

verification will no longer be necessary.

#### Visibility of Occupants

The basis for the visibility of occupants issue is that fulfillment of the requirement for number of occupants in a vehicle in the HOV lane will be related solely to their visibility. It would be necessary to write into the legislation a presumption clause that, unless the required number of persons is visible, the vehicle is in violation. This visibility presumption may be a rebuttable presumption so that the driver of the vehicle could present proof of the existence of the required number of occupants. The importance of this statutory language is that the burden of proof is initially on the motorist not the citing officer.

#### Mailing of Citations to Owner of Vehicle

HOV citations may be mailed to the owner of a vehicle in violation of the HOV facility if two legal concepts, decriminalization and presumption, are included in the jurisdiction's statutes or ordinances. Inclusion of these two legal concepts should preclude challenges made against citations mailed to the registered owner. Most states have established prima facie evidence presumptions in municipal parking ordinances whereby the registered owner is presumed to be the violator. These prima

facie presumptions have been found to be valid and constitutional. Where moving violations are treated as noncriminal infractions, they may be considered no different from parking violations. This is especially true where no points are assessed against a driver's record for the violation and the only penalty is a fine.

#### Citation Issued by Nonwitnessing Officer

Speed devices such as radar and air surveillance have been used extensively to allow nonwitnessing officers to cite the violator. Where the appropriate statutes or ordinances have been passed or judicial precedent has allowed, such citations issued by nonwitnessing officers have been consistently upheld by the courts.

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## Transit Lane Enforcement in the Central City

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Transit lanes in crowded urban core streets are potentially effective for improving transit operations when they are available to transit vehicles. Concurrent-flow transit lanes are susceptible to violation by motorists. Police enforcement is often costly and inconsistent. A 2-year demonstration grant, from the Urban Mass Transportation Administration to San Francisco, tested the concept of self-enforcing lanes by using improved lane markings to heighten motorist's awareness and, hence, voluntary compliance. A separate study of nontraditional enforcement techniques was included within the grant funding. The results of the test showed negligible change in motorist's behavior, but the research uncovered valuable information about more significant contributors to transit delay, namely, double-parked vehicles and a spotty parking enforcement program. Subsequent implementation of new transit lanes on a downtown San Francisco street reflected the lessons learned on design techniques and enforcement priorities.

Enforcement has always been cited as a key factor in the design and operation of transit priority treatments. In the central city, enforcement of transit lanes, malls, and other transit preferential features is both important and difficult. In San Francisco, effective enforcement of transit lanes in the central city poses a problem of unique complexity.

The central city area of San Francisco was originally laid out during California's gold rush era. As a result, the area is characterized by short blocks and narrow streets that are well suited for pedestrians. Today, however, transit vehicles, trucks and commercial vehicles, private automobiles, and bicycles all compete with the pedestrian for use of the streetscape. In this environment, the curb has become a valuable commodity. The central city

largely lacks alleys and serviceways, and as a result, most of the movement of goods and service deliveries occur at the curb. At the same time that transit vehicles require use of the curb to load and unload, private automobile drivers similarly desire to use the curb for quick business and shopping stops.

The result of this intense competition for use of the curb space in central San Francisco is frequent double parking and general abuse of curb parking and loading restrictions. These conditions contribute to a congested street environment, particularly during the midday when trucks and service vehicles are most prevalent. The general level of street congestion that prevails in the central area also encourages drivers to violate transit lanes. At the same time the San Francisco Police Department has been constrained by (a) limited resources, (b) a general public attitude that places a low priority on enforcement of traffic and parking, and (c) a need to ensure that the movement of goods and service operations is not unduly hampered.

These factors have combined to result in relatively poor operating conditions for vehicles in central San Francisco. Transit vehicle speeds of 4-8 mph are common on many street sections. Transit drivers often avoid use of transit lanes to stay clear of curb activity and avoid being trapped behind a double-parked vehicle.

#### BACKGROUND

In 1977, a formal study program, designed to di-

rectly address the problem of transit lane design and enforcement in central San Francisco, received an Urban Mass Transportation Administration (UMTA) grant. The 2-year demonstration project would focus on practical means to improve transit lane enforcement and performance. Ultimately, the findings of the demonstration project would be applied to the design of new transit preferential treatments on the narrowest portion of four downtown streets. The demonstration project was just one of a continuing series of study, design, and implementation efforts undertaken as part of San Francisco's transit preferential streets program.

In 1972, in order to improve the overall efficiency of transit vehicles, the city adopted a transit-first policy. The transit preferential streets program was initiated to implement that policy. San Francisco now provides an extensive system of transit preferential treatments. For the most part, however, these treatments have met with mixed success and public acceptance. Two related problems have clearly emerged to limit the success of the transit preferential treatments, particularly the central area transit lanes:

1. The lanes were subject to continuous violations by motorists and repeated blockage by double-parked vehicles and
2. The lane markings and signing lacked high visibility and were confusing to motorists.

These problems resulted in a general lack of acceptance of the value of the lanes by the public, the transit drivers, downtown merchants and businesses, and the police. If not resolved, it was feared that the ongoing efforts to fully implement the transit priority street program would be halted and that already implemented treatments would be eliminated.

Two elements of the UMTA project were designed to deal directly with the enforcement problems:

1. A self-enforcing transit lane demonstration project and
2. A review and evaluation of nontraditional enforcement techniques.

The goal of the self-enforcing transit lane demonstration project was to test the belief that improved transit lane markings and signing could improve enforcement characteristics. The improvements would be designed to reduce violations and also to facilitate existing police efforts to enforce the lanes. The study involved a before evaluation of the performance of the transit lanes, the design and implementation of the signing and pavement marking improvements, and then the after evaluation of the self-enforcing capabilities of the lanes.

This study involved the identification and the evaluation of innovative techniques of transit lane enforcement. These techniques were to avoid the costly traditional approach of improved enforcement by allocating additional efforts by police officers assigned to traffic patrol and were to emphasize cost efficiency, public acceptance, and ease of implementation. A particular concern of implementation was the legality of any proposed technique.

#### SELF-ENFORCING TRANSIT LANE DEMONSTRATION

San Francisco adopted an official policy of transit first by resolution of the board of supervisors in 1973. It states,

Declaring that municipal railway vehicles and

other transit vehicles be given priority over other vehicles on San Francisco streets; that the Department of City Planning and the Public Utilities Commission develop a preferential transit street system within six months; suggesting methods of expediting transit service on duly designated "transit" streets.

A report was published by three city departments later in 1973, and several concurrent-flow transit lanes were installed on Mission Street, the Sutter-Post one-way pair, and later on the Geary-O'Farrell one-way pair. The experience with these lanes has been mixed. They have had some impact on motorists' driving behavior and have shifted traffic volumes from the bus-only lane to the remaining general traffic lanes. However, the violation rate remained high and active police enforcement was required in excess of that deemed desirable by the police department.

#### Problem

The concurrent-flow transit lanes in San Francisco are generally designed as 18-ft right-hand lanes and permit parking and goods delivery (curbside loading and unloading) at all times except during peak hours, when no stopping is permitted and towaway is in effect. Since right turns are also permitted from the transit lane, the mere presence of a motorist in the lane does not constitute a violation of the transit lane. To provide traditional enforcement, a police officer must observe the motorist driving in the lane for some distance and continuing across an intersection. Then, having established that a violation of the transit lane has occurred, the officer must stop the motorist to give the citation. This stopping of the motorist for enforcement purposes can result in a more serious blockage of the transit lane than the original violation. Even during the peak hour, when curb towaway is in effect, the stopping of motorists by police can create a blockage of the lane (see Figure 1). Finally, the traditional enforcement only catches a percentage of violators when it is actively pursued, and it is not feasible to maintain active enforcement full time. An additional element present was the reluctance of police officers to enforce these lanes because of a high incidence of motorists claiming they were unaware that they were driving in a bus-only lane.

Although some traditional enforcement is necessary to keep teeth in the laws and to create a credible image to the motorist's mind that the lane is, in fact, reserved for transit use only, some other means of improving the effectiveness of these lanes was needed.

#### Assumptions

It was assumed that (a) a more clearly identified transit lane would result in a reduced rate of violation, (b) fewer police would be required to enforce the lanes, and (c) fewer motorists in the lane would increase the effectiveness of the transit lane and result in improved transit speed and reliability. The concept of designing a self-enforcing lane developed after several years of experience with the initial lane design. A formal demonstration was proposed to the Office of Service and Methods Demonstration, UMTA. A grant was awarded in 1977 for a 2-year study that included three principal elements:

1. A before-and-after measurement of the effect of improved lane markings on the violation rate and transit operational experience,

Figure 1. Enforcement procedures block transit lane.



2. A study of nontraditional enforcement techniques that might be used, and
3. Design of new all-day transit-only lanes for the narrower portions of four downtown streets.

All three elements are essentially complete.

**Methodology**

The research methodology for the self-enforcing lane demonstration was devised by UMTA's Transportation Systems Center in Cambridge, Massachusetts, and the local evaluation consultant, Systan, Inc., of Palo Alto, California. An extensive before data base was compiled in July 1979. The statistics were gathered for three streets where the original lane marking and signing was in place and traditional enforcement had been employed periodically for several years. The three streets included the one-way pair of Sutter and Post and a six-block, two-way segment of Mission Street.

The data collection included time-lapse movie films, speed and delay runs on board buses over the length of the test segments, and a postcard survey of both motorists and bus passengers relative to their awareness of the transit lanes and their feelings concerning the utility of the lanes.

An experimental lane marking was developed by Wilbur Smith and Associates in conjunction with the multidepartmental committee that monitored the project. Bio-Technology, Inc., of Falls Church, Virginia, also made valuable inputs into the design of the markings; they were under contract to the Federal Highway Administration (FHWA) to test and evaluate several kinds of experimental highway lane markings. The adopted test design was a bold lane buffer or striping that included two parallel solid white lines, 8 in apart, with small diamond symbols 10 ft on center between the lines. The transit lane was further defined by large painted diamonds in the lane, diagonal stripes at the beginning of each block, and overhead signs over the lane that clearly state BUS ONLY. These overhead signs were to sup-

plement the existing roadside post-mounted signs.

The after data were collected in July 1980 in a manner essentially identical to the before data.

**Results**

Table 1 (1) shows little change in the motorists' rate of violations, and no measurable improvement in bus operating performance can be seen in the data below (1).

	Post Card Survey (%)		
	Post Street	Sutter Street	Mission Street
Bus Lane Awareness			
Before new markings	94.4	90.4	90.6
After new markings	94.0	91.4	94.1

Overall, 41 percent were not aware of overhead signs and 6 percent were not aware of the street pavement markings.

Bus speeds showed no significant decrease in travel time. Data were not available on how well buses adhered to the schedule on Post-Sutter Streets. On Mission Street, no difference could be detected in mean headways between buses and the standard deviation of buses on schedule.

Bio-Technology gathered independent data on two of the three test streets. Their methodology, which relied primarily on time-lapse films and some questionnaires, compared before-and-after data on the Post-Sutter one-way pair against similar data for a control sample of an adjacent one-way pair, Geary-O'Farrell. The control sample one-way street couplet has the older design, less-elaborate, transit-only lane markings [see Table 2 (2)].

**What We Really Learned**

As with many experiments, what we learned was not necessarily what we set out to discover. The intensive daily scrutiny of the lanes resulted in a clearer picture of what were the true inadequacies of the lanes.

The problem was not one of moving violations by motorists driving in the lane nearly so much as it was one of parked vehicles and fixed obstructions in the transit lane. The vehicles legally in the lane to make right turns or to maneuver into a parking space were one source of delay. These vehicles most often result in the buses moving from the transit-only lane to the general traffic lane to pass. This is a minimum delay factor in light-traffic situations but can become significant if the general traffic lanes are in heavy use. The most serious factor in delay to transit is caused by double-parked trucks, tour buses, and, to a lesser extent, taxicabs and automobiles. Double parking can become so prevalent that, in some blocks, it is more common for a bus to be out of the transit lane than within it. The double parking stems from problems with commercial loading zones (yellow), passenger loading zones (white and green), and special truck loading zones. In short, delay of transit vehicles is primarily the result of inadequate use and enforcement of curb parking restrictions.

Some of these difficulties may be unique to San Francisco, its physical design, its pattern of streets, lack of alleys, the zoning codes for off-street loading, and even the history of police priorities and political pressures. However, many are no doubt similar to problems and situations in other cities and our findings and recommendations may have application elsewhere. Several steps are underway to correct the problems in San Francisco and are listed below. More general recommendations for implementation of concurrent-flow transit lanes

are included at the conclusion of this article.

The immediate tasks necessary in San Francisco to improve the effectiveness of the transit lanes and achieve this goal without heavy reliance on traditional police enforcement of moving violations include the following:

1. A thorough reevaluation of the allocation and placement of curb space to various needs, such as parking, loading, goods deliveries, and turning lanes;
2. Dramatically improved enforcement of the commercial loading zones and passenger loading zones;
3. Changes in the designs of all new buildings, including new hotels, to provide parking for service vehicles, deliveries, taxis, and tour buses on site or in a manner that will least impinge on the transit lane;
4. Adoption of special legislation to specifically prohibit double parking within a transit-only lane; and
5. Tightening of the regulation of day-time street construction along the critical transit streets, especially in areas of heavy midday congestion.

#### NONTRADITIONAL ENFORCEMENT TECHNIQUES

Where self-enforcement and design features of transit lanes are ineffective or insufficient in eliminating violations, other enforcement techniques must be pursued. The need for additional enforcement often arises when parking violations on an existing facility inhibit bus movement. Stricter enforcement practices may be required to reduce the conflict between goods movement and transit in the central areas of many major cities.

Traditionally, the need for stricter enforcement has been met by sworn police officers who issue citations to violating vehicles. However, many police departments question the economics of spending police officers' time on traffic details at the expense of other law enforcement duties. Public response to traffic officers has always been negative, which reinforces the view that other police activities are more important than traffic law enforcement. For these reasons, many police departments are turning to traffic enforcement procedures that do not require the specialized training, authority, and expense of a sworn officer. Although

Table 1. Transit lane violation rate as percentage of all traffic on street.

Street	Time and Direction	Before (%)	After (%)
Mission	Morning inbound	16.5	19.6
	Evening inbound	25.2	23.4
	Morning outbound	20.2	19.6
	Evening outbound	23.0	23.6
Post	Morning inbound	4.7	2.5
Sutter	Evening outbound	5.7	4.5

Note: Data are preliminary.

Table 2. Summary of field study findings.

Issue	Where Intended	Finding
Effect of buffer zone in arterial settings	San Francisco 24-h bus lane	No clear reduction in violations; no change in temporary special use lane intrusions
Effect of shoulder-mounted versus overhead signs	San Francisco	Violations reduced by 25-40 percent; drivers became more aware of special use lane
Effect of complete upgrading in information system	San Francisco arterial	Reductions in violations (25-40 percent) and temporary intrusions; effect lasted 30 days only on one of the two streets; increased driver awareness of special use lane

many such procedures have been widely accepted for a number of years in selected locations, they are given the generic label nontraditional enforcement techniques because they attempt to break from the traditional concept of enforcement in which a single uniformed police officer performs traffic enforcement activities randomly, along with the normal assortment of other police duties.

#### Selective Versus Special Enforcement

Nontraditional enforcement techniques can be divided into two major classes--selective and special, depending on their frequency of application. Selective enforcement is generally a concentrated effort, applied periodically to areas where high violation rates have been reported. Because of the temporary nature of this strategy, no new personnel are normally required. Existing enforcement officers are temporarily reassigned until the program is concluded, usually for a period that ranges from a few days to two weeks (3).

Selective enforcement programs can be very well planned and executed at target areas on a scheduled basis, or they can be implemented based on the need for improved enforcement at specific locations. On the Interstate 35W bus bypass ramps in Minneapolis, selective enforcement campaigns are implemented by the police department when complaints are received from the public and from bus drivers. A selective enforcement program of the San Francisco-Oakland Bay Bridge toll plaza high-occupancy-vehicle (HOV) lanes is instituted following weeks when the violation rate exceeds 10 percent, as reported by toll takers and officers on patrol.

#### Special Enforcement

Special enforcement is characterized by (3) "continuing, systematic manpower allocations and enforcement tactics specifically dedicated to enforce HOV (or transit lane) violations." Special enforcement techniques are especially appropriate when routine enforcement measures cannot effectively address the special needs of the transit priority treatment without sacrificing performance of other duties given equal or higher priority by police management.

Special enforcement techniques vary greatly in their level of innovation, technology, use of police personnel, and cost. A special enforcement technique may be as simple as reallocation of existing staff to a transit priority enforcement battalion or as complex as use of photography and computers to issue citations. Although most special enforcement programs are relatively new and have not been thoroughly evaluated, they are generally regarded as successful from the standpoints of relieving the burden on sworn officers and improving the effectiveness of transit priority treatments.

Selective and special enforcement techniques can be combined in an integrated enforcement program. Use of each technique should be determined by the location of the facility, type and severity of



violations, and availability of enforcement personnel.

#### Enforcement Techniques

Many cities in the United States and elsewhere have used nontraditional enforcement techniques for all or part of their traffic enforcement program. The following techniques were examined as part of the transit preferential streets (TPS) demonstration project in San Francisco.

#### Raised and Differential Fines

The raising of fines for traffic violations is not in itself an innovative enforcement technique, but higher fines can induce self-enforcement when their rates are clearly advertised. Philadelphia recently raised fines for all traffic violations, and preliminary reports indicate both an increase in revenue and a decrease in the violation rate. City officials believe that the success of this program is due largely to the clear posting of the fines for violation of parking laws. Many motorists are willing to risk a citation for violating a parking restriction when the fine is equal to or slightly more expensive than the cost of parking in a downtown parking garage. However, fines that range from 5 to 10 times the cost of parking are a significant deterrent to violators.

Many cities have developed differential fines based on the severity of the violation problem in a given area. Chicago, for example, charges special fines for vehicles that violate parking restrictions on streets designated as snow routes. Parking violations in Chicago normally carry a fine of \$20, but violators on cited snow routes when there is more than 1 in of snow are assessed a \$100 fine. Repeat violations of the posted snow routes are assessed increasingly higher fines (e.g., \$200 for second violation and \$300 for third violation) and finally a license can be revoked.

Implementation of a raised or differential fine program is often politically difficult. However, raised fines tend to increase city revenues without additional public expense and without invoking an unpopular tax. Public acceptance of raised fines can be improved through media campaigns geared toward educating the public about the purpose and scope of the new fines. A selective enforcement campaign, where warning-only citations are written, staged shortly after the raised fines are enacted can attract media attention and effectively prepare the public for the new fines.

#### Civilian Officers

The use of civilians in jobs that are normally performed by sworn officers has increased greatly over the past two decades. A large number of police departments throughout the country, including Seattle and Fort Lauderdale, Florida, have used civilian personnel for all or part of their traffic enforcement program. The work performed by these civilians is usually of very high quality, largely because traffic enforcement is their primary responsibility. In Fort Lauderdale, where civilians write accident reports as well as enforce traffic laws, a study by the police department revealed that reports written by transit aides were of a higher quality than those written by sworn officers when evaluated on the basis of clarity, completeness, readability, explanation, and illustration.

Although San Francisco employed two types of civilian traffic aides prior to the TPS study, the study revealed many problems with their program.

Traffic controllers were employed to direct traffic and issue citations for any traffic code violations they witnessed. However, the civilian aides generally did not have vehicles of their own and thus found it difficult to stop a motorist committing a moving violation. Parking controllers in San Francisco were mobile civilians who were empowered to issue parking citations only. Despite the mobility of the parking controller, problems developed with this program because of the physical danger to civilian aides who do not receive the respect accorded a uniformed police officer.

Despite the problems with civilian programs, they remain a primary resource for improving enforcement levels without employing sworn officers. Civilian officers generally return more revenue to the city treasury than they displace for salaries, training, and equipment. The effectiveness of a civilian program can be enhanced through capital investment in specially marked uniforms and patrol cars. These distinctions also help to give an aura of authority to civilian aides.

In Washington, D.C., a civilian force of 64 persons is responsible for more than half of all tickets written in that city. This program generated more than \$6.5 million in revenue in 1977, and cost approximately \$1 million. A cost-revenue breakdown for this program is shown in Table 3 (4, p. 7). Although the information in Table 3 is 3 years old, it can serve as an order-of-magnitude estimate for the potential application of this program to San Francisco. Additional savings can be realized when sworn officers are supplanted by civilians whose salaries and benefits are significantly lower than those of sworn officers.

#### Transit Employees as Enforcement Officers

Many transit agencies employ, or receive the services of, a transit police unit. In some cities this unit is a group of sworn officers who have full powers, including traffic control. More often, transit police are specially trained employees of the transit authority. In either case, their primary responsibility is crime prevention. The duties of the transit police could be expanded to include traffic control, especially during peak and daylight hours when the perceived danger in riding transit is low.

Other transit agency employees can also be used to assist in traffic law enforcement. In San Francisco, San Francisco Municipal Railway (MUNI) transit service inspectors have the authority to issue citations for both moving and parking violations in the transit lane. San Francisco is currently the only major city to employ such a program, which is seen as moderately successful by both MUNI and the police department. MUNI inspectors are primarily street supervisors and are limited because they operate on foot. Another limitation of this program is the time burden it places on the inspectors, who are fully occupied during peak periods. Their assistance can be most helpful in citing parking violations before and after the peak travel periods.

Public reaction to the use of transit personnel for traffic law enforcement has been generally unfavorable. The public views the role of transit police as strictly one of crime prevention and generally resists having their boundaries expanded. The use of other transit employees for traffic control is also viewed negatively because transit employees are not considered to have enough authority to enforce the law. However, proper public education could help this problem and give more flexibility in the selection of enforcement officials.

Table 3. Cost-revenue profile of civilian enforcement program, Washington, D.C.

Item	Amount
Tickets	
Issued	975 000
Collected (%)	58
Avg collateral per ticket (\$)	11.32
Gross revenue (\$)	6 400 000
Cost (\$)	
Salaries for 64 employees	766 000
Vehicles	97 000
Gasoline and maintenance	24 000
Equipment and supplies	124 000
Uniforms	19 000
Subtotal	1 030 000
Net revenue	5 370 000

### Sleeping Police

The sleeping police technique has been successfully implemented by many cities and highway patrols, including that of Sacramento, California. This technique involves the stationing of an empty patrol car in a visible location in areas where a high violation rate has been experienced. Motorists who are aware of traffic laws generally exhibit a higher degree of compliance in the presence of a police vehicle. This technique is especially effective in reducing moving violations because it is difficult to determine whether a parked car is occupied from a moving automobile. The sleeping police technique can be combined with live foot or car patrols to increase the impact of the decoy. The sleeping police technique can be combined with any of the others to reduce the personnel costs of more-labor-intensive techniques.

### Boot and Tow

A boot-and-tow program is the harshest of the innovative enforcement methods examined in this report. It is also the most successful at reducing violations. This program is actually a combination of two strong enforcement measures: a towing and impoundment and a booting operation. A program of this nature was instituted in Washington, D.C., in October 1978 in response to rampant parking violations in the central area.

Under the towing and impounding component, a unit of 33 civilian officers radio in the license plate number and location of the illegally parked vehicle to their supervisors, who phone or radio the dispatch office of a towing company under contract with the city. The civilian officer places a brightly colored orange citation under the windshield wiper of the violating automobile. The citation serves as a flag to the towing company and frees the enforcement officer from waiting for the tow truck to arrive. John M. Brophy, public parking administrator at the Police Department in Washington, D.C., says that the tow vehicles are radio dispatched within a given beat radius and response time to a supervisor's call generally varies from 15 min to 1 h. All towing operations connected with parking enforcement are provided by a private contractor, who is compensated with towing fees paid by violators. Dispatching and storage operations are controlled by the district.

All towed vehicles are automatically impounded. The registered owner of the vehicle must pay a \$50 towing fine, \$3/day storage charge, plus all fines for previous tickets that the driver may have accumulated. Ten dollars of the \$50 towing penalty is returned to the towing company, leaving the remaining \$40 for the city.

The booting component of the enforcement program in Washington, D.C., is designed to stop repeat-parking-law offenders and to decrease the number of parking citations that are not paid by violators.

Each day, a special group of traffic enforcement personnel is given a list and description of vehicles that have four or more delinquent tickets. Every time a traffic ticket of any kind is being issued, the enforcement officer checks the list to determine whether this vehicle has been a repeat delinquent offender. Sometimes an enforcement officer will find a booting candidate that may be parked legally. The vehicle will still be booted even if it is properly parked at that time, provided that it has four or more delinquent charges against it. If one of these cars is found, a boot is applied to the left-front wheel that prevents the vehicle from being moved. The boot will attach to vehicles both with and without a hubcap without harming the vehicle in any way. It can only be removed with a special key that is not reproducible. There has never been a recorded instance of a boot being removed by the violator.

To remove the vehicle, the owner must go to the Office of Traffic Adjudication, as instructed on the boot, and pay a fine of \$25 plus all delinquent ticket charges. If a booted automobile is not claimed within 48 h, the car is impounded, and the towing-impounding fees are charged in place of the \$25 boot charge. This year the department hopes that its staff of 28 full-time civilian field officers will boot 20 000 automobiles.

The boot-and-tow program has been considered successful, both by the police department and the transit authority. The primary positive impacts of the program have been the following:

1. Improved deterrence--The system discourages illegal parking because violators are aware of the high penalties of impoundment or booting.
2. Reduced operating costs--Contracting costs less than towing by the city; the district did not have to invest in a large equipment inventory or place an added burden on its vehicle maintenance operation; further, the civilian aides cost less than sworn police officers on a one-to-one comparison.
3. Increased towing activity--Increased towing activity, from 60 cars/day to 450 cars/day, improved clearance of critical automobile and bus lanes and reduced the number of hazardous and flagrant violations. From a January 1976 study of parking violations in the district, it was concluded that up to 40 000 cars daily commit a parking violation for which they could be towed.

A boot-and-tow program is relatively capital intensive. However, the experience of the District of Columbia indicates that the municipality can expect a net gain in revenues from this project, especially when fines for violations are increased for more serious or repeated violations. The boot-and-tow operation in Washington, D.C., cost approximately \$2.8 million in 1977, including one-time start-up costs of approximately \$600 000. The program currently has net receipts of more than \$10 million, some of which is used to finance transit service.

Table 4 (5, p. 8) summarizes the costs and revenues derived from the program in Washington during the start-up year. One additional revenue source that is not cited in Table 4 is the expansion of parking meter revenues, which have risen by more than 35 percent since the boot-and-tow program was inaugurated. Much of this increase can be attributed to the self-enforcement aspect of assigning high penalties to parking violators.

Table 4. Cost-revenue profile of boot-and-tow operations.

Item	Tow (\$)	Boot (\$)	Total (\$)
Revenue			
Tow revenue <sup>a</sup>	5 625 000		5 625 000
Boot revenue <sup>b</sup>		400 000	400 000
Delinquent fine revenue		3 734 000	3 734 000
Storage fee <sup>c</sup>	750 000		750 000
Gross revenue	6 375 000	4 134 000	10 509 000
Expenses			
Contract towing <sup>d</sup>	1 125 000		1 125 000
Salaries and supplies	624 000	457 000	1 081 000
Start-up costs	404 000	181 000	585 000
Total	2 153 000	638 000	2 791 000
Net revenue	4 222 000	3 496 000	7 718 000

<sup>a</sup>Tow revenue = 25 trucks x 12 h x 1.5 tows/h x 250 days x \$50.

<sup>b</sup>Boot revenue = 10 crews x 8 boots x 250 days x 16 000 collections x \$25.

<sup>c</sup>Storage fee = \$3 x no. of tows.

<sup>d</sup>Contract towing = \$10 x no. of tows.

### Photography

Still photographs have been used as an aid to the traffic enforcement officer in experiments in England and New Zealand. Professional photographers are placed on the civilian police staffs and are used in accident investigation as well as in enforcing routine laws by photographing the license plate number of the car in a picture that clearly shows the infraction. A sworn officer or other civilian personnel issues a citation after the photographs are developed. The photograph is then considered admissible evidence in traffic court. Both the programs in England and New Zealand are still in the initial stages.

In this country researchers have been experimenting with the use of remote-controlled, time-lapse movie photography as a means of observing traffic flow. Three areas have been identified in which photography may be useful in enforcing traffic laws on transit priority streets. These are identifying violating vehicles, obtaining evidence of a violation, and studying violation patterns.

A number of problems are associated with the use of photography as an enforcement tool, except in cases where moving or still photographs are used to identify violation patterns rather than for identification of a particular violator. For the most part these problems need not preclude the use of photography as an enforcement tool but will limit the amount and usefulness of the data that may be obtained.

### Camera Placement

To take a clear picture of a vehicle suitable for submission as evidence in traffic court, an average distance of 50 ft between the camera and the automobile should be maintained. This consideration poses a problem for facilities that do not have an adequate median or sidewalk area. Camera placement may also be affected by security considerations. Photographs used for observation purposes only should be taken by a well-hidden camera so as not to bias the sample. Cameras placed in the open may contribute to self-enforcement, but they are also susceptible to vandalism.

### Weather and Lighting Conditions

Weather conditions are impossible to control and are thus, perhaps, the greatest single barrier to the use of this technique. Lighting variations, especially during the evening peak hours, can affect photograph quality. Other ambient conditions, such as thick fog or rain, can further impair photograph reliability.

### Cost

The initial capital investment in camera equipment and the processing can be significant for this technique. These costs are particularly burdensome because the capital items may not replace any labor hours. Although a photographic detection system is highly mechanized, the analysis of data obtained from this technique is quite labor intensive.

### Legality

Many municipal codes will not allow photographs as evidence in traffic court situations. In addition, there is a constitutional implication of invasion of privacy. Extensive research should be done on this aspect before an enforcement program is implemented.

### Public Education Programs

Public awareness is a critical element in any enforcement program, particularly when the program includes innovative enforcement techniques. As the level of enforcement increases, so too should public awareness. However, public awareness is not a replacement for enforcement, it simply enhances a well-planned enforcement program. An extensive public education effort can reduce violations by giving active enforcement measures a self-enforcing characteristic. People who understand the need for improved enforcement generally have a more positive attitude toward the new enforcement program and the enforcement officers who carry it out.

In the planning phases of a project, informal and formal public meetings and hearings are an appropriate forum for discussion of the enforcement program and its content and consequences.

A small expense for pamphlets or news releases may generate far more coverage as the media gain knowledge of the new programs. Inexpensive techniques for public education include news releases and conferences, public service advertising, transit advertising space, speakers bureaus, and pamphlets or handouts. All public information should emphasize the positive aspects of a change in the enforcement program, such as improved transit trip times and generally improved traffic flow. Where possible, drivers should be made to feel that they have several avenues of recourse, which vary from the judicial process to riding transit.

In all cases, the primary message should be a simple statement of (a) what the law states and what is prohibited, (b) what will be done if a violation of that law occurs, and (c) what the consequences are if a violator is apprehended or cited. Other messages may be integrated, including the rationale for the law and appeals for mutual cooperation for the public good.

### SUMMARY AND CONCLUSIONS

The San Francisco experience with a transit-first policy and transit lanes on city streets extends over 7 years. The program got off to a good start with a fair amount of interdepartmental cooperation, high expectations, and an extensive program of transit lanes and other transit preferential improvements. However, the program began to languish from a combination of inattention and less-than-hoped-for impacts on transit operating performance. Resistance to expansion of the program to areas of greater need, hence greater potential impact on motorists and merchants, grew and political and staff support waned. One particular problem was the cost and difficulty of providing an active enforcement program with police personnel.

A 2-year UMTA grant has provided a full-time staff person to oversee the program and the means to fund and experiment with nontraditional enforcement techniques, including the design and evaluation of self-enforcing transit lanes. This focused attention has resulted in a new awareness of the potential and limitations of concurrent-flow transit lanes on city streets. An unanticipated byproduct of this study is a new emphasis on enforcement of parking regulations and a closer scrutiny of allocation of curbside parking and loading functions and their impacts on bus operating performance.

A number of lessons learned from this experience should be transferrable to other cities that have or may be planning concurrent-flow bus lanes. Several of these important lessons or recommendations are listed.

#### Self-Enforcement by Design

The chief conclusion of the San Francisco study was that properly designed streets and transit priority treatment would lead to lower violation rates. Attention should be given to proper width, lane markings, curb bulbing, and bus-stop design. Curb bulbing is the moving of the curb out the width of a parked car (6-7 ft) at a bus stop. This will prevent cars from parking in the bus stop. A poorly designed facility will continue to be an enforcement problem even with the most sophisticated and innovative enforcement techniques. Specifically, the following practice is recommended.

1. If at all possible, avoid lane designs that incorporate parking or turning movements within the lane by nontransit vehicles;
2. Design lanes that are highly visible, including a buffer strip between the lane and adjacent general travel lanes, large diamonds and the words "bus only" stenciled on the pavement, large roadside signs, diagonal markings or chevrons at the beginning of each block, and, if feasible, overhead signs that call further attention to the bus-only designation;
3. Design transit lanes of adequate width; if they are to include curb parking and loading, a minimum of 20 ft is recommended;
4. Develop the maximum publicity concerning the existence and purpose of the lanes and point out that enforcement by regular police personnel is an integral part of the program. If the fine for driving in the lane is written on the signs, this is an additional self-enforcing technique; and
5. Try to eliminate problems in the design stage by providing for the necessary loading, delivery, and service vehicle functions off-street, or at least away from the transit lane.

#### Public Information and Innovative Enforcement Techniques

Public information must be a part of both self- and active-enforcement programs. Public information is critical in both distributing factual information and gaining public acceptance for a new enforcement program.

The most effective of the innovative techniques are those that set strict penalties for violations, and thus encourage self-enforcement and reduce police labor hours in traffic enforcement. A properly administered boot-and-tow program, such as the one in Washington, D.C., is an excellent example of a good, strict enforcement plan.

Finally, in adopting a new enforcement plan, evaluate each element on the basis of cost, ease of implementation, public acceptance, and coordination with other elements of the enforcement plan. A fully integrated plan should incorporate both self- and active-enforcement techniques and should use both selective and special enforcement measures.

The Board of Supervisors in San Francisco has authorized a 10-month demonstration and evaluation of the first major new exclusive bus lane in several years. The lane was installed on Stockton Street through the heart of Chinatown and the Union Square retail area downtown early in 1981. Everything that has been learned in the last 2 years about the real and assumed causes of delay to transit influenced the design. The self-enforcing lane markings, lane signs, wider lanes, relocated midblock bus-curb bulbs, and a careful look at all adjacent land uses and the curbside access needs were incorporated in the Stockton Street lane. Enforcement, especially of the parking, loading, and double-parking regulations, is a key element of the 10-month program. This is the first time the city has authorized a transit-only lane in an area where it is vitally needed. Success will depend on the combination of many factors in the design and operation of the transit lane. However, in San Francisco, we are concerned that a large measure of the success or failure of the transit lane will depend on the enforcement and that enforcement begins in the courts.

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