I-5 Columbia River Crossing
Technical Analysis

Introduction to Tolling & Survey of Tolling Experience

Technical Memo 6.1

Prepared by

The Larkin Group, Inc.
The Underhill Company, LLC
Siegel Consulting

April 2004

Proverb: 'For example' is not proof.

The Purpose of this Report

The purpose of this paper is to help staff, elected officials and other readers develop a broad understanding of tolling terminology, methods, and issues. Tolling projects in the United States and Europe provide illustrations.

This report is *not* intended to be an evaluation of tolling and tolling alternatives. Information about the experience and results of particular projects is included to illustrate issues and is not meant to be conclusive or definitive.

Finally. this report does not address recommendations regarding the identification of project alternatives for Scoping and the DEIS. Those recommendations will come out of the detailed technical work of the transportation, tolling, financial and other tasks, and the work of the policy committees, and the partner agencies and jurisdictions.

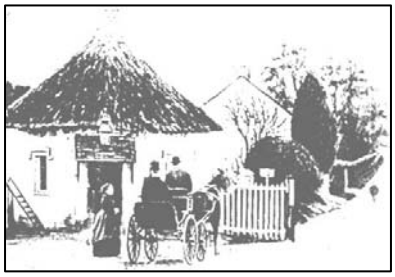
Annotated Contents

A Note on Web-based Research: The information about current projects was gathered primarily through on-line research from numerous, often conflicting, and sometimes dated sources. As much as possible, facts presented here were confirmed through the projects' own websites or through multiple sources. However, the author did not contact each project directly and confirm the information reported here. Where it seemed significant (for example project results reports that are some years old) the dates of the data reported are noted in the text.

1. Tolling – What to Charge

It's not your great-great-grandfather's toll booth

Back in the Olden Days, road tolls were collected by human beings standing at toll booths. Either every vehicle paid the same toll, or the toll collector determined which type of vehicle it was – 2-horse cart, 4-horse carriage, raggedy-old-mule wagon – and charged accordingly. In some places things have changed; in other places toll collection varies only slightly from 100 years ago.



Tollbooth in the Olden Days

What today's tolling terms mean

New ways of charging tolls require new names to describe them. Fixed and differential tolls are the historical mainstays of tolling; variable tolls have also been popular in the last few decades. More recently, advances in computing and communications have been applied to tolling, resulting in many more options for ways to charge tolls and ways to pay them.

Tolling Types and the Terms that Describe Them

Fixed	All vehicles pay the same toll at all times.	**Differential**	Different classes of vehicles pay different tolls, for example trucks pay more than cars.
Variable	Tolls change according to time-of-day and/or day-of-week, based on a preset and unchanging toll schedule.	**Dynamic**	Toll rates change in real time in response to changing traffic congestion.
HOT Lanes	HOV/Carpool lanes are available to SOVs if they pay a toll. "HOT" is an acronym for "High Occupancy Toll" and is a subset of variable or congestion pricing.	**Pay-as-you-go or Distance-based**	Charges the driver for all miles driven, regardless of where or on which facility.

Broad Pricing Terms

Value Pricing	A term that encompasses different types of variable, dynamic and HOT-lane tolling.	**Congestion Pricing**	Another term that encompasses different forms of tolling focused on reducing congestion.
Peak Period Pricing	Tolls (variable, dynamic, and/or HOT lane) used to manage capacity and/or congestion in the peak.	**Cordon or Ring Pricing**	Tolls are imposed to cross into and/or to travel within a certain zone – generally a downtown area.

1.1 Fixed and Differential Tolls

Fixed and differential tolls don't warrant a great deal of discussion here as they are the two most familiar systems. Fixed tolls means charging every traveler the same price, regardless of what type of vehicle they are driving or any other factor.

Differential tolls – more common than fixed tolls in actual use – differentiate the toll according to vehicle type, but charge every like-type vehicle the same toll. The one common exception to this is charging a different toll (or no toll) for carpools and vanpools (although this is consistent if one assumes that vehicle "type" can also be defined by the number of passengers).

History tells us the first Columbia River bridge between Portland and Vancouver had a toll of 5¢, presumably for all vehicles – which, at the time, included horse-drawn wagons. After the second bridge was opened and tolls were reinstated to pay off the new bonds, differential tolls were charged according to the following schedule.

Historic Columbia River Bridge Tolls
Differential Tolls

Vehicle Type	Toll
Cars	20¢
Light Trucks	40¢
Heavy Trucks	60¢
Busses	60¢

A more up-to-date differential toll schedule might look like this one from the Rhode Island Turnpike Authority. The pricing scheme is simple – $1.00 per axle, Discounts are available with the use of pre-paid tokens or electronic toll collection (ETC), with ETC fast replacing the tokens. Discounts are not available to commercial vehicles.

Rhode Island Newport/Pell Bridge
Toll Schedule – Differential

Vehicle Classification	One Way Toll Booth	Bulk Purchases
Two-axle automobiles, pickups and vans up to 8,000 lbs Gross Vehicle Weight (GVW), cars, self-contained campers & motorcycles	$2	60 tokens for $50 11 tokens for $10
11 crossings/10 tokens	$10	
Two-axle vehicles over 8,000 lbs (GVW), trucks & buses	$2	5 tickets/$10.00
Three-axle trucks, buses & combinations	$3	5 tickets/$15
Four-axle trucks & combinations	$4	5 tickets/$20
Five-axle trucks & combinations	$5	5 tickets/$25

Differential tolls for HOVs. The idea of using tolls to encourage people to travel in carpools and vanpools has a long history. Reduced tolls for HOVs were introduced on the **San Francisco-Oakland Bay Bridge** in 1971; by 1973 peak period carpool use had doubled, with more than half the peak morning commuters across the bridge using the HOV lanes. In 1975 tolls for HOVs were dropped altogether and the number of peak period carpools more than doubled from 1973, although the increase was probably more related to the substantial time savings from bypassing the toll plaza.

Fixed or Flat Tolls

Pros	Cons
Simple to collect: No technology is required to implement or collect the tolls (though automatic toll collection is possible and can be used if desired). **Predictable**: Travelers always know what they will pay to use the facility, without having to think about time of day or memorize a complex toll schedule.	**Doesn't manage demand**: Only the toll itself acts as a regulator on use of the facility. If the tolls are high enough some travelers may choose to use an alternate route – if one is available – or may choose not to make the trip. The tolls themselves, however, because they are fixed, cannot be used to manage the use of the facility based on changes in demand or congestion. **Doesn't maximize revenue**: Travelers will pay more to travel during the peak, increasing overall revenues.

Differential Tolls

Pros	Cons
Simple to collect: As with fixed tolls, no technology is required to implement or collect the tolls. Defining HOVs as a vehicle class – and setting lower tolls – is a straightforward way to encourage ride sharing. **Predictable**: Travelers know what they will pay to use the facility. **Revenue equity**: More money is collected from heavier vehicles which place greater wear and tear on the roads and bridges.	**Does not manage demand**: Same as fixed tolls, with the exception of preferential HOV tolls which can be used to encourage ridesharing and so reduce the number of vehicles using the facility.

1.2 Variable Tolls

The concept of peak and off-peak pricing for services – such as airline seats, phone calls, and electricity – is well established; its extension to road space is easily understood, though not always well accepted.

The purpose of variable tolls is to give travelers an incentive to travel outside the peak period, or a disincentive to travel within it.

Some variable toll projects add levels of complexity – for example making lower tolls available only to regular users.

Like fixed and differential tolls, variable tolls are also predictable, and relatively simple. The toll schedule is set and unchanging – but different tolls are charged at different times of day and/or on different days of the week.

Variable tolling project examples

Sunday Evenings in Paris

Parisians are inclined to walk or take the Metro to work, but on the weekends they like to escape the city in their cars. The result is huge traffic jams on Sunday evenings as everyone tries to get back into the city at the same time.

In 1992, a tolling experiment was tried on the A-1 Highway between Lille and Paris, which was already a toll road. On Sundays only, between 4:30 pm and 8:30 pm, the tolls were increased 25%, and during all other hours between 2:30 pm and 11:30 pm they were reduced 25%.

Results: The total Sunday traffic on the road did not change, but traffic during the peak evening hours was reduced by 15%. At the end of the experiment the tolling scheme was made permanent.

However, when similar Sunday tolling experiments were tried on other, *non-toll* roads into Paris the popular outcry was so great that the experiments were abandoned.

Lee County, Florida: "Avoid the rush, pay half as much!"

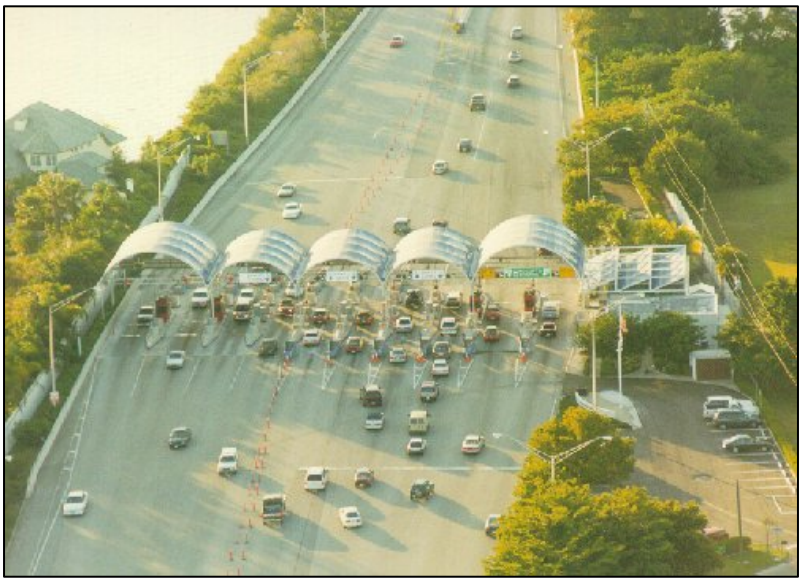
Two major toll bridges cross the Caloosahatchee River between Fort Meyers and its residential suburb, Cape Coral. The County wanted to spread the peak, but was worried about lost revenue. It also didn't want to reward drivers, such as tourists, who just happened to arrive at the bridges at a certain time.

The County's approach was to *reduce* tolls 50% just before and after the morning and afternoon peaks. Peak, midday, night and weekend tolls remain unchanged. Thus, the program rewards drivers who shift out of the peak but doesn't penalize those who don't.

Only drivers who sign up for prepaid electronic toll collection can take advantage of the reduced tolls. These drivers can then be educated about the program, and it targets those who are most likely to be able to change their habits – that is residents instead of tourists.

Results: Most likely users are retired or working part-time; shopping trips are most likely to be affected.

As of 2003, 71% of eligible drivers changed their travel times at least once a week; most saved only 25¢, some saved 50¢. The travel effects of the toll reduction diminished over time, as the savings remained at 25¢. Subsequently the base toll increased to $1.00, increasing the savings to 50¢ for cars. The program has now been extended to trucks, which also save 50% off higher, per-axle tolls.



Cape Coral Bridge Toll Plaza

New Jersey Turnpike E-Z Pass & Value Pricing Toll Program

The primary objective of the New Jersey Turnpike Authority's Value Pricing Toll Program was to generate new income, as the current tolls were not sufficient to cover facility costs.

Policy objectives included to:

- shift travel out of the peak (and potentially increase it) to times with excess capacity
- increase the use of electronic E-ZPass
- shift travelers to mass transit
- shift some commercial traffic to night travel
- eliminate toll discounts that *rewarded* high frequency commuters

The Authority's new tolling structure, introduced in March 2001, combined pleasure and pain to reduce peak traffic on the six tunnels and bridges between New Jersey and New York City.

Tolls were increased by 8%, but EZ-Pass users could avoid the entire increase if they traveled off-peak. In a subsequent phase, off-peak tolls were to increase by 5% for everyone, but peak tolls would increase by an additional 10%. E-ZPass users could save $1.00-$2.00 by traveling outside the peak.

Results: Program evaluation was affected first by the transportation impacts associated with 9/11, and subsequently by the economic recession.

Traffic shifted out of the peak enough to reduce congestion on the bridges and tunnels. The greatest shift was to the early morning hour before peak toll rates go into effect. Although the percentage changes are very small (less than 3%), the result has been to shorten the length of the morning peak by as much as 20-30 minutes on some facilities. Afternoon travel has been less price-elastic and less likely to shift out of the peak.

Revenue generation exceeded forecasts, and E-ZPass use increased.

George Washington Bridge between New Jersey and New York City

New Jersey Port Authority Toll Rates on Bridges and Tunnels to NYC

Current as of March 2004

	E-ZPass Off-Peak Hours	E-ZPass Peak Hours	E-ZPass Overnight Hours	CASH All Hours
Autos	$4.00	$5.00	n/a	$6.00
Motorcycles	$3.00	$4.00	n/a	$5.00
Carpool	$1.00	$1.00	n/a	$6.00
Trucks (per axle)	$5.00	$6.00	$3.50	6.00
Buses	$2.70	$2.70	$2.70	$3.00

Peak Hours	Weekdays: 6-9 am, 4-7 pm Sat. & Sun. 12 noon – 8pm
Overnight Hours	Midnight to 6 am weekdays
Off-Peak Hours	All other times

Variable Tolls

Pros

Demand management: Variable tolls are a straightforward and direct way to manage demand, through incentives and/or disincentives to shift travel out of the peak.

Although more complex than fixed or differential tolls, variable tolls are not too difficult to communicate, and can be posted on fixed (i.e. non-changing) signs, printed in brochures and so on.

Cons

Complexity: The primary complexity with variable tolls is communicating to drivers:

- First, what tolls are charged when, and
- Second, "synchronizing watches" – that is not having to argue with drivers about what time it is.

Variable tolls can be difficult to manage without electronic toll collection. One reason Lee County restricted toll reductions to drivers using ETC was to avoid arguments with toll collectors about whose watch showed the correct time.

1.3 Dynamic Tolling

Dynamic tolling changes tolls in real time in response to traffic conditions.

Toll authorities across the country and around the world are rapidly introducing electronic toll collection systems, which can easily be applied to traditional pricing structures. For newer tolling plans, however, a sophisticated electronic system that helps both to manage the facility and to collect tolls is a requirement. (The details of the hardware are discussed below in Chapter 3.)

A number of elements must combine to make dynamic tolling work. Traffic conditions on the tolled facility must be constantly monitored and evaluated. Drivers must receive the changing information about what the toll will be if they decide to use the facility, and they need to receive this information in time to make a choice *not* to use the facility if they don't want to pay the toll. This presumes there is an alternate route and the driver has time to choose it (that is to switch lanes, or choose an entrance or an exit).

Variable and Dynamic Tolling – Project Example

SR-91 Value Priced Express Lanes

The SR-91 Express Lanes opened in 1995. The facility consists of a new 10-mile, 4-lane freeway built in the median of an eight-lane, un-priced freeway. Toll collection on the 91 Express Lanes is fully automated – drivers must obtain a transponder to use the lanes.

Orange County, CA

The parallel freeway is among the most congested routes in California; 35-40 minute delays were common before the 91 Express Lane project opened. Immediately after the project opened – providing an overnight capacity increase of 50% – peak delays dropped, for all travelers, to an average of 5-10 minutes, though over time as traffic has grown the delays have increased.

The cost of constructing the facility was $3.5 million per lane-mile; the project was a public-private partnership with private financing, construction and operation under the auspices of the independent "Transportation Corridor Agencies." In 2003 the Orange County Transportation Authority, a public agency, bought the project.

The 91 Express Lanes actually publish a toll schedule (see below) – consistent with **variable tolling rather than dynamic tolling**. However the fact that the schedule is so complex, and **is subject to change at any time in response to traffic conditions**, makes this more akin to a dynamic tolling project.

A "91 Express Club" offers a 20% discount to travelers using the lanes more than 20 times a month.

HOT Lanes: The basic HOT lane concept is that excess capacity in HOV lanes, free to car- and vanpools, is sold to non-HOVs on a space-available basis. The 91 Express Lane project reflected part of this concept when it opened, by allowing 3+ HOVs to travel free. Two-person carpools who chose to use the lanes were considered to reap savings by splitting the full toll two ways.

SR-91 Express Lanes – Orange County, California

After the lanes had been operating for two years the pricing structure was changed to charge 3+HOVs half the toll. HOVs must be registered to qualify as the electronic collection and enforcement equipment cannot count passengers.

Conversion from Private to Public: More recently, after the project was acquired by a public authority in 2003, the policy was changed again to allow 3+HOVs to travel free except between 4:00 and 6:00 p.m. on weekdays, eastbound, when they are charged half the toll.

Motorcycles, emission-free vehicles, and cars with disabled-license plates also travel as 3+HOVs.

Making the daily decision to use or not to use the lanes: Changeable highway signs display the current toll prior to the entrance to the lanes. The 91 Express Lanes is a single continuous stretch of highway with no intermediate access points.

Results

Traffic: Opening the project, which increased corridor capacity by 50%, increased overall peak period traffic immediately, and reduced average vehicle occupancy (AVO). Traffic in the corridor has continued to grow but AVO has not increased to prior levels.

Ridesharing: There was a one-time 40% increase in 3+ HOVs but they represented only 4% of the total traffic. Imposing tolls on HOVs did not change the total number but about 2,000 switched from the paid lanes to the free lanes.

Who uses it: Frequent users (20+ trips per month) represent about 12% of all users. About 40% of those using the corridor use the Express Lanes at least occasionally.

In 1995, 40% of the Express Lane users were middle income, but by 1999 – after tolls had increased – only 25% were.

Traffic volumes: The Express Lanes carry about 1400-1600 vehicles per lane in the peak, equal to the adjacent freeway. The added capacity in the corridor initially reduced congestion on the unpriced freeway, but congestion has once again grown enough to push some drivers off the facility in the peak (onto arterial streets).

Peaking Patterns: The afternoon peak became much sharper after the 91 Express Lanes opened. Tolls were then tweaked to spread the peak, but with limited effect, demonstrating the inelasticity of evening peak demand.

Travel Time and Safety: Demonstrated travel time value for lane users is about $6-$14/hour [as of Dec. 2000]. Surveys show that travelers routinely overestimate their time savings, and tend to believe the Express Lanes are safer; perceived safety is a major reason for using the lanes.

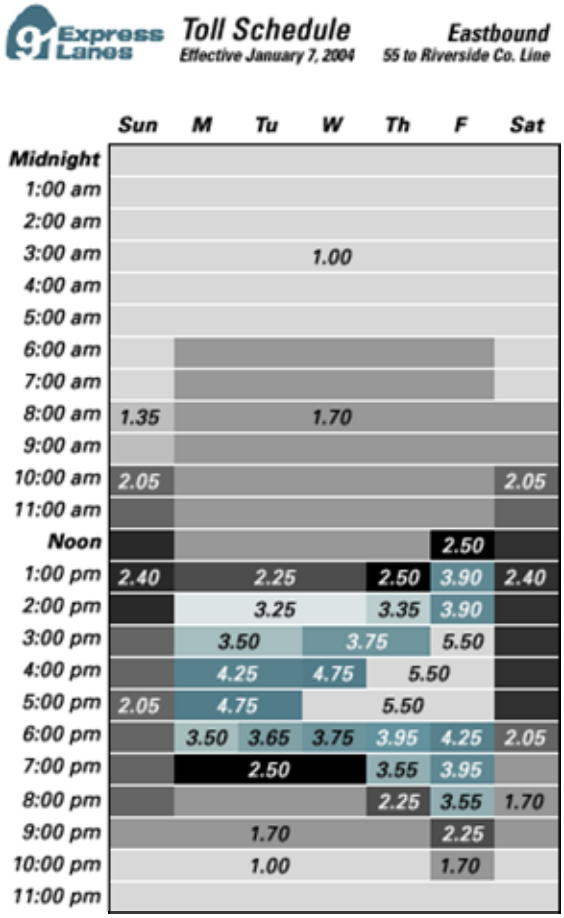
Emissions: Modeled corridor emission levels are equal to what would have been the case if general purpose lanes *or* HOV lanes had been added to the unpriced freeway instead.

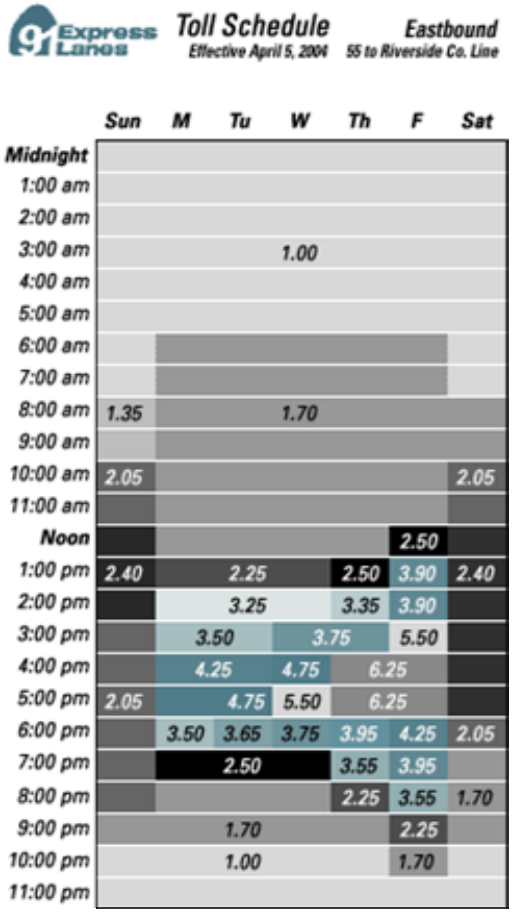
Public Opinion: Initial approval of the dynamic/variable tolling was at a high of 55-75% when the project opened, but subsequently dropped to 30-50% [as of 2000].

Approval of private companies operating toll roads for profit also fell from a high of 50-75% to 30-45% after the project had been operating for five years.

91 Express Lanes Toll Schedules

Comparing Eastbound Schedules for January 2004 with April 2004 shows how the toll schedule is tweaked in response to congestion patterns





Be sure to check the toll on our message signs before entering the 91 Express Lanes. Toll schedules subject to change without notice. *Please refer to the 91 Express Lanes Application and Agreement.* ***Tolls vary to optimize traffic flows.*** *Tolls are for one way travel during times and days shown. Copies of our toll schedules are available at our walk in Customer Service Center or print this page.*

Another view of the SR-91 Express Lanes in Orange County, CA

The SR-91 "Toll Plaza" is an overhead gantry
HOVs use a separate lane

Dynamic Tolling

Pros	Cons
Managing Congestion, Maximizing System Performance: In its purest form, dynamic tolling allows capacity to be calculated in real time, and then sold to those willing to pay at whatever rate will maximize the desired performance characteristics (which could be system capacity, travel time on the facility, total revenues or other desired outcomes).	**Communications & Predictability**: The greatest snag on the road to perfection for dynamic tolling is the ability to tell customers what they're going to pay, when. If drivers receive information only after they *start* their trip, the ability to maximize the performance of the facility or entire transportation network is diminished. The 91-Express Lanes project has two responses to this. First, drivers can always pay nothing because there is a free parallel route. Second, although the project 'reserves the right' to change tolls at any time in response to congestion on the lanes, it publishes a detailed schedule of tolls which it almost always follows. Longer term, dynamic tolling projects will adapt the systems already in place to inform drivers about road conditions from their homes or offices, by adding price information. **Hardware**: Hardware costs are higher with dynamic tolling. More sensors are required and additional customer communication is required for multiple entry-exit points.

1.4 HOT Lanes – High Occupancy Toll

High Occupancy Toll Lanes sell excess capacity in HOV lanes to solo drivers, willing to pay for a faster trip. A variation to this is on the Katy and Northwest freeways in Houston where HOV3+ travel free while HOV2s can pay to use the HOT lanes but no SOVs are allowed.

A few successful HOT lane projects are now operating and many more are proposed. While projects generally focus on conversion of existing HOV lanes to HOT lanes, the SR 91 project detailed above is an example of applying a partial HOT lane concept to new construction.

The concept of HOT lanes developed largely out of the public perception that HOV lanes are underutilized. No amount of carefully crafted data about total persons-per-lane-per-hour, much less transit reliability statistics, feels convincing to a driver who is sitting at a complete standstill in a congested general purpose lane, watching a carpool or bus whiz by in the adjacent lane every 3 or 4 seconds. Quite simply, it looks like there's a lot of space in that lane to fit a lot more cars. And, in fact, often there is.

That same frustrated driver may pick up a cell phone while actually stuck in traffic to call his or her legislator, or more likely the friendly neighborhood talk radio host (who happens to be conveniently broadcasting a phone number), to complain, "Didn't I already pay for that lane with my tax dollars? It's half empty. Why can't I drive in it?"

Recognizing the fragility of most HOV networks – put covers over a few signs and they can become general purpose lanes overnight – transportation planners need ways to preserve HOV capacity while meeting the political imperatives of congestion-weary drivers, voters and taxpayers.

An unforgiving press dubs them "Lexus Lanes"
Despite the apparent public demand for them, a quick review of HOT lane projects confidently announced, followed by a look at the struggles of implementation, highlights some of the public perception problems inherent in successfully introducing HOT lanes.

Early on, the HOT lane concept was tagged with the moniker "Lexus Lanes" – implying luxury travel for the well-to-do. HOT lane proponents respond that the lanes would be much more attractive to a parent rushing to pick up their child at daycare, trying to avoid a $1.00-a-minute fine for being late. Compared to that, they say, what's an extra buck or two to get there on time. HOT lanes have also been called "pay-as-you-drive-faster-lanes".

That said, successful HOT lane projects are operating in Houston, San Diego and Orange County, California..

HOT Lane Project Example

I-15 FasTrak
San Diego, CA

Hot Lanes & Dynamic Tolling

In 1996, San Diego converted two reversible HOV lanes in the median of the I-15 freeway to HOT lanes. The HOT Lane segment is 8 miles long with a single entry/exit point at each end. The facility had been operating as HOV-only since 1988, but had never filled to capacity. The main freeway is 8 lanes.

Monthly passes. The project has grown with the hardware. Initially, 500 monthly passes were sold to solo drivers for $50 per month. This was later increased to 1,000 passes at $70 per month. Solo drivers displayed a monthly permit which allowed them to use the lanes.

FasTrak. In 1998 FasTrak came on line, tolling was automated and monthly permits were replaced with transponders, which also must be displayed in the windshield. Until 1999, carpools and SOVs were required to use separate lanes to enter the facility. This was replaced with a system where people who normally drive alone, but who happen to have a passenger, can put their transponder in a "silver static bag" that prevents the equipment from reading it and deducting the toll from their accounts.

Tolls: The tolls range from 50¢ to $4.00 and are recalculated every six minutes based on congestion. FasTrak reserves the right to push the tolls as high as $8.00 under unusually congested conditions. The published toll schedule (see below) shows the *highest* possible toll for each time period. Drivers are notified of the current toll through roadside signage before making the choice to enter the lanes.

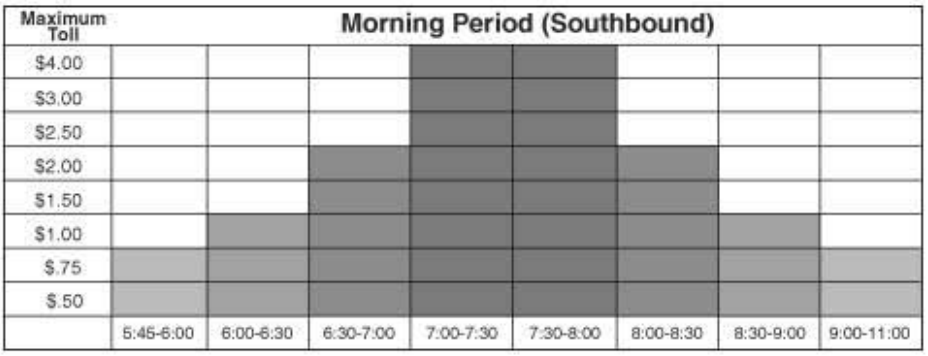
Fines: The fine for driving alone in the HOT lanes without a transponder is $271. The fine for forgetting to take your transponder out of the silver bag starts at $20 and goes up with repeat violations.

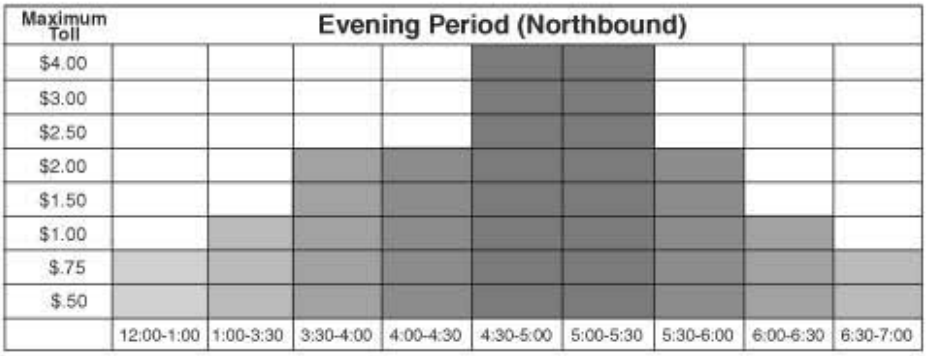
Revenue: HOT-lane toll revenue is used to pay first for operations and enforcement, and then for an express bus route in the corridor. Annual operating costs are currently about $750,000, plus $60,000 to pay the California Highway Patrol for enforcement. An additional $1.2 million is collected to fund the bus service.

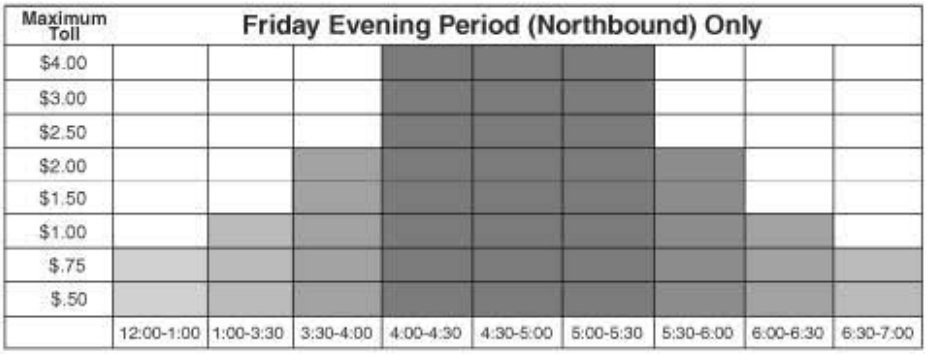
Results: Plans are now underway for a major 12-mile extension of the project and HOT lanes are also planned for other area freeways.

Traffic counts: In the first three years of the project traffic on the HOT lanes increased 130%. HOVs made up about 75% of the traffic, and toll-paying solo drivers the other 25%. With this percentage of toll-payers, the project generates enough revenue to pay its own costs and to support the express bus service in the corridor.

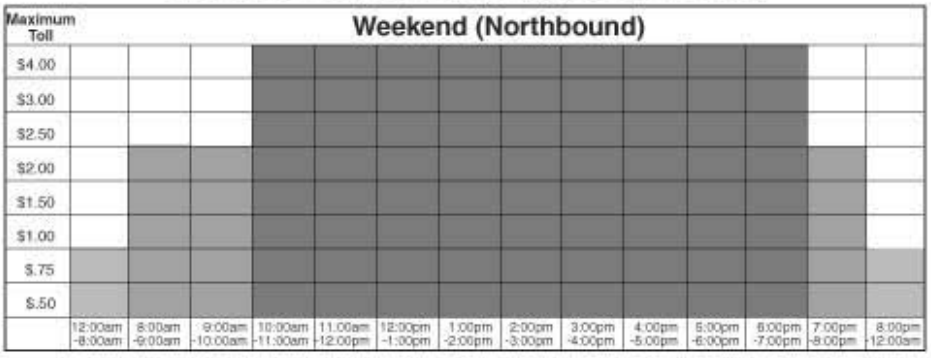
Express Bus Service supported by I-15 FasTrak Toll Revenue in San Diego







Weekend Toll Schedule (as of 3/05/2004)



I-15 FasTrack, San Diego
Toll Schedules showing *Maximum* Tolls
Actual tolls may vary every 6-minutes and are shown on roadside signs

HOT Lanes

Pros

Managing Congestion, Maximizing System Performance

Filling "empty" HOV space with paying SOVs (or HOV3+ space with HOV2s) effectively increases total facility capacity and, at least initially before traffic growth fills the additional space, reduces overall facility congestion and delays for everyone.

Existing HOV facilities are generally considered for HOT lanes when they reach a threshold of congestion with 2-person carpools, and when existing HOV use is low, with corresponding general purpose lane congestion. At a certain level of demand the lane slows below acceptable levels, trapping all users, including bus riders, in congestion. In order to keep the lane moving, its necessary to change the definition of a carpool from 2+ to 3+.

At that point, however, because there are so many fewer 3+ person car- and vanpools, the lane will suddenly have excess capacity. This is the capacity that can then be "sold" in a HOT lane operation.

Cons

Public Perception

Public perception of HOT Lanes is complex. Surveys of drivers in areas where HOT lanes are operating show strong acceptance of the concept, but surveys in areas considering HOT lanes often show strong resistance to the idea.

Some drivers are resentful of the entire HOV system, asserting, "I paid for all the lanes with my tax dollars, I should be able to drive in all the lanes."

To others, the perception is that something is going to be taken away from carpools – "the lane was built to encourage ridesharing which saves the environment" – and sold to single occupant drivers, "rich, Lexus-driving ones."

1.5 Pay-as-you-go or Distance-Based Pricing

Briefly, this is an idea that would charge drivers for the miles they drive, not directly related to their use of a certain facility or to passing a particular cordon.

Support for the idea has been based on a number of factors including:

- as fuel tax revenues decline relative to miles-traveled because of more fuel efficient vehicles, new sources of revenue are needed to build and maintain the transportation system; and

- drivers who pay directly for every mile driven might drive less, reducing the congestion and pollution impacts of transportation, as well as wear and tear on the roads.

To date, however, figuring out how to collect these tolls has been a major barrier to implementation, overshadowing all other considerations.

Increasingly, with the availability of satellite global positioning systems (GPS), the low cost of building transponder-like equipment into every vehicle along with associated automatic vehicle identification (AVI) systems, plus the widespread use of electronic payment for every other daily purchase, the technology will catch up with the concept, at which time the debate can shift to policy issues.

The same technology can also allow programs to be fine-tuned in a way that would not previously have been possible, for example charging drivers not only based on total miles but also where and when they drive. Linked with in-car communication systems this would add a direct transportation system management component to any project.

A distance-based pricing scheme for trucks in Switzerland is discussed in the Section 3, on Tolling Hardware.

this page blank

2. Where to Charge

This section reviews the different *places* tolls are charged. Most people in the western United States associate tolls with **crossings**, primarily bridges but also tunnels.

On the east coast, where much of the highway system was constructed well before the 1956 Federal-Aid Highway Act, **facility-based** tolls are common. Drivers there are long accustomed to passing through toll plaza after toll plaza, dropping coins in a basket or handing them to an attendant.

More recently, although the first modern project is already nearly 30 years old, a few cities have started to experiment with **cordon or ring** tolls – that is charging drivers to enter and/or drive within the congested city center.

In addition, a great deal of research and planning is now underway on the idea of **distance-based** tolls, that is charging drivers based on miles driven rather than for their use of a specific facility. One project has gotten off to a strong start in Switzerland, while one in Germany is floundering and is, temporarily at least, on hold. [See Chapter 3 for details about the Swiss system.]

Tolling Fact

In March 2004, voters in seven San Francisco Bay Area counties voted 57-43 to raise tolls on the region's bridges from $2 to $3. The increase will raise about $125 million a year to be spent on projects in the bridge corridors: traffic bottlenecks; new public transit; seamless and safe transit connections. The current $2 toll is split between projects approved in the 1988 Regional Measure 1 and seismic retrofit.

2.1 Tolls at Crossings – The Columbia River

As the purpose of this paper is to help its readers develop a broad familiarity with tolling, and as its target audience is no doubt already familiar with the traditional tolling of bridges, this section offers a short diversion back and forth across the mighty Columbia – the tolled, and non-tolled bridges up and down the river from Portland and Vancouver.

The Lewis and Clark Bridge

The Rainier-Longview bridge, was originally privately-owned. When it opened in 1930 **tolls were steep**:

Cars and Trucks	**$1.00**
Pedestrians	**10¢**

Because of the high tolls, private ferries continued to operate across the river after the bridge opened. Workers would also drive to one end of the bridge, and then carpool across to save on the tolls. Now publicly owned, the bridge went toll-free in 1965. [As a side note: The bridge was designed by Joseph Strauss who subsequently designed the Golden Gate Bridge. Comparing the two bridges it's obvious that San Francisco must have paid him more.]

Pacific Highway Bridge

The original Pacific Highway drawbridge between Portland and Vancouver opened Valentine's Day, 1917, with a **5¢ toll**. Ferry service that had served the crossing for years made its final trip the same day.

Streetcars crossed the bridge until 1940, when the tracks were paved over. Originally built and owned by the two counties, the bridge was taken over by the two states in 1929, the tolls removed, and the bonds paid off with tax dollars.

Tolls in 1960

Vehicle Type	Toll
Cars	20¢
Light Trucks	40¢
Heavy Trucks	60¢
Busses	60¢

A second bridge

To serve the growing traffic on the new I-5 freeway, a second parallel drawbridge opened in 1958. After a two-year refurbishment of the old bridge – including raising the height to reduce drawbridge openings – tolls returned in 1960 to pay off the new bonds for both bridge projects. In 1967 the bridge debt was retired and the tolls were removed.

I-205 Glenn Jackson Bridge

The Glenn Jackson Bridge opened, **toll free**, in December 1982 connecting I-205 in Washington and Oregon for the first time. In 1983, with the second crossing open, traffic on the I-5 bridge dropped by 20,000 vehicles a day, all of which was diverted to the new I-205 bridge along with 18,000 new trips. Overall, there was a 14% increase in total river crossings that year. The I-205 bridge now carries about 10% more traffic than the I-5 bridge.

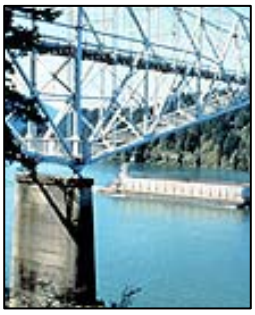
Daily Traffic Volumes (2002)

I-5 Bridge	124,000
I-205 Bridge	136,000

Bridge of the Gods

Leaving Portland or Vancouver and driving east, the next opportunity to cross the Columbia River is over the Bridge of the Gods. Opened in 1926, the entire structure sits – apparently not at all precariously – on four bolts.

The toll is only $1.00, but that is not likely to influence Portland/Vancouver drivers who would have to travel 100 miles out of their way (round trip) to take advantage of it. Toll revenue pays to maintain the bridge – 25¢ per bolt per crossing.

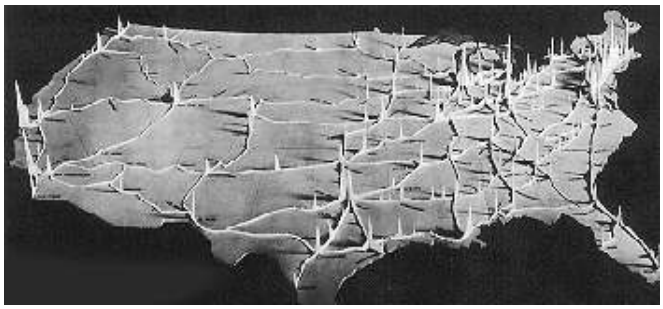


Two of the four bolt locations holding up the bridge can be seen in the bottom left of this picture

2.2 Facility Tolls – Highways

To toll or not to toll

In 1938 Congress directed the Bureau of Public Roads (BPR) to study **a national system of tolled superhighways**. BPR concluded that on much of the proposed 6-route system – 3 routes north/south and 3 routes east/west – the tolls would not raise enough money to cover costs.[1]



Peak Traffic Volumes in the 1930s

The 1939 Plan. In response to these findings, President Roosevelt went back to Congress in 1939 with a plan for free highways. The plan called for any route with more than 2,000 vehicles per day to be at least 4 lanes. World War II intervened but planning continued; aside from the transportation benefits, the returning soldiers would need jobs to keep the country from sinking back into the Depression.

States stick with tolls. Construction finally started on the new interstate highway system in 1947. But with the need huge and the federal contribution small, some states decided to forego the federal largesse and build tolled highways in the interstate corridors. Work continued on defining and funding a major network of national highways, but in 1950 war once again intervened, this time in Korea.

$175 million vs. $50 billion. Once a truce was in place in Korea, Congress again turned its attention to the highways, authorizing $175 million to the states for construction, with a 60-40 federal match. President Eisenhower, citing the "waste of billions of dollars in detours and traffic jams," responded to Congress with a request for $50 billion over 10 years.

Tolls vs. taxes. Although it took two more years and several iterations, a compromise finally allowed Eisenhower to sign the 1956 bill that is widely considered the true birth of the Interstate Highway System. Everyone agreed about the need for highways – the question was how to pay for them. Elements of that debate continue to echo today:

- A 1955 plan was killed by trucking, petroleum and tire lobbyists who didn't like the proposed taxes.
- In 1956 the truckers, in a turnaround, supported *doubling* the gas tax.
- Ultimately only Senator Russell Long of Louisiana voted against the bill – he didn't want to raise the gas tax.

[1] The details in this short history are from: *Creating the Interstate System*, by Richard F. Weingroff

Eisenhower wanted tolls. Eisenhower later said: "Though I originally preferred a system of self-financing toll highways… I grew restless with the quibbling over financing. I wanted the job done." When it was clear that tolls would be a sticking point, he agreed to rely solely on fuel taxes.

From 1956 to 1991. The 1956 compromise allowed toll roads, bridges and tunnels to be designated part of the Interstate Highway System, but only if they met system standards and were critical system links. The alternative, constructing parallel federal highways along the pre-existing turnpikes, was obviously absurd.

No tolls allowed. Still, the Act required new facilities built with federal funds to be toll free, and deferred the decision about whether states should be reimbursed for turnpikes built without federal funds or with less than the 90-10 match. The secretary of transportation was told to study the question. The answer came back in 1991 when Congress passed ISTEA which finally approved the reimbursement.

April 2, 2004. The U.S. House passed a bill allowing tolls, with conditions, on interstate highways. Action now moves to the Senate.

***Life Magazine*: Road-of-the-Future**
Are we there yet?

Fuel tax instead of tolls. In 1956 the federal gas tax was 2¢ per gallon. To pay for the new Interstate highways the gas tax went up fifty percent, to 3¢. How much was 3¢? The price of a first class stamp. The federal gas tax is now 18.4¢; a first class stamp is almost exactly twice that.

Then and Now

Highway Tolling Project Example

Garden State Parkway

New Jersey

New Jersey's Garden State Parkway is 172 miles long, with 305 entrances and exits, and 32 toll plazas – 11 on the mainline and the remainder on on/off ramps. Today, mainline cash tolls for cars are 35¢ and ramp tolls are 25¢. Cash truck tolls range from 50¢ to $2.10, depending on the size of the truck and whether it's a mainline or ramp toll plaza. A car traveling end to end would pay about $3.85; trucks are only allowed on the southern end of the Parkway.

Construction started in 1946, but by 1950 only 18 miles had been built. The state needed to find more money – they turned to tolls. In 1954, two years after toll-backed bonds were in place, the highway was 80 miles long and a year after that 152 miles were complete. Originally 4 lanes along its entire length, the Parkway has since been widened to as much as 14 lanes in some locations.

Getting a share of gas and hamburger sales

In addition to operating the road itself, the Parkway contracts with gas stations and restaurants to operate within its right-of-way, and takes a share of the sales. This common toll road practice was specifically prohibited in the federal legislation establishing the Interstate system. As part of its contract, the Parkway controls fuel prices – which it sets at 2¢ above market rates.

Stopping to pay tolls is good, it lowers blood pressure

Though motorists might not agree, toll plazas are good, or so said the Parkway's designers:

One criticism of today's expressways is the tedium and hypertension they create within the driver. A short "break" en route, every twenty miles or so, relieves the monotony and removes the cause of many accidents.

Garden State Parkway Main Line Toll Plaza

Garden State Parkway Off-ramp Toll Plaza

From toll plaza to *E-ZPass* to *Express E-ZPass*

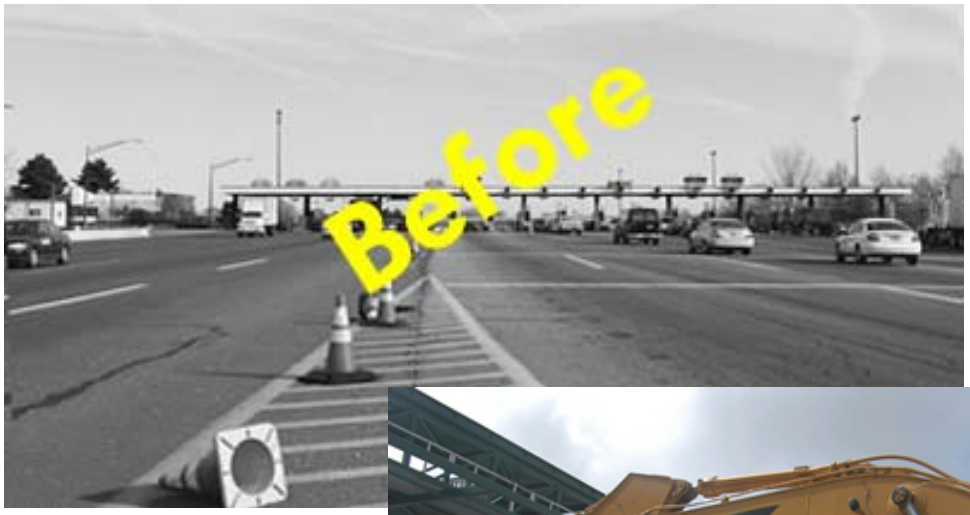
Not all drivers carry exact change, and the Parkway wants to accommodate them. Thus, in lieu of dropping coins in a basket, drivers were invited to take an envelope in which to mail back a quarter or thirty-five cents. The envelopes proved very popular, but only 4% of those who took them, returned them, an annual revenue loss of about $125,000 (or half a million unreturned envelopes).

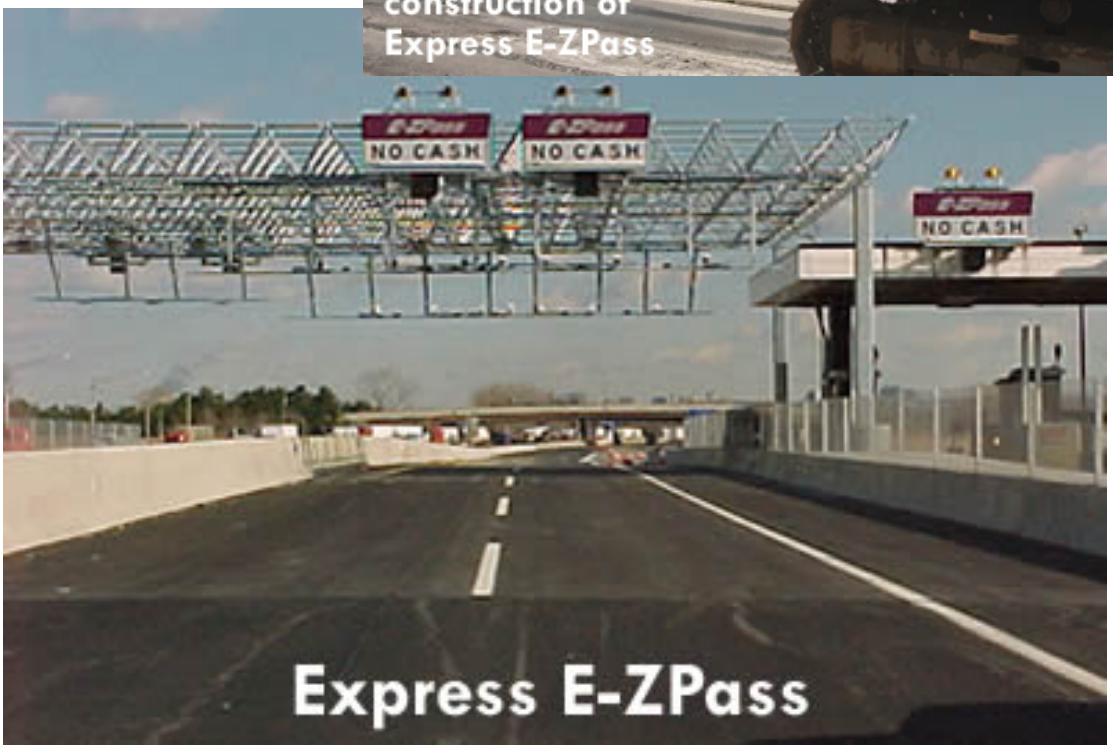
The first improvement came with *E-ZPass*, an electronic toll collection system in widespread use in New Jersey and nearby states. "Standard" E-ZPass allows drivers to pay tolls with a transponder, but requires them to pass through the existing toll plazas and, for traffic safety reasons, to stop or slow to 5 mph. Even with speed limitations, E-ZPass doubles the capacity of a single toll lane.

Express E-ZPass replaces the toll plazas with overhead gantries that read the transponders at highway speeds. However, for traffic safety reasons, implementing Express E-ZPass on an existing facility requires the separation of the through traffic from the toll-plaza traffic. In 2000, the cost estimate for re-building the entire Garden State Parkway for Express E-ZPass was estimated at $100 million (or about 800 years' worth of unreturned toll envelopes).

The entire Parkway has not been converted but, with the Governor occasionally sitting at the controls of the bulldozer (see below), construction of Express E-ZPass lanes is complete at some high volume locations.

With the help of the Governor,
New Jersey Toll Plazas add Express E-ZPass





The complications of toll financing

Originally, the Parkway was the creation and possession of the New Jersey Highway Authority, which was a different government entity from the New Jersey Department of Transportation. The Authority built and operated toll-ways, NJDOT builds and operates free-ways. Over the years, NJDOT and its predecessor, the State Highway Department, built three sections of toll-free parkway using federal funds.

In 1987, these sections were sold to the Authority for one dollar, with the requirement that tolls would never be charged on those 19 miles.

Subsequently, federal funds have been available for upgrades on the free sections, but not on the tolled sections. (In 2003 the Parkway was acquired by the New Jersey Turnpike Authority, which owns and operates the other tolled highways in the state.)

Debate over what next

In 1999, state legislators floated proposals to increase Parkway tolls to $1.00 and reduce the number of toll plazas, which would effectively more or less double the tolls. (As each driver pays a different amount depending on where they enter the Parkway and how far they travel, and as changing the toll structure would change travel behavior, precise calculations are difficult.)

Two years later the governor asked NJDOT to prepare a plan to eliminate tolls altogether. State legislators loved it but bondholders hated it, as did the toll collectors' union.

Now, with the Parkway rapidly converting to E-ZPass, a new governor has proposed eliminating E-ZPass discounts to fill a $300 million deficit. There are currently no E-ZPass discounts on the Garden State Parkway.

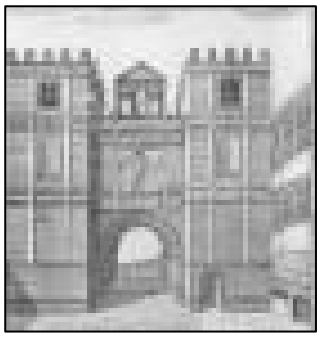
On the New Jersey Turnpike, drivers using E-ZPass save $1.00 off the $6.45 end-to-end toll during peak hours, and $1.60 off-peak.

2.3 Cordon Tolls

Long History but Few Projects

Cordon or Ring tolls are used to create a central district where traffic is limited by imposing tolls on the entire district. The idea has a long history but few modern projects.

Back to the Olden Days. Traditionally city walls, going back thousands of years, had a gated entries and… tolls to enter. Here and there remants of the old city walls and their gates remain, but the toll collectors are long gone. Though their modern incarnation is something much different; the Detroit News recently referred to the toll plazas on the bridges and tunnels ringing New York City as "modern-day city walls."



Aldgate, one of seven gates through the old London city walls

The physical gate is gone but Aldgate is now one of the entrances to London's Congestion Charging Zone

Singapore goes first

The city-state of Singapore was the first modern city to introduce cordon tolls, starting in 1975 with an area-license scheme that reduced traffic in the 2.3 square mile tolled zone by 45% and the number of cars by 70%.

Then Norway

Trondheim, Norway, a city of about 140,000, was the second city to try a congestion ring, starting in 1991. Trondheim initially implemented the toll ring to reduce traffic in the city center, and to raise enough money to complete the ring roads around the city so drivers wouldn't *have* to pass through the center to get where they're going. Without toll revenues the ring roads would have taken 80 years to complete; with toll revenues the time has been shortened to 10 years.

The Trondheim plan includes electronic tolling. Only 2 of 12 original toll entries were staffed; 5 more toll entries have since been added. (In implementing the scheme, some existing roads crossing into the city center were closed.) Electronic payers receive a 20% discount.

The Trondheim Toll Ring was immediately successful in raising revenue, though less so in reducing traffic, both because people living inside the ring, a third of the city's population, don't have to pay and because those living outside the ring are willing to pay.

There has been about a 10% reduction in traffic during tolled hours, and an increase in transit ridership. Traffic has increased about 8% during evenings and weekends, as drivers have moved their shopping trips outside the tolled period.

The Trondheim approach has since been imitated by other cities in Norway including Bergen and Oslo. In Oslo, the toll ring is in effect 24-hours-a-day and has resulted in about a 20% reduction in traffic in the city center.

London is next

London, England, more populous than Singapore, Trondheim, Bergen and Oslo combined, is the first of the world's megacities to use a major cordon-pricing scheme to reduce traffic in the city center. In response to early results of London's ambitious scheme, many more European cities are now actively considering such an approach.

Access Restrictions

A number of cities, including Rome, Florence, Bristol, Oxford, Nantes and many others have introduced access restriction schemes to severely restrict, or eliminate, motor vehicle traffic in city centers. In some cases, these now include tolling elements, but the initial motivation was to protect fragile, old city centers from literally being destroyed by cars.

Florence, Italy

A gateway in the old city wall… missing the gates and the toll collector

Cordon Tolls Project Example – London, England

Congestion charging...

In 2000, Ken Livingston ran for Mayor of London promising to do something about traffic. He won and he has done something about traffic – the London Congestion Charging Scheme. With the project now into its second year, there are plans being developed to double the size of the inner ring.

How the Congestion Charging Zone works

Where: The zone is a 8 square miles in central London including the primary government, business and retail centers. The area is well served by transit including the Underground, buses and intercity trains, as well as London's substantial fleet of black taxis (which do not have to pay the charge).

When: Charge hours are weekdays from 7:00 am to 6:30 pm.

Signs: The system is entirely barrier free. Drivers know they are entering the zone because of the large number of signs before the boundaries, at the boundaries and within the zone itself. In addition, the large red "Circle C' logo painted on the pavement marks the zone.

What to pay: The daily charge is £5 (about $8.80). People who live inside the zone receive a 90% discount but only if they pay in advance for a minimum of one week at a time. (About half of the 136,000 residents of the zone live in car-owning households.) There is no charge if a resident's car is parked in a resident space and not driven. Trucks pay the same fee as cars.

When to pay: Drivers may enter the zone without paying, but are expected to pay before 10:00 pm that day. Between 10 pm and midnight the charge doubles, and after midnight there's a £40 fine tacked on. The fine increases to £80 after two weeks and to £120 at the end of a month. Three-time repeat offenders may have their cars clamped and towed, and the worst of the worst may find their "cars will be sold or crushed…"

Drivers can plan ahead, paying up to 90 days in advance, but there are no discounts for prepayment and, if you change your mind, refunds are only given for payments of five or more days, less a £10 administrative fee.

How to pay: The cornerstone of such an approach must be to make it extremely easy for drivers to pay the charge and the scheme appears to have done that. Any of 9,500 PayPoint locations in the UK will take a cash payment, including 200 located inside the zone at newsstands and elsewhere. Self service machines at parking lots take credit or debit cards. And for 21st century convenience, it's possible can pay on-line, on the phone, or through text messaging on a cell phone. (Once signed up for text-payment, the driver calls, enters a 4 digit code and is done.)

If you'd rather not pay: Drive an electric car. Approved pollution free cars are exempt, as are motorcycles.

Sign on the way out

Enforcement Many experts recommended that the mayor wait to implement his scheme until imminent advances in technology simplified enforcement. However, as politicians everywhere like to make good on their campaign promises if they can, so Mayor Livingston.

Thus, rather than relying on in-vehicle equipment talking to satellites or roadside monitors, the enforcement hardware is based on cameras. Cameras are posted at every entrance/exit to the zone (174 locations) and at about thirty additional sites within the zone. The cameras photograph the license plates of each passing car. Software then tries to match the license photos to the records of those who paid the fee that day. The software gets it right about 90% of the time; the remaining 10% are manually checked. If a vehicle is on the photo list but not the paid list, the owner is sent a notice and must pay the fine. On average about 6,000 people are fined every day (out of about 100,000 entering the zone).

Privacy – Pay the fee and no one will know you were there. The camera records of those who paid are destroyed every day after midnight. The other records are kept until the fee is paid (or, presumably, the car crushed).

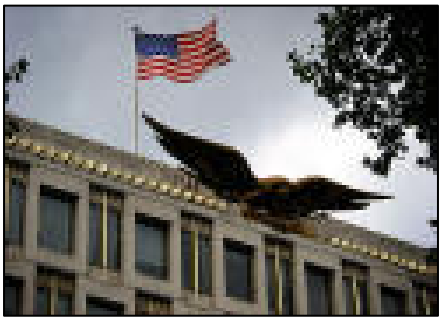
Results

The Congestion Charging Scheme has been in operation for just over a year.

With a starting point of **one million people** entering the charging zone in the **three hour morning peak** – 85% on public transit and 40,000 vehicles per hour – following are some early post-scheme results.

- 29,000 more people come by transit
- 60,000 fewer cars per day
- All day traffic down 16%
- Traffic speeds up 37%
- Buses significantly more reliable – 60% reduction in traffic-caused delays
- 60% of businesses in zone support scheme, 20% oppose it
- 12% of businesses say charge has hurt their business
- The scheme was expected to raise £130 million per year; because of greater-than-expected traffic reductions, it has raised only £68 million (approx. $120 million).

This sign outside the zone tells drivers where it is



**Not everyone agrees it's a good idea.
The Americans, for one, don't like it…**

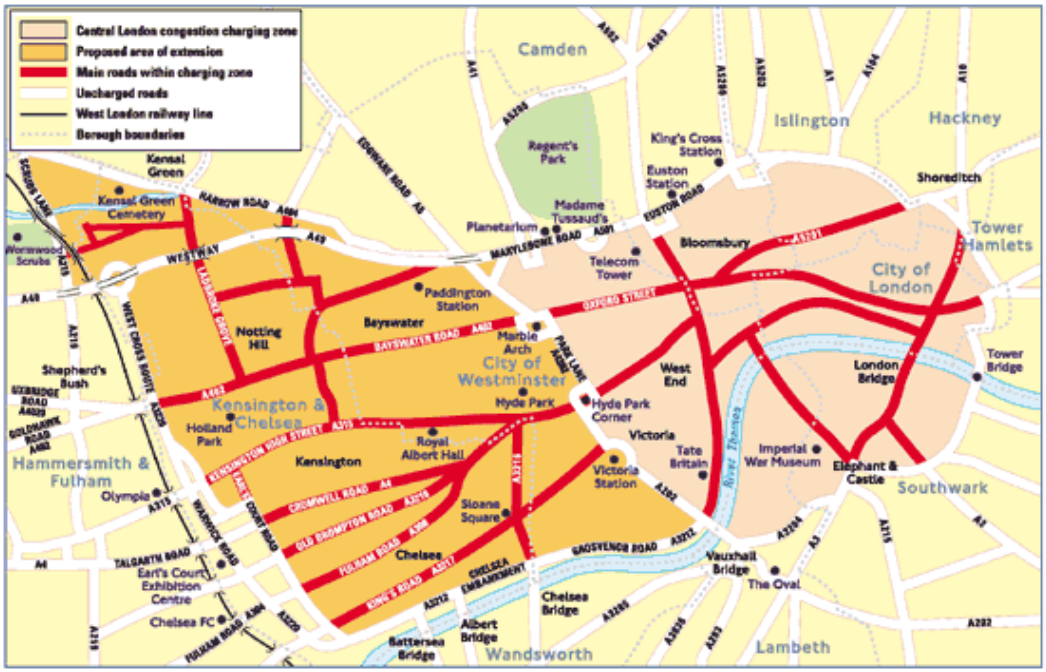
The Association of British Drivers reports: "The US Embassy in London has protested that charging US embassy staff and other diplomats is in violation of the 1961 Vienna Convention, which bars the taxing of foreign diplomatic staff. They've made formal complaints to Ken but he's ignored them."

…nor does the Association of British Drivers

KEEPLONDONFREE
Register your protest against Ken Livingstone's Congestion Charging

Enlarging the zone

Ken Livingston ran for re-election in June 2004, and won. One of his campaign promises was to enlarge the congestion charging zone to more than double its current size.



**The lighter area to the east is the current zone;
the darker area to the west may be added.**

2.4 Distance-based Tolls

Distance-based tolls charge drivers for driving, regardless of where they go or which facilities they use, within broad areas.

Trucks go first

Early schemes to charge heavy trucks for all the miles traveled within a country's borders are now begun or in late stage planning in several European countries. Switzerland's Distance-Based Heavy Truck Fee program was approved by voters in 1998 and is now operating. (See Chapter 3 for details.)

Germany planned to implement a similar scheme in November, 2003 but, beset by technical problems, the scheme is on hold. Austria, France and Great Britain are all in the planning stages.

Waiting for Technology to catch up

Clearly one of the difficulties of implementing any distance-based tolling scheme, is figuring out how to document distance traveled and bill drivers.

The idea of distance-based pricing has been around for a long time, and is often proposed as an alternative (or supplement) to fuel taxes. When fuel taxes are not indexed to inflation they don't keep up with rising prices, and when they are levied on a per-gallon basis they don't keep up with rising fuel economy. Thus, fuel taxes are not able to reflect the actual wear and tear on the roads which is a function of distance traveled, not gallons of fuel burned.

In the past, distance-based toll proposals have suggested mandatory odometer readings and other approaches likely to be burdened with enforcement problems.

Now, inexpensive in-car equipment, GPS technology and electronic billing provide the technology for distance-based road pricing.

3. Tolling – The Hardware and its Jargon

Tolling hardware is no exception to the people-love-jargon rule. This chapter combines a dictionary of acronyms with brief explanations of how different hardware components and systems work. Project highlights cover some of the experiences with different hardware applications.

There is a major overlap between tolling hardware and intelligent transportation systems (ITS) hardware and a huge amount of product research, development and implementation going on. This section does not attempt to capture every piece of available equipment nor detail every system.

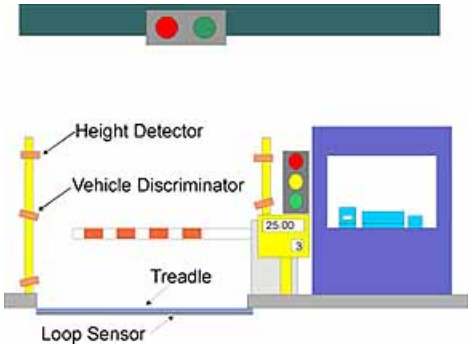
Automated Toll Collection in the Olden Days. Throw coins in the basket.

3.1 Hardware Components

These acronyms are presented alphabetically to provide an easy reference list.

AVC **Automatic/Automated Vehicle Classification**

AVC electronically determines what *type or class* of vehicle is passing – e.g. cars versus trucks. AVC equipment can measure some combination of weight, length, height, number of axles, tire width and can determine whether or not there is a trailer hitch. Some equipment also determines direction of travel and speed and some counts occupants. AVC is used in all-electronic toll collection but is also used along with manual toll collection as a control on toll collector performance and honesty.



This picture shows a schematic of an AVC system used with manual toll collection. In this case its purpose is to prevent the toll collector from taking a truck toll, while entering "passenger car" into the system and pocketing the difference.

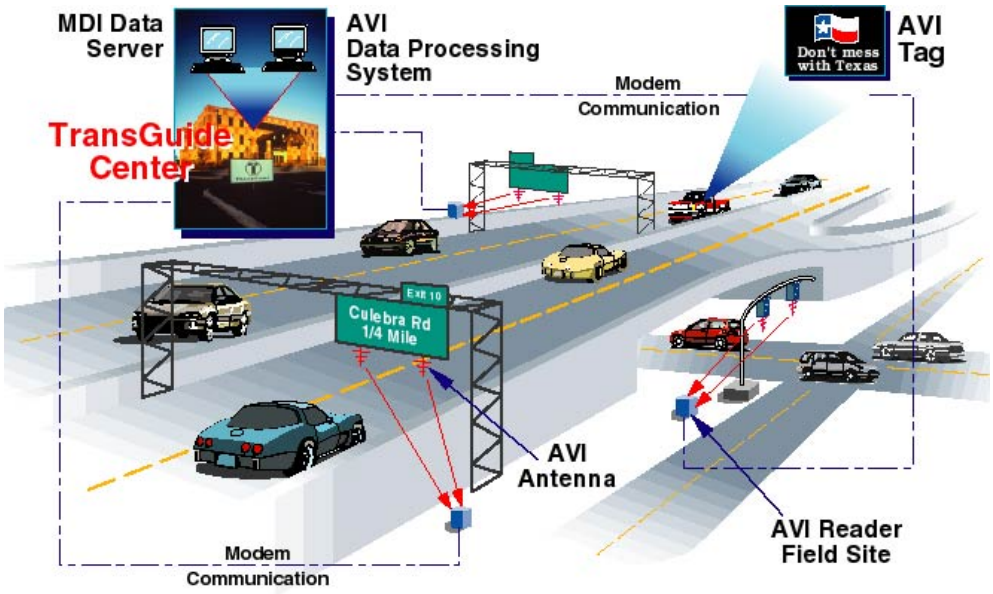
AVC equipment uses some combination of light, sound, lasers, radar and in-ground loop sensors and treadles.

AVI **Automatic/Automated Vehicle Identification**

AVI electronically tells a sensor which *specific* vehicle is passing: "This is Mary Jones's car and she has a paid-up toll account."

AVI systems can read transponders, or they can be camera-based systems that read license plates and do not requires cars to be equipped with an electronic tag or transponder.

This schematic shows a system developed under contract to Texas DOT. AVI is performed by roadside sensors that read tags in each vehicle as they pass the sensors.



ETC **Electronic Toll Collection**

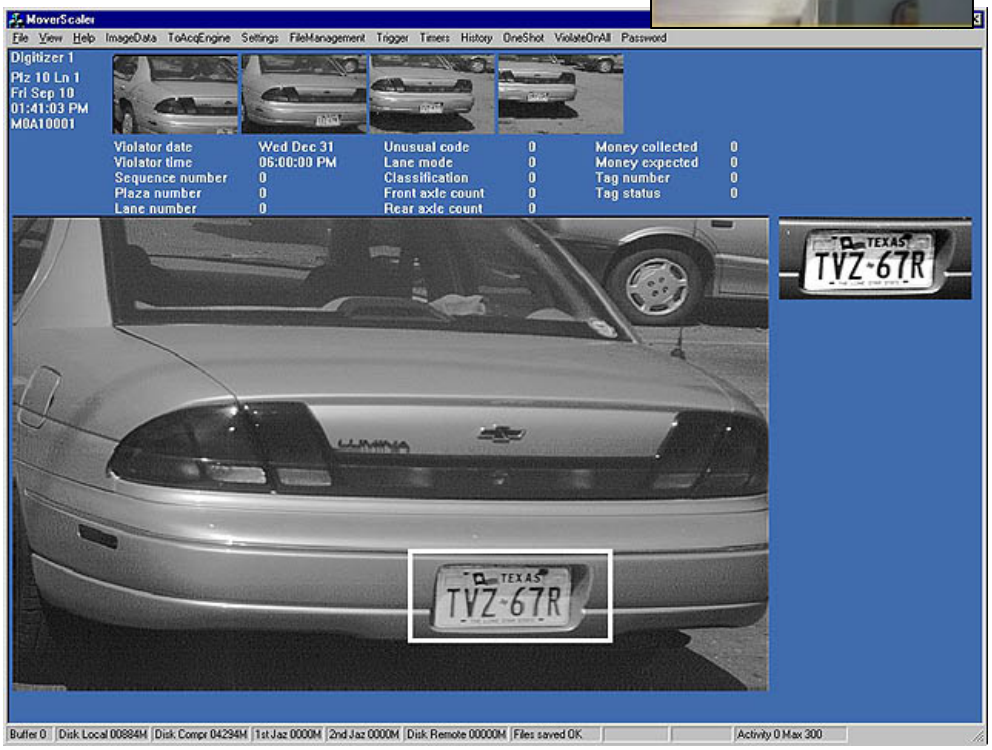
ETC is any system that collects tolls automatically through electronics, versus paying at a toll booth.

GPS **Global Positioning System**

GPS is a satellite based system that tells a receiver where it is on earth. The 24 satellites that operate the system are owned by the Department of Defense, but the service is available for a wide array of consumer products. A GPS receiver in a vehicle can tell a reader where a vehicle is and in what direction and how fast it's traveling. Prices of individual GPS devices have come down in recent years; they are currently as low as $50-$100 and are believed to be headed for around $10.

LPR **License Plate Reader**

LPR is a camera/computer system that takes photographs of license plates and then reads them automatically using Optical Character Recognition software.



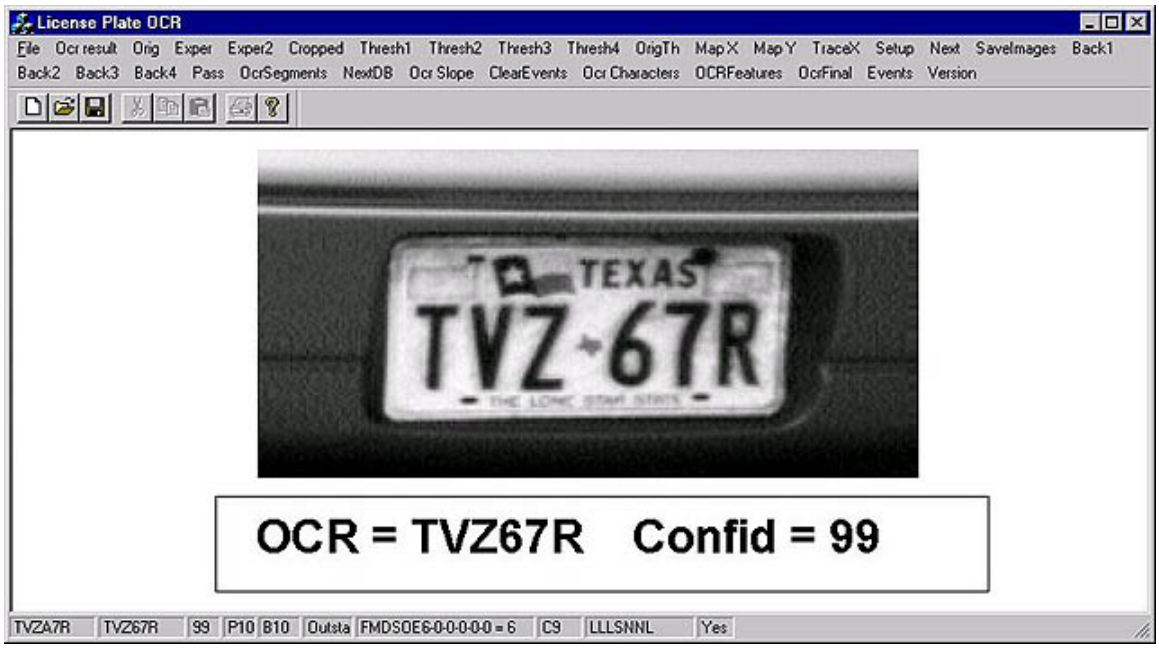
OBU **On-Board Unit**

An OBU is equipment built into a vehicle that combines GPS, communications and computer systems. An OBU can record a wide range of information depending on its specific hardware and software, including when and where a vehicle is driven, as well as speed and other driving characteristics.

OBU can also refer to the simplest of transponders. The OBU shown above has a screen so the driver can see the status of the data being recorded and confirm its accuracy.

OCR **Optical Character Recognition**

OCR is the software that allows computers to translate a photographic image of a license plate into a computer-readable plate number that is read and stored as alpha-numeric data.



Smart Card **Driver swipes a card to pay toll.**

Smart cards require drivers to stop and reach a card out the window to a reader. This kind of smart card technology is the same as that now used in office buildings. Card-sized transponders are also available – see below.

Telematics **Broadly: Integration of telecommunications and computing.**
In relation to tolling: The integration of wireless communications, vehicle monitoring systems and location devices.

Transponder **Latin for "Beige Box"**

A transponder is an electronic device that goes in the vehicle – generally mounted on the windshield – and that is read by a roadside device. It doesn't actually have to be beige *or* a box, and some transponders are credit card size.

New tolling projects, such as the SR-91 Express in Orange County, are barrier free. Cars drive at full speed past roadside detection equipment that reads the transponders. On SR-91, enforcement is immediate and old-fashioned. If the reader doesn't detect a transponder, the California Highway Patrol is on your tail then and there.

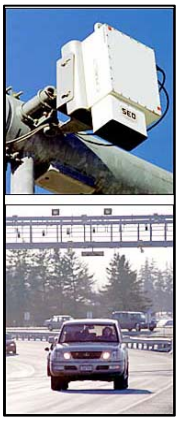
When electronic tolling is introduced in existing projects, ETC and manual collection must be designed to co-exist side-by-side, at least until there's a 100% conversion to ETC.

Stopping for safety, not toll collection. One of the challenges in combining manual and electronic toll collection is haw to safely move vehicles that don't need to stop through the toll plaza and the merge required after the toll plaza. Some facilities require all drivers to stop, whether or not they have ETC; others set low speeds for driving through the toll plaza and the merge beyond; while others funnel ETC vehicles into toll plaza bypasses.

Solar powered transponder reader

VES **Video Enforcement System**

VES can be configured in many ways. The simplest systems simply take a photograph of the vehicle license plate and, often, the driver. Such systems are familiar to many as they are also in widespread use for automatic speed enforcement and catching drivers who run red lights.

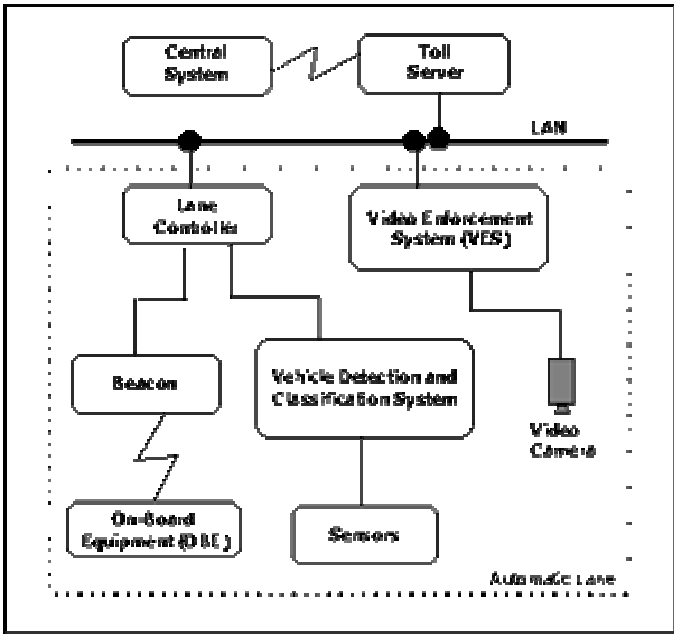


In London's Congestion Pricing Zone, cameras take pictures of every vehicle. License plates are read by computers using OCR and electronically matched to a list of toll payers. If there's a match, the information is discarded. If there's not a match, the photo is checked manually and, if the toll has not been paid, a violation issued.

In other toll configurations, cameras are triggered only when a vehicle passes a sensor that notes the vehicle but does not detect a transponder, or detects that a toll account is not paid up.

Video enforcement has now been configured to operate at highway speeds but with a wide range of success rates, from very high to very poor.

.



VPS **Violation Processing System**

A general term that refers to any method of citing drivers who pass through electronic or barrier-free toll systems without paying.

Hardware Project Examples

Harris County Toll Authority

The Harris County Toll Road is 83 miles long with nine toll plazas on the mainline. Tolls for cars are $1.00 cash or 75c with EZ Tag; the Sam Houston Bridge toll is $2.00 cash and $1.50 with EZ Tag.

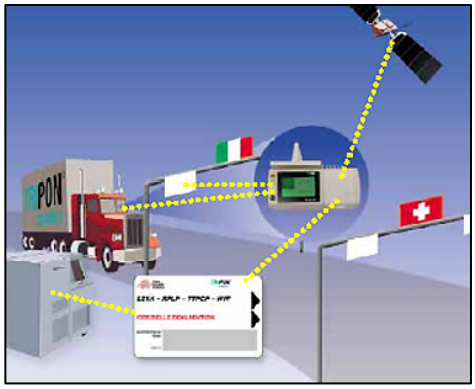
Merging safely requires stop. Because of the physical tollway design, all vehicles must come to a complete stop at the toll plazas, even those that pay electronically, to allow for safe merging of traffic beyond the toll plazas.

Video Enforcement System. Cameras take pictures of the license plates of vehicles that pass through the EZ Tag lanes without a transponder. After three violations a mailed notice is sent to the driver, demanding the payment of all tolls and a $5.00 fine for each violation. If payment is not received within ten days, fines can go to $200. About 5-10 percent of the fine notices result in a hearing; no case has ever been thrown out.

Financing / Tolling. The tollway and bridges were financed with general obligation bonds backed by the County, as approved by a ballot measure in 1983. After the bonds are retired the toll roads will become the property of Texas DOT which may continue to operate them as toll facilities if it chooses, or may convert them to free facilities maintained with tax dollars.

Swiss Distance Based Heavy Vehicle Fee

The numbers of trucks crossing the Swiss alps has grown tremendously in recent years. The Swiss would like to reduce truck traffic impacts on the environment, on the roads and on other drivers. An outright ban on heavy trucks at night and on Sundays was enacted, but it alone did not solve the problem. The long term goal is to encourage shippers to transfer more containers from trucks to rail for long distance transport. Use of rail is already very high, and additional growth is limited by capacity.



In 1998, a nationwide referendum on the idea of charging trucks a heavy vehicle fee was passed, 57-43. In addition to providing a financial disincentive for trucks, the fee revenue is used to maintain the roads and repair the damage caused by trucks. To support growth in rail transport, the voters approved a $20+ billion rail modernization program, including new tunnels, half of which will be paid for with toll revenue.

In 2001, the Swiss replaced the former flat fee for trucks with the new program and implemented a system that charges all heavy trucks, both Swiss and foreign, a fee for driving in Switzerland based on mileage, emissions and capacity (not weight).

Technology Every Swiss heavy truck is fitted with an on-board-unit (OBU) that tracks every mile driven in Switzerland. The use of GPS technology instead of roadside sensors discourages moving to side roads to avoid the fees.

Foreign truckers register when they enter the country and pay for their road use at pay stations, using credit cards or currency. They may also participate in the OBU program but it is voluntary. Swiss truckers get a monthly bill.

The failure rate of the on-board units is less than 0.3% and the costs of collection are about 6%. Capital costs were about $200m, plus $1,150 for each on-board-unit. The units were issued free to 55,000 Swiss truckers.

Fees Fees are based on distance, emissions and the highest authorized weight of the truck (to discourage driving not just full trucks but empty trucks as well). It was difficult, from the data available to determine the average fee for a truck crossing Switzerland, but it appears to be in the range of $170 (€140). The rates are scheduled to increase by 80% by 2007.

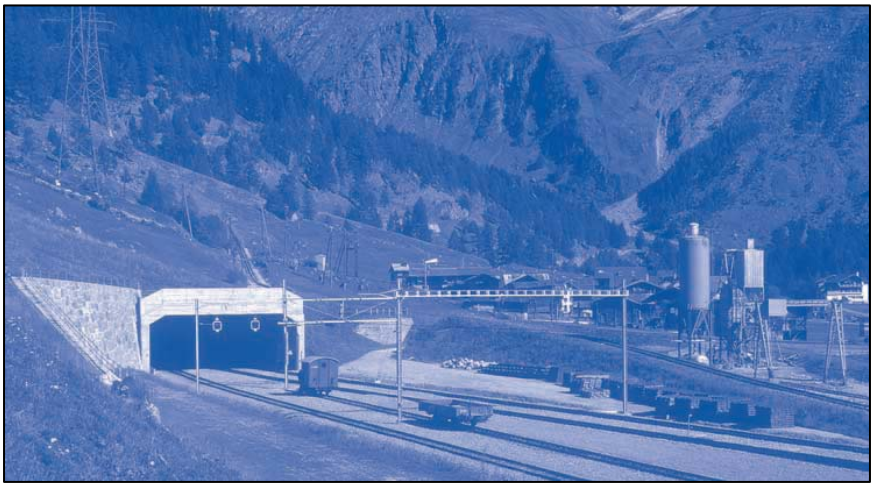
Results In the first year, truck traffic decreased by about 4% and in the second year by about 3%, after increasing 7% a year in the previous years. There has been a shift to lower-emission vehicles and a shift to smaller vehicles. Prior to the

implementation of the fee there was a 45% increase in truck sales, as fleet owners "right-sized" their vehicles to actual loads and chose low emission models.

Long term results are difficult to project because of the short time the fee has been in effect and because the infrastructure for greater rail shipping is not yet in place.

Switzerland – the Problem

Part of the hoped-for solution – More containers moved to rail



Truck tolls will help pay for more rail tunnels through the Alps

Toronto Bypass 407 ETR – "Express Toll Route"

407 ETR, a 63 mile toll road north of Toronto, had been on the region's wish list for decades but never finished.

In 1993, the Province of Ontario invited private sector proposals to develop the highway as public-private partnership. The private sector would construct the freeway and manage it for 35 years, after which it would revert to the province. The province would secure financing, guaranteed by toll revenues.

The freeway opened in 1997, about 40 years after it was first conceived, as the world's first, new, all-electronic tollway. For thousands of daily drivers the highway works as advertised, however technological and political problems plague the road. The province sold its interest in the highway to a private consortium two years after it opened, and extended the lease term from 35 years to 99 years.

The Technology Side – How it works

Not enough room for toll plazas. When the private consortium took over the ETR 407, they inherited a partially built project, including two major freeway-to-freeway interchanges constructed without toll plazas. Inserting the toll plazas after the fact was deemed prohibitively expensive, contributing to the idea of building an entirely electronic toll road.

Open access to all – the bills come later. The next imperative was that the road accommodate all travelers, not just those who signed up in advance. There are no toll facilities of any kind, no barriers to entering the road, and little on-road enforcement. In short, anyone can drive on it, with or without a transponder. For those without a transponder the bills are mailed to the vehicle's registered owner.

Except for trucks. The 407 ETR's license plate photo system is able to capture only the rear license. For trucks this is likely to be the license of the container owner not the trucking company. (Other types of photo enforcement systems geared to trucks can take photos of the cab license.) Trucks, therefore, are required to have a transponder, to ensure that bill goes to the trucking company.

Gantries instead of toll plazas. Every entrance ramp to the 407 ETR has two gantries. As vehicles pass under the first one, it detects whether or not there is a transponder and, if there is, it reads it and records who has passed. Equipment on the first gantry also classifies the vehicle by using lasers to create a three dimensional image. If there is not a transponder, cameras mounted on the second gantry take a photograph of the license plate.

Exit ramps are also equipped with gantries and when a vehicle leaves the freeway, it's either recorded through reading the transponder or, again, through video records.

Reading the license plates. License plate information is read through optical character recognition backed up by human eyes when necessary. Trip matching software links ons and offs, creating a trip length for billing purposes. The Ontario government matches license plates to owners and provides the information to the private operator for billing purposes.

Monthly billing. Road users receive a bill at the end of the month, just like a bill for telephone service, electricity or any other utility. It shows the times and lengths of trips and the tolls owed. Drivers with transponders can pre-arrange payment through a credit card. All drivers may pay their bill on-line after they receive it, or mail an old-fashioned check.

Enforcement. Ontario police provide highway patrol services on the freeway, under contract to the consortium. They have normal police powers, as well as the power to "seize and search" transponders – that is check to see if they're working. Major enforcement, however, comes with the bill. Those who don't pay incur late fees, are referred to a collection agency, and ultimately are subject to not having their vehicle license plates renewed, although the Province has now suspended that penalty due to the volume of billing disputes.

VEHICLE CLASS	PEAK RATE weekdays 6 a.m. - 10 a.m. and 3 p.m. - 7 p.m.	OFF - PEAK RATE weekdays 10 a.m. - 3 p.m. and 7 p.m. - 6 a.m. weekends and holidays
Light	**13.95¢ / km**	**13.10¢ / km**
(5,000 kg and under) Passenger cars, vans, limos, pickups, sports utility trucks, light duty trucks	$3.35 extra Video Toll Charge per trip without a transponder	$3.35 extra Video Toll Charge per trip without a transponder
Heavy – Single Unit	**27.90¢ / km**	**26.20¢ / km**
(Over 5,000 kg) Single unit trucks, tractors, school buses, transit buses, recreational vehicles	Transponders are mandatory $50.00 **Heavy Vehicle Video Toll Charge Per Trip**	Transponders are mandatory $50.00 **Heavy Vehicle Video Toll Charge Per Trip**
Heavy – Multiple Unit	**41.85¢ / km**	**39.30¢ / km**
Trucks or tractors with one or more trailers	Transponders are mandatory $50.00 **Heavy Vehicle Video Toll Charge Per Trip**	Transponders are mandatory $50.00 **Heavy Vehicle Video Toll Charge Per Trip**
Light Vehicles without a transponder whose rear licence plate is not visible to or recognizable by the toll system are subject to a $50.00 flat toll charge plus tolls per trip.		

Variable and Differential tolls. The 407 ETR charges tolls according to time of day, day of week, type of vehicle, distance traveled. A flat "non-transponder" toll is added to the price of each trip for those without them.

Under the rates shown here, a 35 mi. peak trip without a transponder would cost $11.50 (cdn). (The Ontario government is currently disputing these rates.)

Tolling Trucks on Germany's Autobahn

You may be able to drive as fast as you like on Germany's autobahn, but if you're a truck driver, you're going to have to pay. As soon as they get their new tolling system sorted out.

Briefly, Germany intended to implement a heavy vehicle toll on the autobahn, similar to the Swiss system discussed earlier in this section, but using more complex technology.

Toll Collect. The German system, developed by a private consortium called Toll Collect, was scheduled to be rolled out nationwide in 2003. Truck movements would have been monitored by on-board-units communicating with satellites and reporting to toll authorities by mobile phone. Bills would be paid electronically and automatically, with the money deducted from truckers' bank accounts.

With the system not yet working, Toll Collect announced a delay to 2006. The German government then cancelled the contract and, citing projected loses of €156 million a month in uncollected revenue, is suing Toll Collect. Toll Collect's investment to date is estimated at €700 million.

Gantries already span the autobahn. The project remains up in the air (and in the courts) as Toll Collect would like to be able to deliver a system and recover its investment. The roadside gantries with enforcement cameras and lasers already span the autobahn in hundreds of locations, and onboard units are already in the trucks.

But other countries make simpler approaches work

In addition to Switzerland, other European countries have implemented distance-based road tolls for trucks.

Austria. Starting this year, Austria introduced truck tolls averaging 22¢ a kilometer. On-board-units in trucks are monitored by a roadside system of microwave sensors that track distance traveled. Truckers pay at one of 422 pay stations. Toll payments are expected to generate €600 million annually.

France. In France truckers pass through entrance barriers where they take a ticket. On exiting the road they pay for distance traveled. This is an old system that has been used successfully on turnpikes for decades without sophisticated tracking equipment.

Italy. Italy uses a system similar to the one in France. Truckers can pay in advance at the beginning of their trip, or pay at toll stations along the way.

3.2 Enforcement

With traditional toll booths enforcement occurred at the point of payment. Now, with electronic tolling options added to the mix, enforcement needs to include other approaches. The hardware elements required for enforcement were introduced earlier in this chapter. Following is a brief discussion of enforcement approaches.

First… It Must be Illegal to Avoid Tolls

The first step in enforcing toll collection is to make it illegal not to pay. Commonly, toll enforcement statutes may 'forgive' a first time offender (though require that the toll itself be paid), and follow with increasing fines for subsequent violations, and/or raise the fine the longer it remains unpaid. Ultimately, as with parking tickets, statutes may require all unpaid tolls and fines to be paid before a vehicle license can be renewed.

Pay-As-You-Drive Enforcement

For the purposes of this report, pay-as-you-drive systems are defined as those where drivers can pay tolls at staffed, coin drop, or electronic toll booths, and are immediately recognized to be in violation if they fail to do so. In actual operation, such facilities may be combined with pass-through lanes for vehicles with transponders. (Discussion of enforcement for drivers who illegally pass through without paying is included below in the section on pre-pay enforcement.)

Barrier enforcement: Arms that raise and lower provide a physical barrier to toll violators, but also add time and reduce toll lane capacity.

Real-time ticketing: The next most straightforward way to enforce toll payment is to immediately send a highway patrol car after violators and issue a ticket.

New and Improved "Toll Basket"
Gives change or takes credit cards

Pre-Pay Enforcement

As defined here, pre-pay systems are those that allow (and/or require) drivers to register with the toll agency and, through transponders or other technology, maintain a toll account that can be charged (in advance or after-the-fact) for travel on the toll facility. As above, this type of system can be combined with traditional toll booths for drivers who are not pre-registered.

Barrier-Free-to-All-Users Enforcement

Also called "Open Road," examples of systems that are barrier-free and open to all-users include London's Congestion Zone (pg 2-12) and Ontario's 407 ETR (pg 3-10).

blank page

4. Tolling – Why to Charge

Historically, tolls have been charged for one reason: to raise money.

More recently, tolling has been developed as a way to manage demand on overloaded transportation facilities, to manage network-wide performance by influencing people's travel choices, and to protect certain areas from excessive traffic.

This section briefly reports the results of tolling projects relative to revenue generation and TDM and TSM goals.

4.1 Tolls to Raise Revenue

But First, A Brief History of Tolling on Interstate Highways

Monroe's other doctrine – No Federal Toll Roads

In 1822 Congress sent President James Monroe a bill establishing tolls on the Cumberland Road to pay for its preservation and repair. President Monroe, "with deep regret," vetoed the bill, stating that he could not find in the constitution a federal right to operate toll roads. Although he doubted the states could do an adequate job of it, he concluded it's clearly their job to do.

It may seem an historical aside, but Monroe dedicates several pages to asking if the constitutional right to wage war can be extended to a constitutional right to build toll roads. He finds that it can *not*, but it's an interesting antecedent to Eisenhower's birth of the Interstate and Defense Highway System.

Eisenhower's National System of (Tolled) Interstate and Defense Highways

Between James Monroe and Dwight David Eisenhower, the country had clearly established a precedence of massive public works projects, most recently during the Depression. Nevertheless, when President Eisenhower wrote Congress in 1955 in support of more federal dollars for highways, dollars he expected to be supplemented with tolls, he returned to James Madison's theme commenting:

> *"In the case of an atomic attack on our key cities, the road net must permit quick evacuation of target areas, mobilization of defense forces and maintenance of every essential economic function. But the present system in critical areas would be the breeder of a deadly congestion with hours of attack." [February 22, 1955]*

As for how to pay for this vital "road net":

> *A sound Federal highway program, I believe, can and should stand on its own feet, with highway users providing the total dollars necessary for improvement and new construction. Financing of interstate and Federal-aid systems should be based on the planned use of increase in revenues from present gas and diesel oil taxes, augmented in limited instances with tolls.*

Who needs tolls – raise the gas tax once and you're set for all time

Congress didn't approve the tolls, but it did increase the gas tax by a whopping 50%. That, however, was a one-time only necessity. In a mid-century burst of magical thinking, it was confidently predicted that the fuel tax would never have to be raised again. The more highways that were built, the more people would drive, the more they would pay in fuel taxes, and the more money there would be to build and maintain the highways.

In fact, the tax did rise very slowly – increasing from 3¢ to 4¢ in 1956 but then staying at that level for an astounding 23 years, when it was raised to 9¢. Today it stands at 18.4¢ where it's been since 1993.

Tolls on the interstates… (we abandoned the other Monroe Doctrine, too)

On April, 2, 2004, the U.S. House of Representatives passed the Transportation Equity Act reauthorization bill (HR 3550) and on April 8th it was sent to the Senate. The bill specifically authorizes the collection of tolls on federally funded interstate highways (with a number of conditions). At this writing the bill is in the U.S. Senate.

Project Revenue Examples

Both Oregon and Washington have a history of using toll financing to construct bridges with the tolls tied to bond repayments and eliminated once the bonds are retired. Ongoing expenses for operation and maintenance are then covered by taxes.

San Francisco-Oakland Bay Bridge

When the SF-Oakland Bay Bridge was under construction, drivers were promised that tolls would be collected just long enough to repay the bridge bonds. That promise that was not kept. Though the bridge was paid for within the first 20 years, toll revenues keep on flowing.

Tolls continued to finance operations and maintenance of the seven state-owned Bay Area bridges. In 1988, a regional measure was put on the ballot proposing a $1.00 surcharge on all bridge tolls, to fund a region-wide collection of transportation projects. The measure passed and it was followed in 2003 by Regional Measure 2, adding another dollar for still more projects, which also passed.

Funding transit with bridge tolls. The seven Bay Area state-owned bridges collect about $170 million annually in "base tolls" – Regional Measure 2 tolls will add another $125 million for transit projects and seismic retrofit, including nearly $50 million a year for transit operations. Overall, over $1.5 billion worth of new transit spending is identified in Regional Measure 2, with money for light rail, BART, commuter rail, new bus service, terminal improvements, ferries and historic streetcars.

Hood Canal Bridge, Washington

The Hood Canal Bridge is a bridge that did keep its promise to eliminate tolls, although not before Mother Nature eliminated half of the first bridge.

A floating bridge, originally built in 1961 for $26 million, the Hood Canal Bridge opened with a $1.30 toll for car and driver, plus 30¢ for each additional passenger. In 1970 tolls were simplified with $1.50 flat toll – regardless of

how many kids you stuffed in the back of the car. In 1979 a severe storm blew the eastern half of the bridge off its mooring and it floated a short way down the tidal basin and sank to the bottom.

Tolls abandoned in favor of tax financing. After the bridge was rebuilt in 1982, this time at a cost of $143 million for only half a bridge, the new toll rate was set $2.50. The tolls were reduced to $2.00 a year later and eliminated altogether in 1985, by which time the new tolls had only generated about $20 million. Washington taxpayers are shouldering the rest of the burden. (Reconstruction of the bridge started a third time last year, but was stopped when Native American remains were found on site and is now delayed for at least an additional year.)

Pssst… Wanna buy a bridge?
As an aside: Readers may actually BUY this bridge – check on-line where you will find:
$400,000(US)
THE HOOD CANAL BRIDGE SECTION WILL NOT BE AVAILABLE FOR DELIVERY UNTIL APPROX. 2006 SO PLENTY OF TIME TO PUT PERMITS IN PLACE.

Garden State Parkway – Taxes-for-Tolls

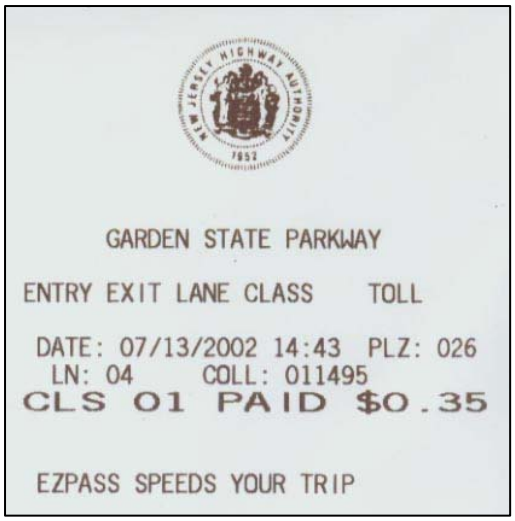
In New Jersey, the Transportation Commission the governor and the legislature have been engaged in an ongoing conversation about the gas tax, in which the governor has raised the idea of a swap – taxes for tolls.

Raise the gas tax and abolish tolls? The state considered a 12.5¢ to 15¢ gas tax increase and the governor weighed in with a proposal to eliminate tolls on the Parkway as a sweetener. The revenue estimates for how many cents on the gas tax would be required to replace lost toll revenue vary widely, with a range of about 3¢ to 6¢.

With a backlog of about a billion dollars in paving projects, and seven billion dollars in deficient bridges, plus unpopular cuts in transit, there was ultimately no agreement to raise the gas tax or abolish the tolls. The debate continues, with gas tax increases as high as 23¢ proposed. And the debate will probably continue to continue.

Fines aren't the most reliable financing

Also in New Jersey, in 2002 the state planned to repay $300 million in bonds sold to finance installation of E-ZPass largely through fines levied on toll evaders, as well as by selling fiber optic capacity on the roads to private companies.



Spending $19 million to collect $6 million. Four years later, in 2002, toll evasion fines totaled $6 million, but the legal costs and payouts associated with false claims totaled $19 million. Meanwhile the telecommunications industry hasn't shown much interest in buying fiber optics space.

As a result, the fines-plus-fiber-optics plan has been cancelled and a new company is now paid about $40 million per year to operate the New Jersey electronic toll collection and enforcement system.

4.2 Tolls to Manage System Performance and Demand

Using tolls to manage transportation system performance and demand is far from an exact science, however there is a lot of evidence from projects around the world that it does work. Some of these we have seen earlier in this report. Following is a quick recap.

Lille-Paris Sunday Evening Congestion	Tolls were increased on an existing toll road by 25% during the peak driving hours when Parisians return home from the weekend. Tolls were reduced 25% before and after the peak. **Result**: 15% shift out of the peak.
Lee County, Florida	Tolls reduced by half just before and after the peak periods, for regular users only (must sign up for prepaid electronic toll collection). Actual cost reduction ranged from 25¢ to 50¢. **Result**: Small shift due to the very low dollar savings.
New Jersey E-ZPass Value Pricing	Off-peak tolls for E-ZPass users reduced by $1.00 to $2.00. **Result**: Traffic shifted out of the peak enough to reduce congestion. Largest shift was drivers traveling in the very early morning hours.
I-15 FasTrak San Diego	HOT lane and dynamic tolling project, on 2 reversible lanes of new capacity in median of existing freeway. **Result**: HOVs make up 75% of HOT lane traffic. Project pays for itself and generates $1.2 m annually to fund bus service.
London Congestion Charging Zone	Drivers charged £5 a day to drive in eight square miles in central London, weekdays 7:00 am to 6:30 pm. **Result**: 29,000 more transit riders; 60,000 fewer cars. Traffic is speeded up and buses are more reliable.

Switzerland Distance-Based Heavy Truck Fee

Trucks charged a per mile rate for all miles driven in Switzerland, based on emissions and capacity. Average fee about $170 to cross Switzerland.

Result: Truck traffic declined slightly after years of steady increases. Money will be spent partially on rail capacity, which is expected to reduce truck traffic even further, once it comes on line.

blank page

5. Tolling – Public Acceptance

Among the greatest impediments to new toll projects in the western United States is a public that is unfamiliar with tolling except on bridges and is unfamiliar with electronic tolling and how it works. All-electronic tolling can replace toll plazas and their delays with convenient automatic toll collection, but raises privacy and billing issues.

As a reminder, this section, like the ones before it, is not an evaluation or analysis of tolling issues – it attempts only to describe them.

5.1 Issues inherent to tolling

Cost, fairness, the effects on low-income drivers, and the privatization of transportation facilities are all issues inherent to tolling, regardless of how the tolls are collected.

Cost and Delay. No matter how tolling schemes are designed, how the tolls themselves are collected, or how the revenue is spent, tolls are essentially a user fee for the use of a specific facility (or the road network as a whole in the case of distance-based tolls). In the western United States there is a long history of tolls on crossings and the public is generally willing to pay. A larger issue in urban areas may be the inconvenience and delays caused by toll plazas; electronic tolling offers relief for this.

Trucks pay more and it goes right to the bottom line. For truckers, the highways are their guideways and there are no alternatives. They can't telecommute or go to 4-day workweeks, or even shop closer to home. In 1998 **Arkansas** floated a proposal to toll three major interstates. One of them, I-40 between Little Rock and Memphis, is one of the most heavily traveled interstates in the nation; among its users are about 30,000 trucks a day. Arkansas projected road tolling would generate a much-needed $80 million a year. Truckers projected $60 million of that would come from them and successfully sidelined the proposal.

Fairness and Low-Income Drivers. The debate about the effect of tolls on low income drivers circles around a consistent set of issues which are somewhat contradictory, but that clearly frame the debate. These include:

- tolls will limit low-income drivers' access to roads;
- tolls will improve transportation access for low-income people because revenues can be spent to improve transit;

- tolls are revenue neutral, simply moving financing from the fuel tax, and don't affect low income drivers more than any other drivers;

- tolls benefit low income drivers by reducing congestion and speeding their trips (to the daycare center where they're going to be charged $1 a minute if they're late).

Two External Viewpoints. Congressman James L. Oberstar of Minnesota, who sits on the House Transportation and Infrastructure Committee spoke about tolls and low-income workers in a recent speech [November 2003]:

Tolls do not provide revenues for a comprehensive, connected highway system. Further, simply tolling a roadway presents some serious equity problems and could effectively close these roads to low-income workers. Everyone should have the same opportunity to use our Nation's roads.

One tolling option that may reduce congestion and could provide a sufficient equity balance is High Occupancy Toll Lanes, or "HOT Lanes"...

While this may be a way to employ tolling to reduce congestion, we want to be sure that it is indeed equitable. HOT Lanes are already in use in Orange County, California, San Diego, and Houston and early evidence demonstrates that they help relieve congestion and are used by a wide variety of people. Moreover, at least some of the toll revenue collected is used to provide additional bus service in the HOT-lane corridor.

Robert Poole of the Reason Foundation expressed a different view [April 1, 2004]:

Folded into just about every pricing or toll-related provision of HR 3550 is a requirement that "low-income vehicles" pay reduced toll rates.

The first question is WHY? Do low-income people get discounts on Amtrak? From the US Postal Service? From airlines? Then why should such discounts be provided on highways?

The second question is how this would be carried out in practice. I suppose people eligible for food stamps could produce evidence that they are eligible when they sign up for their transponder, and the transponder would then be coded to charge lower rates.

> *But seriously, folks - why gum up a sensible and workable set of techniques for managing traffic and raising money for better transportation with this kind of stuff? I know, this is supposed to be an answer to those worried about "Lexus Lanes." But the data from real projects on SR 91 and I-15 in California show that people of all income levels are glad to have the opportunity to pay for a faster trip when they really need it. And we can also use HOT lanes as fast, reliable Bus Rapid Transit corridors, providing superior transit options for lower-income people. Surely that's the better way to go.*

Private versus public roads. Government routinely builds public projects through contracts with private businesses. Tolling offers private investors an additional source of funding to earn back their investment and makes possible far more complex public-private arrangements. Less straightforward than a simple construction contract, broad based public-private partnerships introduce a whole new set of issues for drivers and taxpayers.

- Who sets the tolls?
- How are project revenues spent?
- What is a reasonable rate of return for a private partner?
- Who controls enforcement and what penalties are associated with non-payment?
- How are problems resolved?

The three public-private partnership projects discussed elsewhere in this report appear to have had very different outcomes in terms of public acceptance.

The SR-91 Express Lanes opened as a private project, public approval quickly dwindled, and the project was taken over by a public agency.

The I-15 FasTrak project in San Diego began as a private project, has very high public approval ratings, and continues to operate as a private project.

Finally, the 407 ETR highway in Ontario, Canada has been plagued since its inception with public perception problems and has been a political football for rival political parties. It calls itself "The World's Smartest Highway," but others have dubbed it "The World's Most Controversial Highway."

5.2 Public Acceptance: Issues inherent to electronic tolling

Privacy

The single greatest issue for electronic tolling systems is probably privacy, yet projects up and running today make it clear that most people are not concerned. By the tens of thousands, people voluntarily sign up for electronic toll payment accounts that automatically track their travel. In some systems, however, the only choice a driver has to ensure complete privacy is: "Don't drive there."

Once drivers are signed up (or even if they aren't), the accuracy of billing may become an even larger issue than privacy.

On-vehicle and roadside equipment used to calculate and collect tolls provides a lot of information to tolling authorities, information that is, of course, subject to both private and public misuse and disclosure.

Public concern appears to be overwhelmingly focused on issues associated with government agencies having access to information about an individual's travel patterns. However, an even greater concern, affecting nearly everybody, might be the inevitable desire on the part of private companies to access the data for marketing purposes, and their willingness to pay generously for the opportunity to do so. Many tolling projects are managed by government, but increasingly private enterprise has a hand in implementation and operations, and controls all data collection.

On board equipment and privacy

GPS – You know where you are… and so do we. Global positioning systems are now being used to track vehicle movements as a basis for toll payment. Collected data is kept for varying lengths of time, and may or may not be governed by privacy policies.

Australia has developed a tolling privacy policy for the entire country. Elsewhere privacy protection is left up to individual governments and agencies, or to private contractors who manage toll collection systems.

Tolling, of course, is not the only use for GPS tracking. Soon, all cell phones will have a GPS chip to allow emergency services to find you if you dial 9-1-1.

OBUs – It's watching you drive. On-board-units are now being included as standard equipment on some vehicles and will likely become increasingly common. Proprietary systems such as **OnStar** are sold to drivers who willingly pay a monthly fee to let General Motors know where they are at all times – should anyone at GM care to look. The FBI lost a case, recently, in which it claimed a privilege to use OnStar to track a bad guy, but the case was settled two years after agents had already done it.

OBUs are also used to track *how* you drive, such as whether you speed or put on the brakes too fast – functions of interest to commercial fleet owners and rental car companies. In-car 'black boxes' can work just like those in airplanes, telling police and insurance companies what happened in the last minutes before a crash. (A rental car company in Connecticut used such information to add $150 to the bills of speeding customers, or in the case of one customer who sped three times, a total of $450.)

Project Examples – Privacy

Following are some examples of how privacy plays out in projects operating today. It is essentially anecdotal, but it is these types of anecdotes, widely reported in the press, that inform people's opinions.

France

The French concern for privacy appears to be much stronger than in some other European countries and has affected implementation of electronic tolling schemes, specifically delaying a plan to levy a distance-based, system-wide toll on heavy trucks. Their concerns have been fed by stories such as the following:

Toll records fail to support alibi – did the mayor lie? A Paris businessman was accused of bribing a football coach to fix a game. His alibi was provided by a mayor from northern France who said he was lunching with the businessman in Paris on the day and time he was alleged to have been offering bribes. Smart card toll records between the mayor's town and Paris showed no tolls paid that day by the testifying mayor who was then accused of perjury. He asserted that because he was traveling on private business he'd paid the toll himself with cash, rather than using the town-issued smart card.

London

The London Congestion Charging scheme relies entirely on photographs of license plates to enforce tolls. It deletes all the photos of the toll-payers within 24-hours, only keeping those of drivers who owe money. However, the following situation offered by a toll-opponent illustrates the vulnerability of individual drivers.

Catching the cheating boyfriend: Alice thinks her boyfriend visited his other girlfriend – inside the London toll ring – rather than going to work in the suburbs. Alice calls the helpful information number and speaks to an operator, before the end of the day.
Alice: Hello, I drove into the charging zone today and I can't remember if I paid the toll or not. Can you help me?
Helpful operator: What is your plate number?
Alice: [recites boyfriend's plate number]

Helpful operator: Yes, we have you in the system and you're shown as paying today.

Well the boyfriend may be cheating on Alice, but at least he pays his tolls.

Toronto

You can pay cash and stay anonymous, but where? On the 407 ETR, discussed at length in Chapter 3, it is possible to pay cash tolls up front and so, theoretically, to maintain complete anonymity. But where? There are no toll booths on the freeway itself – you have to make prior arrangements. And of course if you want to be completely anonymous, you have to make prior arrangements in person at the highway's Woodbridge, Ontario office – to pick up the transponder – and, given that you will have paid a substantial cash deposit for the device, you'll need a second visit to return it.

Virginia

Virginia's turnpikes use the Smart Tag system for toll payment. Despite promises that the information would only be used for toll payments, the state DOT turned over collected driver information to law enforcement officials who were investigating the anthrax attacks. This caused quite a furor among Smart Tag using motorists.

Virginia DOT's privacy policy illustrates the magnitude of privacy issues facing drivers. Following are excerpts.

In order to establish a Smart Tag account, a patron provides certain personal data to VDOT: name, social security (or drivers license) number, address, make and model of car, license plate number, credit card number, etc. As the patron uses the Smart Tag to pay tolls, even more personal data is accumulated by VDOT – times, dates and locations of travel through various toll facility locations. With the advent of video enforcement systems, an additional component is added – i.e. a picture of the vehicle if the driver is classified as a "violator" on the toll facility. Over the years, VDOT has been asked by outside entities for various types of Smart Tag data for widely divergent purposes. Some examples include:

- *Marketing firms – to identify and solicit names and addresses of specifically targeted populations.*
- *Estranged spouses – to identify travel patterns of their ex-partners.*
- *Investigative firms – in the course of investigating individuals, businesses and political figures.*
- *Law enforcement agencies – during criminal investigations.*
- *Individual patrons – checking on their personal account activity.*
- *Credit collection agencies – researching potential collections.*

…Recognizing the sensitivity of much of this information, VDOT obtained an exemption from the State's Freedom of Information Act:
§ 2.1-342.01. Exclusions to application of chapter.

A. The following records are excluded from the provisions of this chapter but may be disclosed by the custodian in his discretion, except where such disclosure is prohibited by law:
72. As it pertains to any person, records related to the operation of toll facilities that identify an individual, vehicle, or travel itinerary including, but not limited to, vehicle identification data, vehicle enforcement system information; video or photographic images; Social Security or other identification numbers appearing on driver's licenses; credit card or bank account data; home addresses; phone numbers; or records of the date or time of toll facility use.

Current Privacy Policy:

Smart Tag information is currently limited to employees who need access in order to perform their jobs. Access by outside parties is not routinely allowed. In some instances, however, we allow the sharing of patron information:

- *To law enforcement agencies conducting criminal investigations.*
- *In accordance with subpoenas or court orders.*
- *To track repeat violators.*
- *In summary form (i.e. not specific to any individual patron) for individuals or organizations conducting research.*

Privacy Policy Statement:

*…We do **not** volunteer information about you to other individuals. We do **not** sell data about our customers to marketing firms. We do **not** provide specific patron account or activity data to other organizations except as required by law and for violation enforcement.*

Project Examples – Billing Errors and Security of Financial Information

Overall, the history of electronic toll collection technology in the United States shows that the technology is largely accurate and reliable. **Millions of tolls representing billions of dollars have been collected electronically over the past ten years. Most have been audited by independent firms and have shown exceptional accuracy.** And, given that the technology is relatively new, future advances should improve its reliability even more.

However, billing problems do occur and unquestionably annoy individual drivers. They also damage entire projects when the problems hit the papers and affect the project's credibility. The following anecdotes illustrate problems that have occurred on some projects.

Toronto The 407 ETR has $15 million (cdn) in uncollected tolls outstanding, but the government will no longer assist in enforcement – by not renewing license plates of scofflaws – because billing errors have been so widespread.

Charging to take your picture over and over again. Here's an on-line posting from a Michigan family who visited relatives in Ontario.

We noticed the toll signs at the 407 at Hwy 401, but after entering the 407 … we never saw any booth, nor toll rate signs. Two months later, we received a bill in the amount of $37.55. Excuse me, but isn't this quite excessive? Here's how the bills breaks down:

- *9 August*
  - *Hwy401-Derry $0.30 toll charge, $3.30 video charge*
  - *Derry-Dufferin $5.10 toll charge $3.30 video charge*
  - *Dufferin-Brock $3.95 toll charge $3.30 video charge*
- *10 August*
  - *Brock-Jane $4.64 toll charge $3.30 video charge*
  - *Bathurst-Hwy401 $5.06 toll charge $ 3.30 video charge*
  - *Account Fee $2.00*

Then, the only way to pay these fees is to pay with Visa or Master card, since a visit to Steeles Avenue in Woodbridge, Ontario is a bit far.

Bills make it to New York but go astray in Canada. Another on-line correspondent complains:

I'm a Toronto resident... I was in NY state before 2003 and had received several 407 bills on my US address, no problem - paid on their website...But had quite a hassle once back in Canada as they sent bills to my undeliverable old (1986!!) address in BC, which I found out when my 79-year old mum started receiving nasty calls from a collection agency! Got it all cleared up… Drivers beware!

New Jersey

E-ZPass records visible to all. In 2000, an E-ZPass customer checking his account was surprised when clearly visible account information – for all the other customers – showed up on his computer screen. No bank account or credit card numbers were displayed and the system was immediately shut down for security repairs.

London

35,000 appeals against inaccurate billing, three-fourths successful. In the first year of the London Congestion Pricing Scheme 35,000 appeals were filed against penalty notices, and three quarters of those appeals have been won by the drivers. It's not clear if the appeals process is purposefully slanted to favor protests, in the interest of reducing controversy as the scheme gets off the ground.