Automated Vehicle Occupancy Verification Systems
Policy and Legal Implications

David Ungemah, John Lowery, John Wikander, and Ginger Goodin

Managed lanes require effective vehicle occupancy enforcement policies and programs to operate successfully. Several semi- and fully automated techniques for determining the number of persons in a moving vehicle, including operator-monitored video cameras and infrared composite imaging, have undergone limited field testing. The technical merits of in-vehicle and roadside systems for automated vehicle occupancy verification systems have been examined extensively. This paper complements those efforts by providing the policy and legal implications of automated systems for occupancy enforcement. The primary form of automated enforcement technology currently used in the United States is photographic imagery recorded by automated violation detection systems. For moving violations, these systems almost exclusively take the form of red light and speed enforcement, unlike toll evasion, which is typically punishable as an infraction. Principal objections to automated enforcement for occupancy purposes have involved privacy and due process concerns. Under an automated occupancy enforcement tool, the occupancy enforcement regime would likely face the same legal and privacy challenges as automated enforcement cameras and similar devices. This paper examines the current legislation related to automated enforcement practices, as well as an illustration of the arguments against their use. These arguments raise questions about the legality of automated enforcement systems and the perceived invasion of privacy some drivers may associate with such systems. The three primary privacy issues associated with an automated system for occupancy enforcement concern the photographic record of occupants, vehicle infrastructure integration barriers, and the legal definition of a high-occupancy vehicle infraction.

High-occupancy vehicle (HOV) lanes have been in operation for almost four decades. They were first implemented on Virginia’s Shirley Highway (I-395) in 1969 as an exclusive busway. The concept of HOV lanes was born when four-or-more person carpools and vanpools were permitted access to the facility in 1973. Initiated during a time of high fuel costs, fuel shortages throughout the United States, and public concerns regarding mobility, HOV lanes provided yet another incentive to carpool or vanpool. HOV lane miles have more than doubled in 10 years, from approximately 1,300 lane miles in 1995 to over 2,500 in 2005. The majority of these HOV lane miles are located in California (1,000), Georgia (400), and Texas (300) (1). However, during the same time period, vehicle miles traveled increased 25%, while the percentage of use and the absolute number of carpools and vanpools for commute trips have declined to a 30-year low—10,057,000 trips in 2003, down from 11,852,000 in 1993 (2).

Given the substantial travel time savings that HOV lanes can offer, carpooling rates have increased significantly in HOV corridors (over 100%), even as carpool rates nationwide have declined by 30% during the past two decades (3). However, severe congestion in the general-purpose lanes has tended to cause animosity on the part of the general public toward HOV lanes if they are underused (4). As a means of mitigating the empty lane syndrome, high-occupancy toll (HOT) lanes have been promoted as an effective way of using the excess capacity without damaging the HOV lanes’ travel time advantages (4). The growing use of pricing as a means to readily manage demand is facilitated by the development of electronic toll collection (ETC) technology as an increasingly practical and inexpensive tool. Pricing helps to maximize the use of available pavement and still prioritize operation for HOV use. The introduction of pricing into the HOV operation is seen by many as an opportunity to further manage the facility by spreading peak-hour demand and allowing other users into the lanes as capacity allows. Together, HOV and HOT lanes are often known as managed lanes.

Managed lanes require effective enforcement policies and programs to operate successfully. Enforcement of vehicle occupancy requirements is critical to protecting eligible vehicles’ travel time savings and safety. Visible and effective enforcement promotes fairness and maintains the integrity of the facility to help gain acceptance among users and nonusers.

Vehicle occupancy verification is a principal impediment to more efficient managed-lane enforcement. A myriad of technologies has been developed and refined in recent decades to improve the integrity of enhanced transportation systems. However, the target of many of these technologies has usually been the vehicle rather than the occupants. Several semi- and fully automated techniques for determining the number of persons in a moving vehicle, including operator-monitored video cameras and infrared composite imaging, have undergone limited field testing. However, no automated solution has yet been developed for permanent field implementation, and no system has been found foolproof enough to satisfy traffic courts in upholding citations issued. As a result, managed-lane facility operators have traditionally relied on field enforcement to manage occupancy violations.

As more and more managed lanes emerge that cater to a wider array of users through pricing, enforcement is made more complicated. Among the greatest challenges in implementing a HOT lane is determining who is a qualified carpooler, that is, who receives free or

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reduced pricing for travel on the facility. For priced lanes, persistent violation problems can breed disrespect for enforcement and result in a significant loss of revenue. In the extreme, some sponsoring agencies are considering eliminating rideshare incentives on their managed lanes because of the difficulty associated with monitoring and enforcing these users. The consequences of unchecked violators resulting from enforcement challenges affect not only mobility but also revenue. The growing number of HOT lane projects—both new and adaptations of existing HOV lanes—will require effective enforcement to protect toll revenues. Table 1, which summarizes the various active and planned managed-lane projects, illustrates that the HOV component continues to be an important element of planned facilities.

With over 100 HOV lanes in operation and 50 HOT and HOV lanes projected for the near future, there is a developing market for a more efficient, automated system for occupancy verification and enforcement. Even express toll lane (ETL) facilities, which imply no discount or free use by HOVs, may eventually incorporate a carpooling component to the pricing program, as evidenced by the change in policies on the SR-91 express lanes in Orange County, California (7).

Altogether, the importance for technologies that automate the enforcement function of verifying occupancy is apparent. Various studies by FHWA, the FHWA-administered HOV Pooled Fund Study, the San Diego Association of Governments (SANDAG) in California, and the Ontario Ministry of Transportation in Canada have examined the technical merits, requirements, and availability of automated vehicle occupancy verification systems. Many of these technologies appear to be ready for controlled tests, with an eye to facility deployment in the medium term.

Although the technical merits of in-vehicle and roadside systems for automated vehicle occupancy verification systems have been examined extensively, the policy and legal implications of automated systems for occupancy enforcement have not. This paper augments the technical systems research with a description of those implications and suggests issues to be addressed in the conceptual development phase.

### Table 1: Inventory of Managed-Lane Facilities (5, 6)

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Operational</th>
<th>Planned and Under Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOV</td>
<td>Over 100 (22 states)</td>
<td>33 (11 states)</td>
</tr>
<tr>
<td>HOT</td>
<td>7 (5 states)</td>
<td>17 (6 states)</td>
</tr>
<tr>
<td>ETL</td>
<td>0</td>
<td>12 (4 states)</td>
</tr>
</tbody>
</table>

Note: ETL = express toll lanes.

### Table 2: Annual Costs for HOT Enforcement (8)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>I-15, San Diego</th>
<th>I-394, Minneapolis, Minnesota</th>
<th>SR 91, Orange County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centerline length</td>
<td>13 km (8 mi)</td>
<td>18 km (11 mi)</td>
<td>16 km (10 mi)</td>
</tr>
<tr>
<td>Number of lanes</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Budget year</td>
<td>2001</td>
<td>2005</td>
<td>2005</td>
</tr>
<tr>
<td>Annual enforcement costs</td>
<td>$60,000</td>
<td>$200,000</td>
<td>$360,000</td>
</tr>
<tr>
<td>Costs per lane mile</td>
<td>$3,700</td>
<td>$8,900</td>
<td>$9,000</td>
</tr>
<tr>
<td>Source of enforcement funds</td>
<td>Toll revenues</td>
<td>Toll revenues</td>
<td>Toll revenues</td>
</tr>
</tbody>
</table>

### Status and Update: Traditional and Automated Managed-Lane Enforcement Practices

Many HOV facilities in the United States have operated successfully with low violation rates by using an effective combination of law enforcement resources, physical enforcement areas on the facility, and supporting fine structure and adjudication authority. However, as transportation funding concerns grow, the cost of a manpower-intensive operation to enforce HOV requirements comes into question.

Vehicle occupancy verification currently depends exclusively on manual methods. The primary method is direct visual observation of the interiors of vehicles by enforcement personnel. Operational techniques for verifying and enforcing minimum vehicle occupancy requirements on managed-lane facilities include stationary patrols and roving patrols. Team patrols use various combinations of stationary and roving patrols working in unison to monitor a managed-lane facility and to apprehend violators. Potential combinations may include multiple stationary patrols, multiple roving patrols, or a combination of stationary and roving patrols. The team approach is generally used on managed-lane projects when it is impossible or considered unsafe for a single officer to detect and apprehend a violator. In this case, one officer detects the occupancy violation and subsequently informs another officer stationed downstream for the purpose of apprehension.

Two major technological countermeasures have been employed for toll evasion on HOT and ETL facilities with HOV benefits. These technologies are designed to assist manual occupancy verification efforts by confirming the payment status of lower-occupancy vehicles. One approach to transponder verification uses an automated vehicle identification—activated overhead beacon mounted on the toll reader gantry to indicate when a toll transponder passes under the reader. This approach requires that enforcement personnel are within the line of sight of the tolling zone in order to see both the overhead beacon and the triggering vehicle. However, many ETC systems do not process billing transactions in real time, so this approach cannot determine if a transponder is linked to a valid toll account; it merely indicates that a readable transponder is present in the vehicle. A second approach uses either handheld or mobile transponder verification systems. Handheld systems, which are compact and portable, are suitable in situations where a suspected violator has been pulled over by an enforcement officer. Mobile transponder verification systems mounted on law enforcement vehicles can enable officers to remotely verify transponders from their police cruisers while driving alongside or behind vehicles in the HOT lanes.

The cost of manual occupancy verification and enforcement is large, especially for HOT facilities (Table 2). In 2001, SANDAG
spent $60,000, or $3,700 per lane mile, to enforce the two-lane, 8-mi I-15 project in San Diego. This sum is dwarfed by the sums spent in 2005 for enforcement of the 10-mi, four-lane SR-91 facility in Orange County—$360,000, or $9,000 per lane mile. A similar sum was expended for the 11-mi I-394 project in Minneapolis, Minnesota—$200,000, or $8,900 per lane mile (8).

Much of the disparity in cost arises from the number of man-hours devoted to enforcement. Costs for I-15 are based on one officer providing three 4-h shifts per week, while I-394 enforcement costs reflect twelve 4-h shifts per week. The SR-91 express lanes fund fourteen 8-h shifts per week, with two officers present during morning and evening peak periods.

Comparative costs for well-funded occupancy enforcement programs are typically much lower, although enforcement budgets for HOV facilities can, in rare cases, be just as large as those for HOT facilities. The 2004 budget of $390,000 for enforcing the I-95–I-395 and I-66–I-267 HOV lanes in Northern Virginia equates to $1,700 per lane per km ($2,800 per lane per mile) for the 113 km (70 mi) along these facilities. The 2003–2004 enforcement budget for the 28.8-km (18-mi) Nassau County, New York, section of the Long Island Expressway HOV lanes was $308,000, or $5,300 per lane per km ($8,600 per lane per mile).

Using a conservative figure of $150,000 per project, approximately $16 million is needed annually to adequately fund occupancy enforcement for U.S. HOV and HOT projects. The largest expense in enforcing occupancy compliance is law enforcement manpower for occupancy verification. This figure does not reflect planned projects.

The high cost of visual occupancy verification manifests itself in two ways: infrastructure and operations. On the infrastructure side, visual enforcement requires enough space for an officer to stand and observe the interior of the vehicle cabin and sufficient room to apprehend a violator. Providing that space within the right-of-way can be expensive, particularly in retrofit situations. Physically separating HOVs from toll-paying vehicles has proven to be advantageous from an operations perspective, but it requires a separate lane where HOVs can self-declare their eligibility for a free or discounted toll. The additional lane for HOVs also requires space for the observer to verify vehicle passengers.

The physical presence of law enforcement officers to count people in vehicles can be an expensive endeavor with limited reliability, even if enforcement is random and targeted. HOT lanes have demonstrated that enforcement can be enhanced and HOV violation rates reduced by using revenue generated from the project; nevertheless, transportation funds are scarce, and a reliable, automated method to improve occupancy enforcement while reducing costs can free that funding for other critical project needs.

The two main technical approaches to automated vehicle occupancy enforcement systems are roadside systems and in-vehicle systems.

The first approach, roadside systems, relies on surveillance equipment suitably positioned to obtain pictures or other images of the interiors of passing vehicles. This approach represents an extension of current traffic monitoring techniques and has many of the same inherent benefits and drawbacks, including policy and legal implications. In particular, the difficulty of reliably capturing details from the interiors of fast-moving vehicles requires a high level of performance from the imaging system that can only be obtained by using expensive devices.

The second approach, in-vehicle systems, seeks to leverage the capabilities of next-generation adaptive airbag systems for the purpose of occupant counting. This approach has received considerable attention since its proposal in Automated Vehicle Occupancy Monitoring Systems for HOV/HOT Facilities (9). As outlined in this report, these advanced airbag systems will have the ability to distinguish between an empty seat in a vehicle and one occupied by various-sized adults, infants, and children. This information could then be used by a piggyback system or application to verify the number of vehicle occupants.

Unlike roadside systems, in-vehicle systems would not require expensive, high-precision sensing devices. Furthermore, the sensing systems could be incorporated as standard safety equipment in future passenger vehicles. In-vehicle systems would, however, require a communications capability between vehicles and roadside infrastructure, perhaps in concert with developments from the vehicle infrastructure integration (VII) initiative. Two key obstacles confront any development of in-vehicle-based occupancy verification. In-vehicle systems are predicated on the assumption that occupancy information can be easily retrieved from the advanced airbag systems and subsequently transmitted to roadside communications devices. This assumption may ultimately prove to be invalid if privacy objections or the reluctance of automotive manufacturers to accommodate occupancy verification technologies prove to be insurmountable. The second obstacle facing in-vehicle systems relates to their timetable for deployment. Advanced airbag systems are not expected to become a nearly universal presence in North American vehicle fleets for at least 10 to 15 years or even longer, and it is doubtful that occupancy verification technologies could be easily retrofitted to non-factory-equipped vehicles.

LEGAL AND PRIVACY CONSIDERATIONS OF AUTOMATED VEHICLE OCCUPANCY ENFORCEMENT

Putting aside the issue of technical capability, statutory and policy authority to deploy automated vehicle occupancy verification technologies may be obstructed in many states. Although no state or community has expressly received or been denied the authority to use automated vehicle occupancy enforcement, precedent for automated vehicular enforcement technologies has been set in some locations. For HOV facilities, occupancy violations are typically designated moving violations, and in many states result in assessment of points on the driving record. On the other hand, enforcement for toll evasion is not considered a moving violation in the same sense as a traditional HOV violation, but rather an infraction regarded as theft of service that affects the financial viability of the facility. In viewing the statutory framework, legal concerns, and privacy considerations, there are distinct differences between automated enforcement of moving violations versus automated enforcement of infractions like toll evasion.

The primary form of automated enforcement technology currently used in the United States is photographic imagery recorded by automated violation detection systems. For moving violations, these systems almost exclusively take the form of red light enforcement at intersections and speed enforcement (either fixed or mobile). Principal objections to automated enforcement involve privacy and due process concerns.

Automated occupancy enforcement tools would likely face the same legal and privacy challenges as automated enforcement cameras and similar devices. Therefore, we examine the current legislation related to automated enforcement practices as well as an
illustration of the arguments against their use. These arguments raise questions about the legality of automated enforcement systems and the perceived invasion of privacy some drivers may associate with such systems.

**Statutory Framework**

As of October 2006, 21 states and the District of Columbia have passed legislation regarding the operation of automated enforcement cameras for the purpose of detecting speed or red light violations (10). These laws generally include provisions allowing enforcement agencies to cite the registered vehicle owners by mail. Some states, such as Arkansas and Utah, require that an officer be present at the time that the citation is issued. State legislatures in New Jersey, West Virginia, and Wisconsin have banned the use of automated photo enforcement for any purpose. These and other differences in automated enforcement laws are summarized in Table 3. Violators issued citations by existing enforcement systems are generally not penalized with a moving violation, thereby placing much less importance on the ability of the enforcement system to recognize the driver.

There are currently two approaches that have been implemented by state governments with regard to the implementation and operation of automated enforcement systems (11). One approach places the responsibility of the recorded violation on the driver of the vehicle. Therefore, cameras must be positioned so that a frontal view of the vehicle and driver are recorded. The photograph of the driver must also be of sufficient quality so as to clearly determine the identity of the driver. Of the 18 states that have adopted legislation permitting the use of automated enforcement cameras, Arizona, California, Colorado, and Illinois require that photographic evidence of the driver be obtained. The San Francisco, California, red light-running program photographs the driver and matches the image to a driver’s license photograph. A citation in this case, which carries the same penalty as if it had been issued by an officer, can only be issued if both photos show the same individual (12).

Another approach is to hold the registered owner of the vehicle responsible for violations recorded by enforcement cameras, thereby only requiring enforcement cameras to capture photographic evidence of the vehicle’s license plate. Because it is much less important for an automated enforcement system to identify the driver when the penalty associated with the violation is not the same as a traditional moving violation, citations issued in this manner typically carry a standard maximum fine and do not assess points on the driver’s record or count as a moving violation. However, the difference in penalties between a violation caught on camera and one witnessed by a police officer is the source of some opposition, as discussed later.

Toll evasion, a consideration for HOT lanes, is typically punishable as an infraction, not as a moving violation. Although there are inconsistencies in the use of the term “moving violation,” most use the term only to refer to a violation that assesses points on the driver’s record. The important distinction to make between toll evasion versus a red light or speed violation is that toll evasion penalties do not assess points on the driver’s record. (Florida is the only state in which a statute mentions the assessment of points for toll violation.)

**Legal Issues**

The constitutionality of automated enforcement has been challenged many times, but in all cases the government has been upheld (13). Opponents of automated enforcement programs often claim that the use of camera technology constitutes an invasion of privacy and is an affront to rights guaranteed by the U.S. Constitution. However, every court that has reviewed automated enforcement practices has upheld the legality of using camera technology to photograph and cite traffic violators. Numerous state courts, as well as the U.S. Ninth Circuit Court of Appeals, have rejected various challenges to the constitutionality of automated enforcement programs.

Opponents of automated enforcement strategies often argue that owners are presumed guilty when issued a citation. However, the counterargument suggests citations issued by photo enforcement systems merely serve as a summons and therefore do not attach a presumption of guilt (14). Current laws typically state that photographic evidence captured by automated enforcement systems is sufficient to issue a citation to the registered owner of the vehicle. In this way, the photograph serves as prima facie evidence that the owner was operating the vehicle at the time of the offense. However, such evidence may be rebutted by the presentation of any competent evidence that the charged person was not the driver of the vehicle at the time the violation occurred. The registered owner may present a defense in person or, in some states, can simply submit an affidavit stating under oath that he or she was not the driver at the time of the offense. Other states require that the owner identify the driver to rebut the citation.

Although the decriminalization of traffic violations captured on camera allows jurisdictions to issue citations by mail, it has also been the source of opposition. Critics often argue that automated enforcement is in conflict with the equal protection clause of the Fourteenth Amendment because punishments differ between a ticket issued by an automated system and one issued by an officer who witnesses the violation (15). The traditional penalty for speeding or red light running is a criminal misdemeanor whereby points are assessed on the violator’s driving record. The penalty for these same violations recorded by an automated system carries only a fine.

The increasing decriminalization of traffic tickets may also cause public favor for automated enforcement programs to drop because of the increased perception that such programs are intended to serve as revenue generators and not deterrents. However, the typical penalty for driving in an under-occupied vehicle in an HOV lane is usually just a fine, so a citation issued as a result of being detected by an automated system would be the same as if the citation had been issued by

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**TABLE 3** Summary of Automated Enforcement Laws by State (10)

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of States</th>
</tr>
</thead>
<tbody>
<tr>
<td>States with no automated enforcement</td>
<td></td>
</tr>
<tr>
<td>No specific state statute</td>
<td>21</td>
</tr>
<tr>
<td>Photo radar prohibited</td>
<td>3</td>
</tr>
<tr>
<td>Photo radar only under conditions</td>
<td>3</td>
</tr>
<tr>
<td>Automated enforcement prohibited (except toll facilities)</td>
<td>1</td>
</tr>
<tr>
<td>Subtotal</td>
<td>28</td>
</tr>
<tr>
<td>States with automated enforcement</td>
<td></td>
</tr>
<tr>
<td>No specific state statute</td>
<td>9</td>
</tr>
<tr>
<td>Statewide automated enforcement</td>
<td>10</td>
</tr>
<tr>
<td>Jurisdictions or municipalities within a state having automated enforcement</td>
<td>4</td>
</tr>
<tr>
<td>Subtotal</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
</tr>
</tbody>
</table>
an officer. Therefore, this same argument may not be a source of opposition for automated technologies.

**Privacy Concerns**

The U.S. Supreme Court has clearly ruled that there is a lesser expectation of privacy while operating a motor vehicle than in other venues (13). However, many have a perception of privacy while in their vehicles and feel they are giving up this privacy if they drive in an area employing automated enforcement strategies. Many opponents believe that the use of automated enforcement programs is analogous to “big brother” tracking the actions of drivers. Therefore, it is not unreasonable to assume that an automated system for the purpose of verifying vehicle occupancy will face various privacy concerns.

Privacy concerns (or perceptions thereof) may be mitigated by employing enforcement techniques that the public will view as the least invasive. As an example, an automated vehicle occupancy enforcement system employing a seat-sensor device, which is incapable of identifying passengers, may face less opposition than a system involving on-board photography or any other kind of device identifying individuals within a vehicle (9). However, a system that is not able to identify the driver will likely place limitations on the severity of the penalty that can be assessed against the registered owner of the vehicle.

Besides the identification of vehicle passengers, other privacy concerns have arisen in response to the concept of automated enforcement systems. Table 4 illustrates the types of privacy concerns that may be raised with both camera and toll transponder enforcement. Some members of the public have expressed concern that insurance companies will have access to the information obtained by automated enforcement systems, with differential impacts upon insurance rates. For example, a driver whose photo shows a less-than-ideal driving behavior, such as talking on a cell phone or eating in the car, may be cause for the insurance company to increase the driver’s premiums. As another example, commuters who travel long distances on corridors employing automated enforcement technology will likely have information collected at multiple locations. In this way, the system may serve as a means to track vehicles and this information could be used to determine the driver’s travel patterns, which insurance companies could use to determine premiums. Finally, an automated enforcement system that is somehow coupled with the vehicle’s seatbelt sensors will be able to ascertain information on seatbelt use.

**Resolving Concerns**

Privacy for automated enforcement is not significantly different from other areas where privacy guidelines have been formulated. The principles below apply (16):

- Collection limitation—do not collect more data than needed for the primary purpose;
- Data quality—be clear on what level of accuracy to expect from tools;
- Purpose specification—state what the data are used for;
- Use limitation—do not use data for new purposes without consent;
- Security safeguards—keep data safe and secure, and only keep what is needed;
- Openness—tell people when data is collected and what it will be used for;
- Individual participation—let people correct faulty data; and
- Accountability—be proactive in supporting these principles.

**CONCLUSIONS AND RECOMMENDATIONS**

On the basis of the information presented, there are three primary privacy issues associated with an automated system for occupancy enforcement. Those issues are presented below, accompanied by approaches for potentially resolving privacy concerns.

1. Photographic record of occupants. The overriding issue of concern to the public is the capture of images representing the inside of the vehicle, and how that might be used for other purposes. In-vehicle data captured that does not produce photographic images may be more palatable to the public because they cannot specifically identify individual features and behavior. Whether roadside or in-vehicle automated vehicle occupancy enforcement systems develop over time, the principles outlined above will need to guide the use and storage of automated enforcement data.

2. VII barriers. A fundamental tenet of VII development is that it will not be used for enforcement because of privacy concerns. Current VII planning will prevent its being used to notify enforcement agencies of an accident or air bag deployment to protect the privacy of drivers who do not wish to report their involvement in an accident. A number of measures are being taken by manufacturers to maintain anonymity of vehicles and drivers and to prevent specific vehicles from being tracked. This hurdle can be addressed by a driver opt-in approach where the motorist actively agrees to share information. Nevertheless, there will be a need for HOV stakeholder engagement in the VII process to move forward with an in-vehicle application that addresses VII and manufacturer concerns.

3. Legal definition of HOV infraction. HOV infractions are typically defined as moving violations, although they do not have the same impact on safety as do most moving violations. Alternatively, the nature of toll evasion infractions, which seem to be less controversial with the public when enforced by automated methods, constitute a theft of service and carry different penalties for violation. HOV occupancy requirement violations could be considered a theft of level of service because they threaten the operational qualities of the facility.

### TABLE 4 Potential Privacy Threats with Camera and Toll Transponder Technology

<table>
<thead>
<tr>
<th>Risk</th>
<th>Cameras</th>
<th>Toll</th>
<th>Transponders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance company raises rates</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td>Insurance company drops coverage</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location data sold to marketing company</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td>Increased risk of criminal charges</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td>Increased risk of tickets and fines</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td>Data used in divorce proceedings</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental surveillance of teens</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government surveillance and data mining</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ☑ indicates a privacy threat condition is present with the technology.
The statutory, legal, and enforcement framework under which HOV lanes developed over time logically pointed to defining an occupancy violation as a moving violation because there was not a premise for a theft of service approach and no prevailing adjudication method to handle violations as such. However, as more HOVs are adapted to HOT operation and as new HOT lanes are developed, the opportunity exists to modify the way occupancy violations are legally defined. This supports the premise of choice and the prospect to waive privacy rights if a choice is made to use the managed lane and receive the associated benefits.

ROLE OF PUBLIC EDUCATION

Public education and awareness is crucial to the success of automated enforcement programs. Favorable public opinion can be the difference between a successful and unsuccessful program. Successful red light and speed camera programs are often attributable to thorough public awareness and education campaigns. An outreach campaign for an automated vehicle occupancy enforcement system should incorporate the following elements to address the basic principles of data privacy:

- Clear description of the operation of the automated vehicle occupancy enforcement equipment in nontechnical terms,
- Clear statement of the program objectives,
- Description of the advantages of automated enforcement,
- Explanation of other measures being taken to combat violators, and
- Description of the use of the automated vehicle occupancy enforcement data and program revenues.

Public outreach efforts should begin before the implementation of an automated enforcement system and continue even after the system is fully operational. An ongoing public awareness campaign is needed to assure the public that the enforcement program is working in the most effective and fair manner (15). A practical field demonstration of a system, potentially using automated technologies and an aid to law enforcement officers, could provide public comfort and support stakeholder arguments for in-vehicle implementation.

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