HOT Lanes on Interstate 15 in San Diego: Technology, Impacts and Equity Issues

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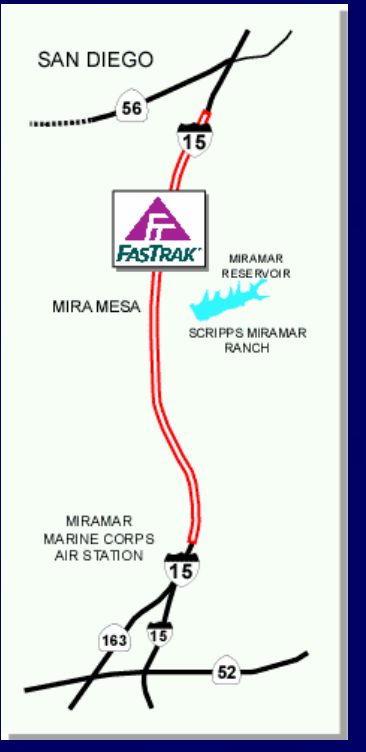
Introduction

- The project is a federally-funded, $9.95 million three-year demonstration program that allows SOVs to use the existing HOV lanes on I-15 for a fee.

- The project began in December 1996 and has been generating revenue for transit service improvements in the I-15 corridor.

Project Location

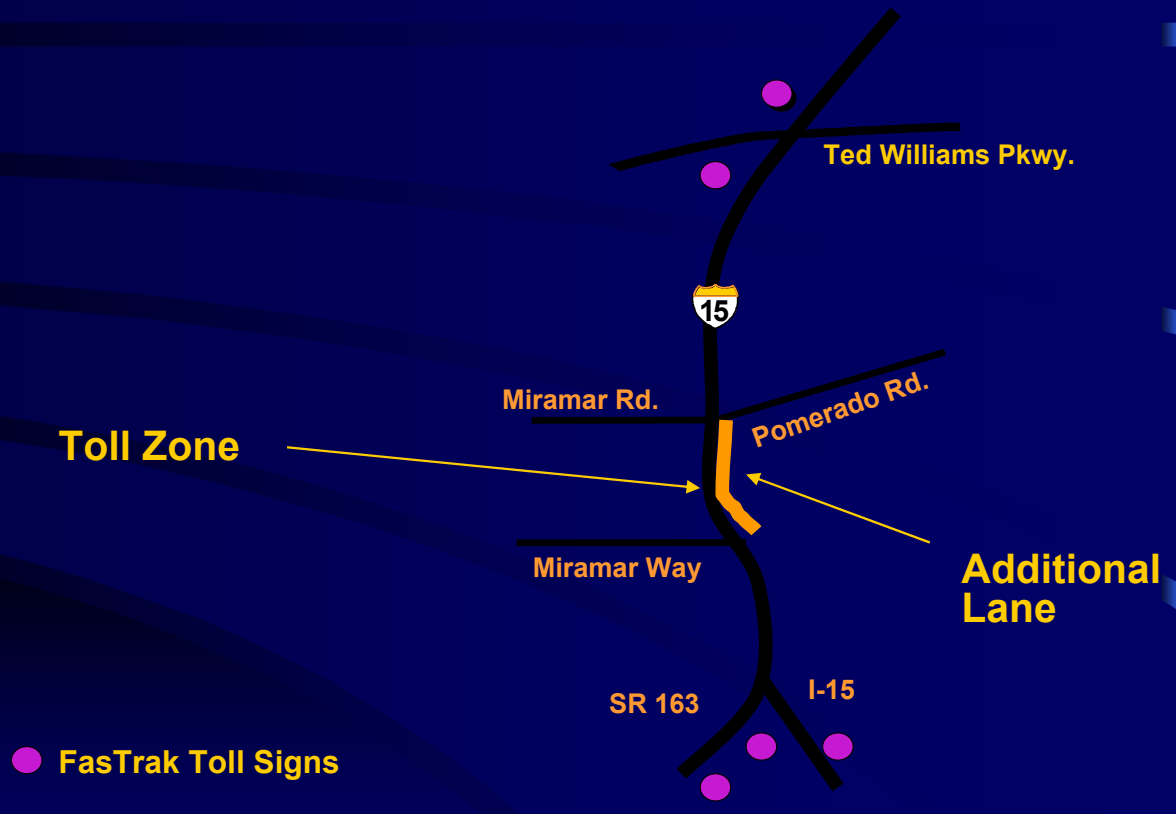
- located along I-15, a major north-south freeway
- 8-mile stretch separated by barriers from the I-15 main lanes
- operates southbound a.m. and northbound p.m.



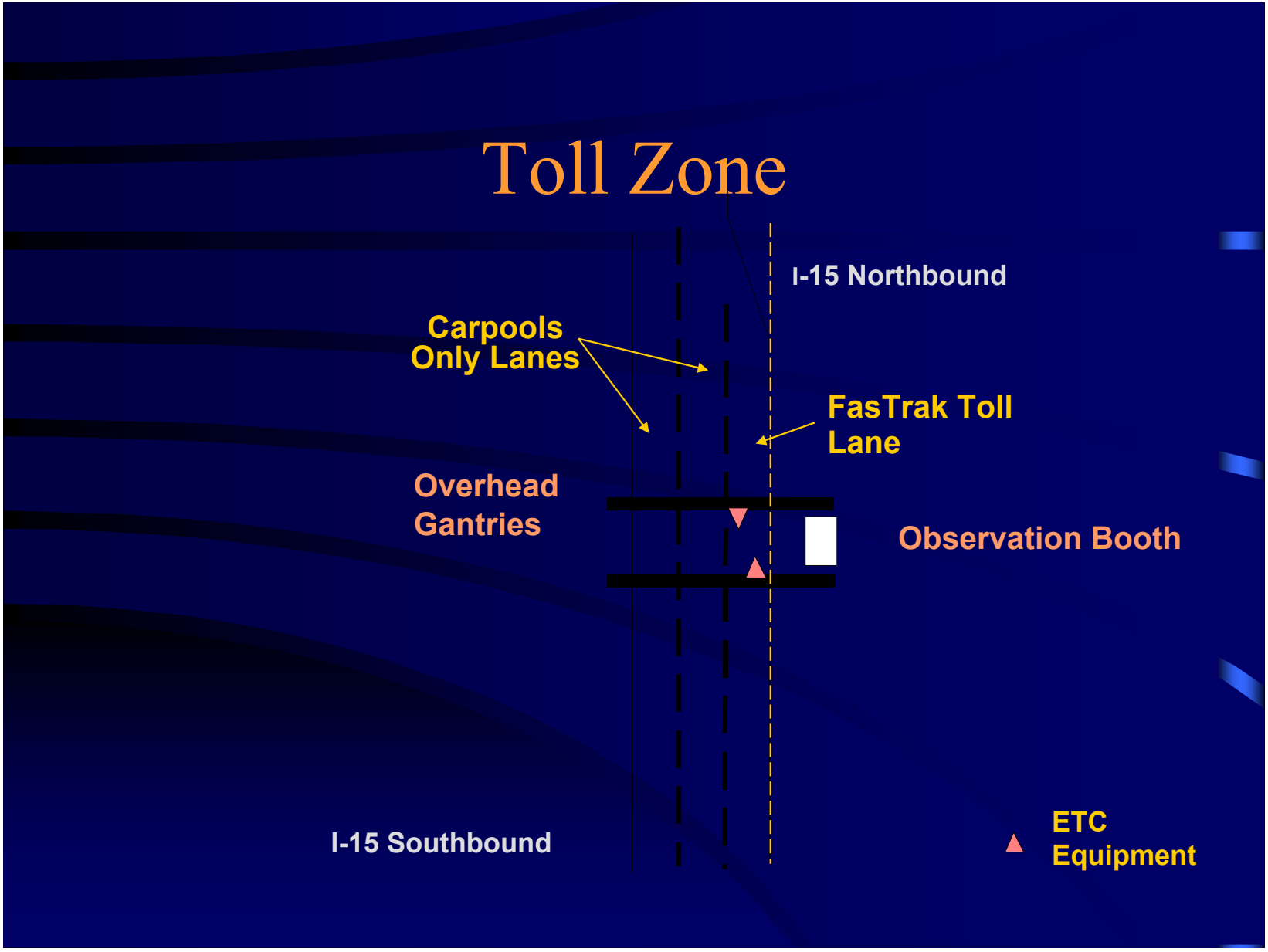
Entrance to the Facility

Existing HOT Facility

Project Elements



Toll Zone


I-15 Northbound
Carpools
Only Lanes
FasTrak Toll
Lane
Overhead
Gantries
Observation Booth
I-15 Southbound
ETC
Equipment

Project Goals

- Maximize the use of the previously underutilized HOV lanes; convert them into HOT lanes
- Improve transit and HOV service along I-15
- Bring congestion relief along I-15
- Test a new road toll system

Funding

- January 1995: project was accepted under the ISTEA Congestion Pricing Pilot program
- $7.96 million grant from the FHWA for project implementation
- $1.99 million in local matching funds
- $230,000 grant from the FTA

California Legislation

- Project required state legislation.
- In October 1994, AB 713 authorized the three-year demonstration allowing SOVs the use of the HOV lanes.
- The law requires LOS B or the pre-existing LOS to be maintained at all times => LOS C

Revenue Use

- State legislation requires all revenues to be used for transit improvements in the corridor.
- I-15 Project revenue is used for a new express bus service - the Inland Breeze.

Project Partners

- SANDAG: coordination and management
- PMT: Caltrans, SANDAG, FHWA, FTA, CHP, MTDB, and FWA
- WSA: Consultant
- TransCore: ETC system operator
- KT Analytics: Consultant to FHWA
- SDSU: Monitoring and Evaluation

SDSU Project Team

- Janusz Supernak, Project Director, SDSU
- Jacqueline Golob, JGA
- Thomas F. Golob, UCI
- Christine Kaschade, SDSU
- Camilla Kazimi, SDSU
- Eric Schreffler, ESTC
- Duane Steffey, SDSU

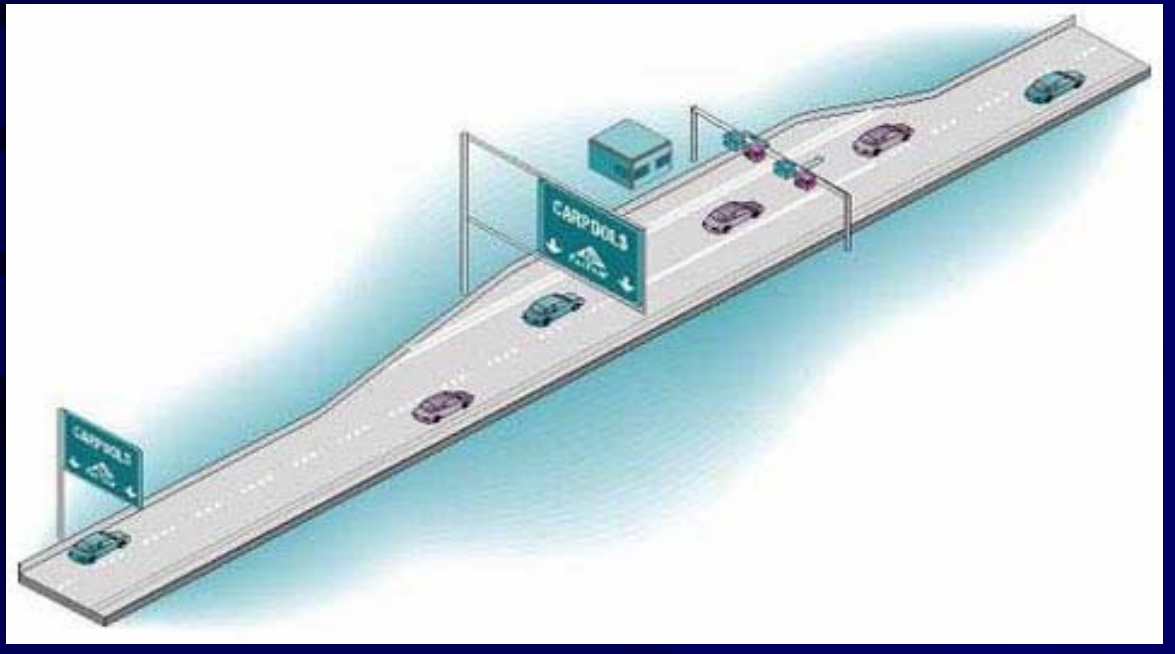
Phase I - ExpressPass

- December 2, 1996 - March 29,1998
- Flat monthly fee for unlimited use of the HOV lanes
- Started at $50 and increased to $70
- $80 was opposed and rejected
- Colored windshield decals
- Visual enforcement by CHP

Transition to Phase II - FasTrak

- Transponders replaced monthly decals in June 1997

ETC System



Phase II - FasTrak

- Introduced in March 1998
- Scheduled end of the project: January 1, 2000
- Extended by the legislation until January 1, 2002
- Extended indefinitely after 1/1/2002

Number of Transponders

- July 1998: 5,000
- Late 1998: 9,000
- Currently : over 20,000

Toll Fees

- Variable per-trip pricing ranging from $0.50 to $4.00 depending on the traffic flow in the HOV lanes and time of day

- Maximum of $8.00 in extreme cases when LOS C is exceeded

Maximum Toll Schedule: A.M.

Maximum Toll Schedule: P.M.

Focus of Studies

- What happened in the I-15 and I-8 corridors in respect to the characteristics examined?
- Were changes on I-15 different from changes on I-8?
- Can changes observed on I-15 be attributed to the project?
- What were the major external circumstances?

Nature of Studies

- The studies use a control system that is imperfect by definition.
- Different factors may influence both corridors and surrounding areas differently over time.

Control Corridor

- major east-west freeway
- I-8 does not have HOV lanes
- I-8 carries less traffic than I-15
- I-8 traffic conditions are generally better than I-15
- different socioeconomic characteristics

External Factors

- Gasoline price changes
- HOV lanes construction on I-5, another N-S commuter freeway in San Diego
- Other factors

Macroscopic and Microscopic Analyses

- Macroscopic (aggregate) travel related data from the I-15 and I-8 corridors
- Microscopic (disaggregate) data about travel behavior of individuals

Macroscopic Studies

- Traffic Study
- Bus Study
- Park and Ride Study
- Cost of Delay Study
- Air Quality Study
- Enforcement and Violation Assessment

Microscopic Studies

- Attitudinal Panel Study
- Land Use Study
- Business Study

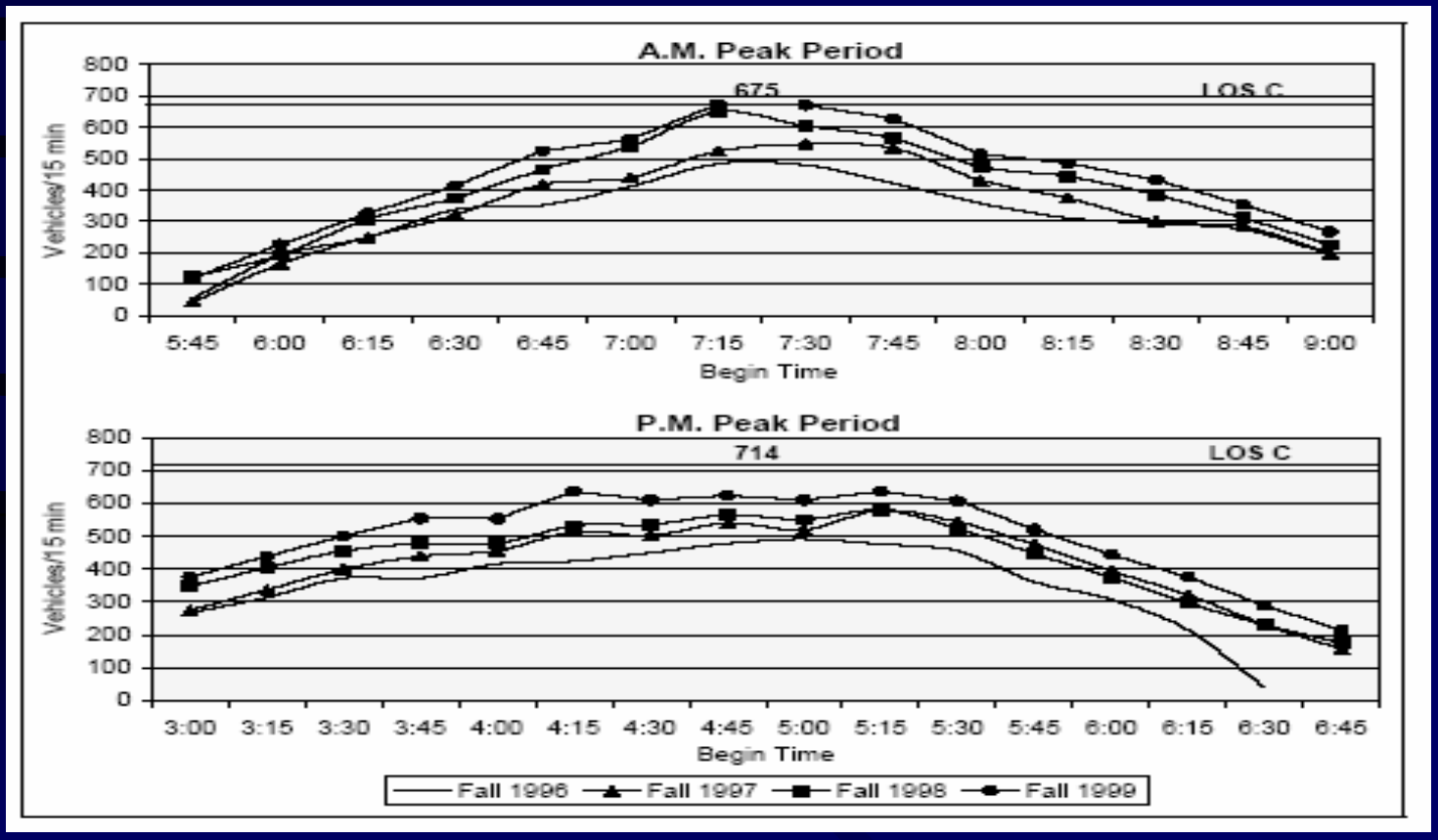
Other Studies

- Media Coverage, Marketing Efforts, and Public Response
- Institutional Issues
- Safety Issues
- Community Outreach
- Acceptance of the Project
- Technical Assessment of the ETC system

Regression Trend Analysis for I-15 Express Lanes Peak Period Volumes

Period	Phase F-statistic	Phase p-value	Trend F-statistic	Trend p-value	Phase x Trend F-statistic	Phase x Trend p-value
a.m.	1.716	0.193	12.529	0.001	2.135	0.132
p.m.	0.446	0.644	17.923	< 0.001	0.753	0.478
a.m. + p.m.	0.923	0.406	28.738	< 0.001	1.812	0.177

Time-of-Peak Distribution of Express Lanes Volumes



Peak Period Utilization Factor (PPUF)
and
Peak Period Distribution Factor (PPDF)

PPUF=Total Peak Volume / Maximum LOS Peak Volume

PPDF= Peak volume sample variation / variance of the reference discrete uniform distribution

PPDF Values Total Express Lanes Volumes

		PPDF*	Changes in Percent	F-value	d-o-f[1]	d-o-f[2]	p-value	Significant at the α = 0.05 level?
A.M. Peak Period								
Spring	1997	60.9%						
			+ 12.0%					
	1998	68.2%						
			+ 1.8%					
	1999	69.4%						
	1997 through 1999		**+ 14.0%**	**11.547**	**2**	**15,405**	**< 0.001**	**yes**
Fall	1996	69.3%						
			- 7.6%					
	1997	64.0%						
			+ 5.6%					
	1998	67.6%						
			+ 1.2%					
	1999	68.4%						
	1996 through 1999		**- 1.3%**	**4.741**	**3**	**21,079**	**0.003**	**yes**
P.M. Peak Period								
Spring	1997	75.1%						
			+ 6.7%					
	1998	80.1%						
			+ 0.2%					
	1999	80.3%						
	1997 through 1999		**+ 6.9%**	**52.235**	**2**	**20,949**	**< 0.001**	**yes**
Fall	1996	73.1%						
			+ 3.8%					
	1997	75.9%						
			+ 2.1%					
	1998	77.5%						
			+ 1.0%					
	1999	78.3%						
	1996 through 1999		**+ 7.1%**	**25.818**	**3**	**27,045**	**0.003**	**yes**

[1,2] d-o-f = Degrees of Freedom

Total Freeway and Ramp Delay for I-15 Main Lanes

		Ramp Waiting Time (t_{gg})	Freeway Travel Time (t_{gg})	Total Travel Time (t_{gg})	Free-flow Travel Time	Total Delay Time
Spring	Mon -Thu	11.8 min	8.4 min	20.2 min	5.51 min	14.7 min
	Fri	5.3 min	5.7 min	11.0 min	5.51 min	5.5 min
Fall	Mon -Thu	16.3 min	9.4 min	25.7 min	5.51 min	20.2 min
	Fri	4.9 min	8.5 min	13.4 min	5.51 min	7.9 min

Assessment of Traffic Study

1) Most of the primary objectives were successfully met.
2) There was a substantially better utilization of the Express Lanes - mainly due to increasing number of program participants.
3) Both ExpressPass and Fastrak proved to be feasible pricing systems.
4) Contrary to common expectations, neither system has negatively affected carpool volumes.

Assessment of Traffic Study

5) Fastrak system was able to redistribute a portion of Express Lane volume from the middle of the peak to the shoulders; ExpressPass system was unable to do it.

6) Use of Fastrak decreased average travel times by only 4-6 minutes. However the reliability of on-time arrival increased greatly; the 99th percentile of travel time on the main lanes could reach extra 20+ minutes.

7) The project moderated emissions levels along I-15 as compared with I-8.

8) The project attracted enough program participants to the Express Lanes to reduce the a.m. cost of delay.

Bus Study

Inland Breeze

- steady increase in ridership but less than expected
- primarily reverse commuting
- moderately successful

Enforcement and Violation

- Substantial decrease in violation frequency since the project start
- The main factor: increased CHP enforcement
- Possible conversion of some SOV violators to program participants
- Slight increase in violations between ExpressPass and FasTrak phases
- CHP frustrated by its low efficiency

Media, Marketing, Public Response

- Media coverage was fair, timely, and generally objective, confined to providing information about the project.
- In late 1997, the media's focus began to shift from coverage of the project itself to the overall discussion of I-15 traffic problems.
- Project leaders developed constructive media relations.

Safety Related Issues

- Program participants highly valued the perceived safety in the HOV lanes as one of the key benefits of the program

Outreach

- Outreach efforts conducted by SANDAG to comply with the Environmental Justice requirements did not attract substantial public attention or participation.

- It appears that the I-15 public did not view the program as controversial during Phase I or Phase II.

Attitudinal Panel Study

- A 5-wave longitudinal study was performed to report travel behavior, perceptions and attitude changes (1500 respondents).
- FasTrak customers were affluent, educated, primarily women, living in proximity of the entrance to the facility.
- Fastrak use was increasingly selective.
- Respondents did not leave carpool for FasTrak.

Attitudinal Panel Study

- Program participants believed they saved about 20 minutes per trip; trips were predominantly work-based.
- Up to 90% of participants paid themselves for the program.
- Travel conditions on the Express Lanes were perceived as satisfactory by both FasTrak users and carpoolers. Both groups viewed program as successful. They thought that the program was effective in reducing congestion.

Attitudinal Panel Study

- Individual participants liked pricing as a solution; they preferred FasTrak over Expresspass.
- Participants valued their new option to effectively fight traffic; thought that pricing was fair.
- Equity issues did not emerge as a problem despite the fact that the program participants came from the high income group.
- Panel respondents did know how the project revenues were spent; they would not favor the idea of spending it on transit improvements.

Perceived Fairness of the I - 15 Congestion Pricing Project
Panel Study Wave 5

Percentage of those who believe project is fair

FasTrak Customers: 96 %

FasTrak Non-Users: 90 %

I - 15 Carpoolers : 70 %

Respondents Preference Concerning the Use of Program Revenues Panel Study Wave 5

I - 15 express bus service

FasTrak Customers: 9 %

Other I - 15 Users: 2 %

I - 8 Users: 0 %

Respondents Perception of Program Revenues Use Panel Study Wave 5

I - 15 express bus service

FasTrak Customers: 34 %

Other I - 15 Users: 7 %

I - 8 Users: 0 %

B/C Analysis Scenarios

- **Scenario 1A**: Base year: 1996 (pre-HOT); n=10 years, i*=3.1%; No delay reduction as based on comparison with the I-8 control corridor

- **Scenario 1B**: Base year: 1996 (pre-HOT); n=10 years, i*=3.1%, Delay reduction based on: "**no HOT project**: current program participants would have to use the main lanes as they were not allowed on the HOV facility."

- **Scenario 2**: Base year: 1988 (pre-HOV); n=20 years, i*=3.5%; Benefits based on: "**No HOV lanes**: all users have only main lanes available."

B/C Analysis for I-15: Assumptions

- **Phases**: 1) Pre-HOV, 2) HOV, 3) EP, 4) FT
- **Periods of Analysis**: HOV - 20 yrs, HOT -10yrs
- **Discount Rates**: as suggested by OMB
- **Cost Elements Considered**: first cost, operation cost, enforcement cost
- **Benefit Elements Considered**: project revenues, reduction in cost of delay, fuel consumption savings
- **Air Quality Changes**: considered neutral
- **Value of Time**: 1988 - $ 5.40/hr of delay; 1999 - $9.00/hr of delay
- **Fuel Cost Savings**: $ 3.00/hr of delay

B/C Calculations: Scenarios 1A and 1B

C = {4+2(P/A,3%,3)+
+[0.8(P/A,3%,7)+0.1(P/G,3%,7)](P/F,3%,3)}(A/P,3%,10)=
= $ 1.926 M/yr

B1= 0.7+ 0.3(A/G,3%,10) = $1.977 M/yr

B2= (0.80 - 0.25) (A/G,3%,10) = $ 2.341 M/yr

SCENARIO 1A (w/o cost of delay benefits)

B/C = 1.977/1.926 = **1.026>1.000**

SCENARIO 1B (with cost of delay benefits)

B/C = (1.977 + 2.341)/1.926 = **2.241>1.000**HOV Lane Cost (1988) : $33 M

SOME BROADER LESSONS

- HOV Lanes can be successfully converted into HOT Lanes on an urban freeway. Implementation can bring some measurable, significant positive impacts both for individual travelers and system-wide operations.
- The main incentives to become program participant are perceptions of increased reliability of free-flow traveling, timesaving, and safety.
- Dynamic, traffic-adjustable pricing leads to a more uniform utilization of the peak period; the fixed price system may actually be counterproductive in that respect.

Conclusions

- The vision of the project was clear from the beginning; the idea to improve transit in the I-15 corridor was non-controversial.
- An influential political champion, Mr. Jan Goldsmith, was able to make the idea a reality.
- The project was consistently presented as a win-win-win solution, with all parties gaining something directly or indirectly; operational performance matched the expectations.

Conclusions (Cond…)

- FasTrak population was steadily growing with some subscribers interested in a "safety net" type of tool to combat congestion when an important trip was at stake.
- FasTrak performance was very reliable: free-flowing travel conditions were delivered 99% of the time.
- FasTrak per-trip pricing system appeared non-elitist allowing virtually anybody to become a subscriber.

Conclusions (Cond…)

- The marketing of the high image of the project was very effective.
- The complexity of the project required good collaboration among several stakeholders; with national visibility of the project was a catalyst to accomplish that.
- The project was very well managed by SANDAG.
- Media coverage was fair and non-sensational.
- The HOT lanes solution did not involve "taking away" any lane; conversion from HOV to HOT version looked like a logical improvement.

Thank You for Your Attention…
Questions?

For more information about the project go to:
http://argo.sandag.org/fastrak/library.html