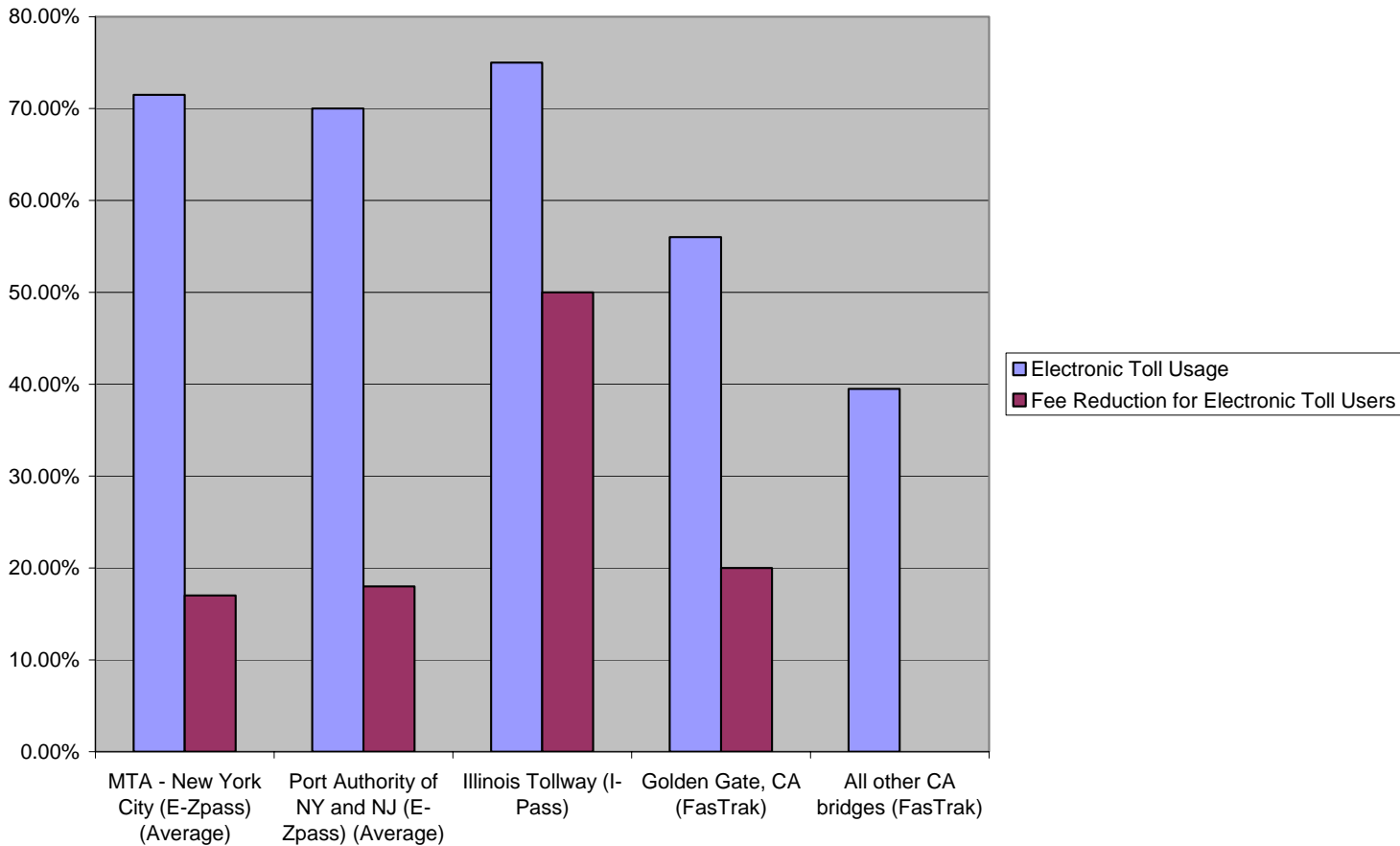
¹² Bedolla, Sengupta, Bollapragada, 2007.

¹³ Brownstone, Ghosh, Golob, Kazimi, Amelsfort, 2002.

¹⁴ Lam and Small, 2001.

¹⁵ It should also be stated that some economists have concluded lower estimates of willingness to pay to reduce travel times, such as the Calfee and Winston (1998) study. However, the Calfee and Winston study uses data from stated preference data, whereas the previously cited congestion pricing studies used *revealed* preference data.

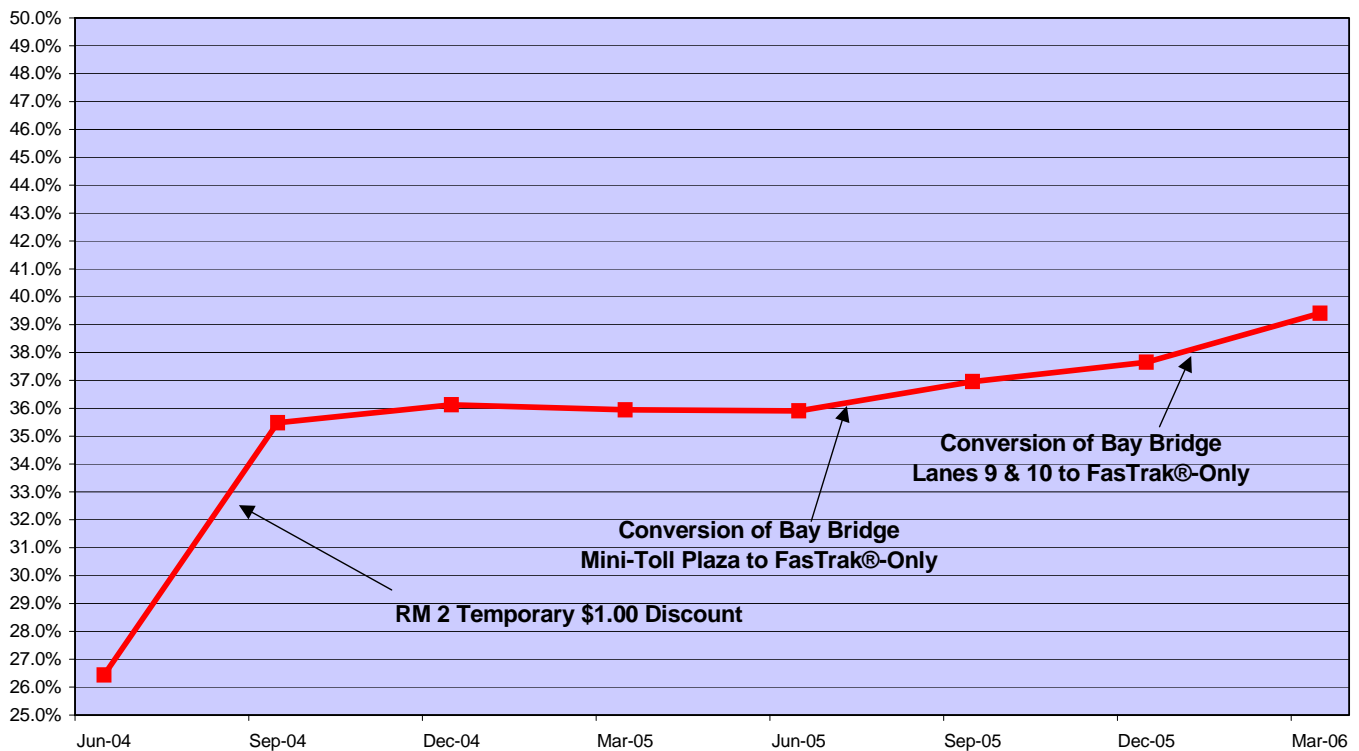
Figure 1: Electronic Toll Usage and Fee Reductions



Although California was the first state to require a state-wide electronic toll system, many other urban states initiated similar projects in the 1990's, such as Delaware, Florida, Illinois, New York, and New Jersey. If California's FasTrak system is juxtaposed to similar electronic systems in these states, it is evident that the Bay Area's electronic toll usage during morning weekday commutes is significantly lower than that of the other similar urban areas (See Figure 1).

Different social landscapes between the urban cities and transportation infrastructure may contribute to some of the differences. However, the thirty percent difference between the New York - New Jersey area, urban Illinois, and the Bay Area, a relevant comparison in terms of demographics, density and population, is quite staggering. The respective usage rates of these three areas suggest that toll areas that have strategically discounted electronic toll collection systems compared to traditional cash transactions have significantly higher usage percentages. The Golden Gate Bridge, which offers the same FasTrak technology as other Bay Area bridges, reveals meaningfully higher FasTrak usage as a percentage of the bridge's traffic than the other seven California toll bridges. Given the similar population and traffic conditions of the bridges, this higher FasTrak usage over the Golden Gate verses the other Bay Area bridges is likely due in part to the Golden Gate's twenty percent discount for FasTrak transactions (\$4.00 per use for FasTrak transactions, \$5.00 for cash transactions). This conclusion seems strengthened by

Figure 2: FasTrak Usage from June 2004 to March 2006

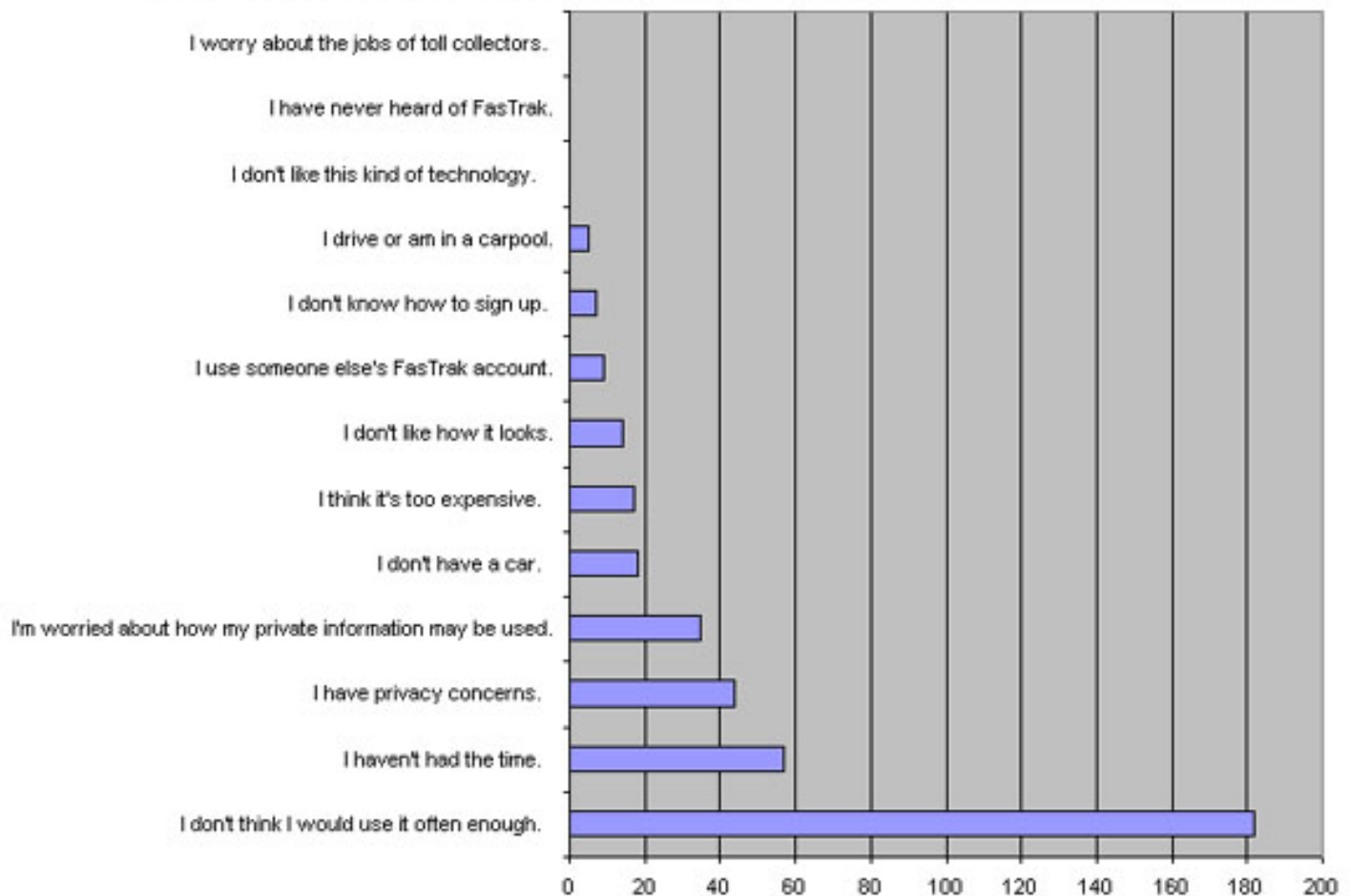


a prior FasTrak-user discount on all Bay Area bridges in the summer of 2004 (See Figure 2). This temporary discount to all FasTrak users was expensive, and despite its achievement of increasing usage rates, is financially unfeasible to make permanent at current toll prices.

However, the discounting of electronic toll collection drivers strategy does not fully explain why the Golden Gate bridge usage is not as high as the usage in New York, New Jersey and Illinois. If we again consider the past studies on willingness to pay, the \$1.00 difference between offering a discount and a non-discount program certainly does not diminish the average net value obtained by reducing a users' driving time. For example, if FasTrak improves a driver's commute by ten minutes, this is worth on average \$5.00, without a discount. Applying the additional \$1.00 discount creates an average net worth of \$6.00.

The suggested contingent value for drivers' willingness to pay for reducing driving time is also supported by survey results. When asked "If there were "express lanes" that alleviated a 5 minute traffic congestion due to the bridge crossing, how much would you pay per use to use an express lane, in addition to the toll?" Assigning a \$0 value to the option of "I would not pay" response, the average amount respondents were willing to pay was \$3.65. Granted, this is a stated preferences finding and not revealed preferences, as this question was asked on a paper survey of theoretical traffic congestion, as opposed to Brownstone et al experiment using real drivers, in real situations, given real choices of congestion traffic pricing. We believe this difference between stated and revealed preferences explains why the Brownstone research finds an average of \$5.00 per ten minutes travel time saved, and our research finds a slightly higher \$7.30 per ten minutes. However, we believe that this demonstrates that on average, driver's feel the utility of FasTrak is worth a significant monetary amount per use.

Figure 3: Top Reasons why Non-FasTrak users have not signed up for FasTrak



Given that users reveal a willingness to pay for use of the FasTrak system, and FasTrak offers no additional fees, one may be tempted to suggest that consumers are irrational buyers of reduced driving time. However, if we carefully examine the reasons non-FasTrak users have chosen not to register for FasTrak, we can more accurately determine the mental model of the customer. Although privacy is not the top surveyed response to the question of why non-FasTrak users have not yet signed up for the service, the results do suggest that many non-FasTrak drivers are concerned about privacy. Privacy and security concerns of electronic transactions are certainly not new concepts.¹⁶ In the past, consumers have been concerned about using debit or credit cards with merchants, and have often had their privacy invaded in the form of direct marketers who somehow obtained their email, telephone or mailing address information. With innovative electronic commerce and wireless technology, however, the scale, scope and immediacy of security and privacy issues can be seen as having been multiplied significantly.¹⁷

In addition, concerns about privacy have also been shown by FasTrak's own user research. In BATA's May 2006 Strategic Plan, they outline four of what the BATA lists as "major misconceptions," one being "The movements of FasTrak users are tracked." However, the BATA does little to counter this user perception, with offering clear

¹⁶ Westin, 1967

¹⁷ Clarke, 1988 and Mason, 1986

privacy guarantees, marketing a secure and protected privacy service, or compensating users with discounted use fees.

For the marketing efforts, we currently are developing clear and consistent marketing messages for the FasTrak® program. Based on discussions to date, the marketing efforts will emphasize these messages: 1) FasTrak® saves time, 2) FasTrak® is convenient 3) FasTrak® is easy to get and 4) FasTrak® is “cutting edge”.¹⁸

FasTrak has effectively transformed what used to be a personal transaction, (an exchange of cash with a Toll Booth collector) and made it an electronic transaction, with an electronic database of charges, payments, and account balances only accessible through the phone or Internet. Since FasTrak operates expensive marketing campaigns and business strategy, we should look to the corporate world for some insight. Consumers have fairly consistently demonstrated that they a) place a financial value on the protection of personal information and location privacy. For example, fifty-five percent of California residents with landlines pay telephone companies \$2.66 per month in additional fees to have their unlisted phone numbers, as do twenty-four percent of New Yorkers. Nationwide, the average is slightly more than a third of Americans have unlisted home numbers.¹⁹ Privacy concerns have been shown to affect consumer buying patterns and decisions. A past survey conducted by the FTC reported that 92% of consumers are concerned, and 67% very concerned, about misuse of their personal information online.²⁰

In addition to information protection, the level of importance of perception of security and privacy has been demonstrated by research in marketing and consumer behavior. It has been extensively concluded that enhancing the favorable perception of security and privacy is one of the most important steps in building trust between the consumer and electronic system, and for sustained activity in electronic commerce.²¹ Past surveys demonstrate that 58% of the respondents of Americans nationwide said that privacy and security were their most significant concern about electronic commerce.²² However, according to a 2004 poll conducted by Boston University, 86 percent of American shoppers use some form of store card or discount card, and 72% of those discount card holders say the benefits of the card are “worth giving up some privacy.”²³ Consumers clearly hold a value to their privacy, and have demonstrated that they are willing to exchange their personal information, as long as they are compensated.

Current FasTrak users also suggested that security and privacy concerns were of importance, ranking the potential improvement of “More secure technology to prevent security and privacy issues” in the top three recommendations (see Figure 4).

¹⁸ Bay Area Toll Authority, May 2006 Report

¹⁹ Hau, Associated Press, June 19, 2004.

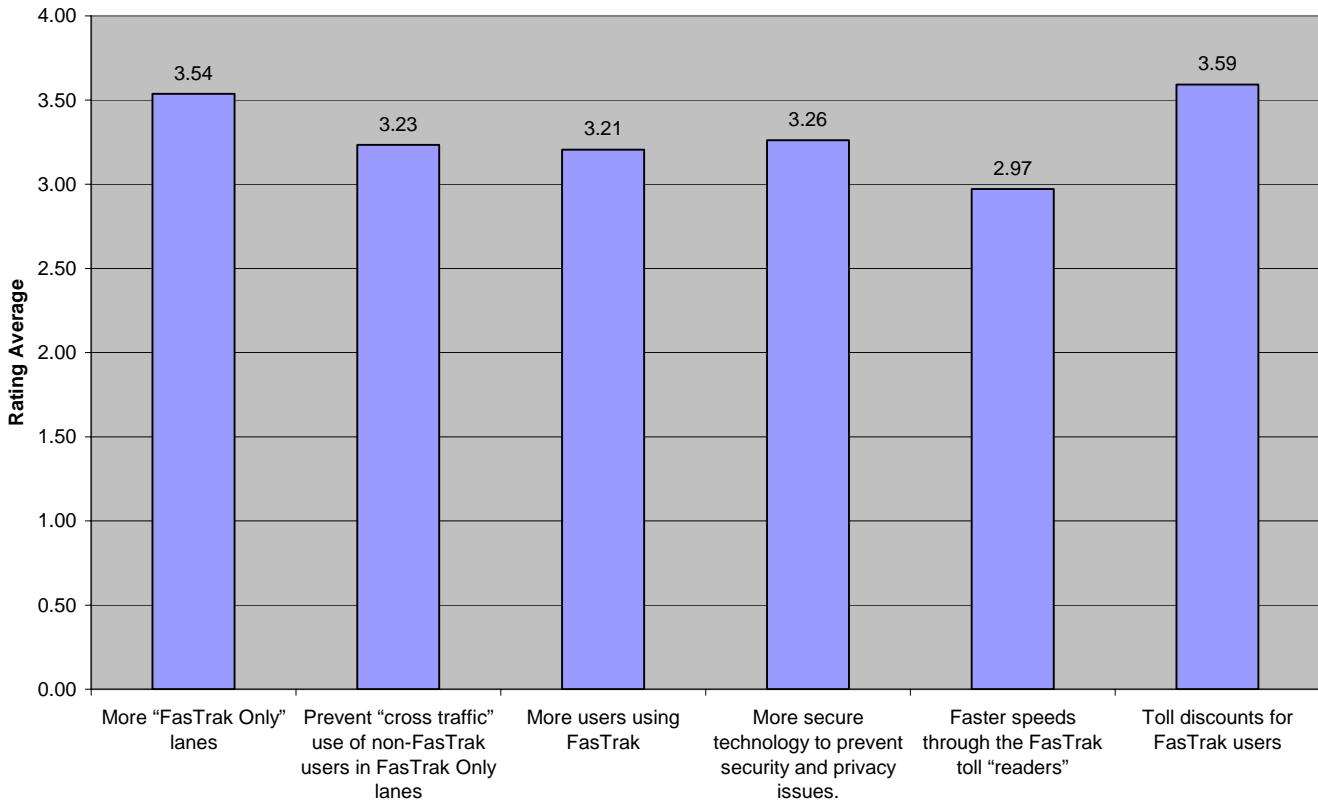
²⁰ Federal Trade Commission, 2000.

²¹ Shneiderman, 2000. Keen, 2000. Friedman, 2000. Hoffman, 1996.

²² Cox, 1999.

²³ Boston University School of Communication, 2004.

Figure 4: Ranking of FasTrak Improvements (FasTrak users only)



	Most Important	Important	Somewhat Important	Not Important	Least Important	Have no opinion
More "FasTrak Only" lanes	21.3%	32.1%	31.0%	11.1%	3.8%	0.7%
Prevent "cross traffic" use of non-FasTrak users in FasTrak Only lanes	18.8%	26.8%	28.2%	15.0%	7.3%	3.8%
More users using FasTrak	15.3%	31.7%	30.0%	8.7%	9.8%	4.5%
More protections to prevent security and privacy issues.	14.3%	25.8%	36.9%	18.8%	3.1%	1.0%
Faster speeds through the FasTrak toll "readers"	6.6%	43.9%	15.0%	15.3%	12.9%	6.3%
Toll discounts for FasTrak users	42.2%	15.3%	18.5%	10.1%	11.5%	2.4%

The clear message demonstrated with this response that most FasTrak users feel a discount would be the most important change to the FasTrak system. However, FasTrak users seem to be somewhat polarized on the idea of toll discounts and having the FasTrak reader's accommodate faster speeds, with 11.5% and 12.9% respectively stating these are the least important improvements. However, only 3.1%, the lowest of all responses, feel more that more protections of privacy are least important. In addition, FasTrak users would value improvements to security and privacy over infrastructure improvements such as faster speeds and preventive measures against "cross traffic."

Discussion and Recommendations

1. Legal Consequences of FasTrak

"Part of the reason Fred has not had success ... is that he takes too much time off. His transponder records ... will show how little he works."

- Plaintiff who used her husband's toll activity in a 2007 California Divorce Case

The Supreme Court has recognized that "[w]hat a person knowingly exposes to the public, even in his own home, automobile, or office, is not a subject of Fourth Amendment protection."²⁴ FasTrak users agree to the Privacy policy and terms of use of the FasTrak service, which includes an explanation that personal information can be used when required by law or ordered so by a court of "competent jurisdiction."²⁵ This apparently includes civil court, as many divorce attorneys seek access to and admit as evidence FasTrak logs. Successful cases include attorney arguments such as whether or not one spouse worked to their maximum earning capacity, marital affairs, and child custody. There have also been cases between a laid-off worker and their employer.²⁶

Consumers also potentially make perceptions of privacy based on highly popular television programs demonstrating the discoverability and use of electronic toll systems. Numerous episodes of the highly acclaimed Law & Order series include fictional police detectives and officers tracing EZ-Pass-equipped cars, or using EZ-Pass (New York electronic tolling system) records to verify an alibi, or for additional use in the courtroom.²⁷ The survey demonstrates that users are still greatly concerned about privacy. It seems clear that FasTrak's location identification and data processing functionality gives users the perception of risk to their privacy. We believe this aspect of FasTrak has been regrettably given little attention in terms of research or FasTrak strategies for marketing. A full explanation of how FasTrak information can be used (ex: civil court), and how it can not be used (speeding tickets can not be assigned based on FasTrak information), should be part of the public awareness campaign, should be outlined in the online Frequently Asked Questions.

2. The Value of Privacy

We feel confident from prior studies and our own Bay Area-wide survey that drivers place a value on reduced travel time in their car as shown with both the survey and prior willingness to pay experiments in California. However, we are equally confident that drivers place a value on their privacy, and although some are willing to give up that value

²⁴ Cf. *Katz*, 389 U.S. at 351; *United States v. Burns*, 624 F.2d 95, 100 (10th Cir.)

²⁵ "In the course of administering FasTrak® accounts, BATA may disclose personal information to third party service providers for the purpose of operating the FasTrak® program (e.g., DMV, municipal courts, account processors or collection agencies); otherwise, personal information will not be disclosed to third parties, except as required by law or ordered by a court of competent jurisdiction." (FasTrak Privacy Policy, 2008 <http://www.bayareafastrak.org/static/privacy/index.shtml>.)

²⁶ Simerman, John. Lawyers dig in FasTrak records for civil disputes. *Oakland Tribune*, June 8th, 2007.

²⁷ "Law & Order: Special Victims Unit", Original Air Date: 8 May 2007 (Season 8, Episode 20)) Episode Number: 232 Season Num: 11 First Aired: Wednesday November 1, 2000,

of privacy to gain the value of reduced travel time, many others are not. Consumer response and implied preferences clearly demonstrates concern and resistance relating to consumer tracking, potential profiling, and problems related to government tracking. Many clearly are unwilling to exchange personal information without the guarantee of their privacy, or compensation in the form of a discount. In order for the Bay Area community to gain all the benefits of the FasTrak system, FasTrak usage needs to increase, both on weekdays and weekends. This requires the BATA to establish similarly high usage rates to that of their New York, New Jersey and Illinois counterparts, all of who have offered a discount system to compensate and incentivize consumers for signing up.

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