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12th International HOV Systems Conference:

Improving Mobility and Accessibility with Managed Lanes, Pricing, and BRT

Conference Proceedings

April 18-20, 2005
Houston, Texas

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16. Abstract

This report documents the proceedings of the *12th International HOV Systems Conference: Improving Mobility and Accessibility with Managed Lanes, Pricing, and BRT*. The Conference was held in Houston, Texas on April 18-20, 2005. The proceedings summarize the presentations from the plenary sessions and the breakout sessions. The plenary sessions included presentations on the high-occupancy vehicle (HOV) system in the Houston area, updates on national activities, and future trends in managing mobility. The luncheon speakers addressed new financing options in Texas and tips for working with the business community.

A variety of topics were covered in the breakout sessions. Updates were provided on HOV facilities in North America, high-occupancy toll (HOT) and value pricing projects, and managed lanes. Information on public perceptions, regional and statewide planning projects, toll collection technology, financing and deployment approaches, and designing and operating projects for multiple user groups was presented.

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12th International HOV Systems Conference
Improving Mobility and Accessibility with Managed Lanes, Pricing, and BRT

April 18-20, 2005
Doubletree Hotel Downtown
Houston, Texas

Sponsored by
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In cooperation with
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Harris County Toll Road Authority
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and
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Conference Proceedings

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OPENING SESSION – MANAGING MOBILITY IN HOUSTON

Katherine F. Turnbull, Texas Transportation Institute, Presiding

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Welcome – That was Then/This is Now – Changes Since the 1987 HOV Conference in Houston

Katherine F. Turnbull
Texas Transportation Institute

It is a pleasure to welcome you to the Transportation Research Board's (TRB) *12th International HOV Systems Conference – Improving Mobility and Accessibility with Managed Lanes, Pricing, and BRT*. The conference is sponsored by TRB's High-Occupancy Vehicle (HOV) Systems Committee, with support from the Managed Lanes Joint Subcommittee, the Joint Subcommittee on Pricing, the Transportation Demand Management Committee, the Freeway Operations Committee, and the Bus Transit Systems Committee.

I would like to recognize the local co-sponsors, including the Texas Department of Transportation (TxDOT), the Metropolitan Transit Authority of Harris County (Houston METRO), the Houston-Galveston Area Council of Governments (HGAC), and the Harris County Toll Road Authority (HCTRA). Houston METRO provided the buses, operators, and staff for the tour this morning. The Federal Highway Administration (FHWA) of the U.S. Department of Transportation is supporting the completion of the conference proceedings.

I would also like to thank the outstanding TRB staff for their assistance with the conference logistics. Rich Cunard, Freda Morgan, and Aaron Grogg did a great job with the hotel and registration arrangements.

David Schumacher, Chair of the HOV Systems Committee, sends his greetings. David is not able to attend the conference due to back problems, but communicates his best wishes for a productive and informative conference.

In addition to welcoming you, it is my charge to provide an overview of the changes that have occurred with HOV facilities at the national level since 1987 when the 2nd International HOV conference was held in Houston. I thought it might be of help to set these changes in the context of other cultural changes that have occurred over the past 18 years.

For example, in 1987 George Bush was President of the U.S. George Bush, that is George W. Bush, is currently President. A gallon of gasoline cost about $1.07 in 1987. Current prices at the pump average about $2.10 for a gallon of regular unleaded gasoline. You could mail a first class letter for 22 cents in 1987. Mailing that same letter today will cost you 37 cents.

In 1987 we were just getting use to the term "just fax it to me, please." Today, with some 605 million Internet users worldwide, we say, "just e-mail it to me, please." If you said iPod to someone in 1987, they would probably think you were talking about a designer vegetable pea pod.

On the sports scene, the Minnesota Twins clinched the 1987 World Series during the HOV Conference, which was held in October. We are still waiting to see who will claim the title this year. The Washington Redskins won the Super Bowl in 1987. The New England Patriots are the reigning champions. At the movies, The Last Emperor was named the Best Picture at the Academy Awards in 1987, while Million Dollar Baby took the Oscar this year.

HOV facilities were still a relatively new element of the transportation system in 1987. There were 20 HOV projects on freeways and in separate rights-of-way in 12 metropolitan areas in North America in 1987, accounting for approximately 130 center-line miles. Today, there are some 130 HOV facilities operating in 31 metropolitan areas. These projects account for approximately 1,600 center-line miles.

There has also been a change in the type of HOV lanes in operation. In 1987, concurrent flow HOV lanes accounted for approximately 54 percent of the operating HOV facilities, with exclusive lanes representing 32 percent, busways accounting for 13 percent, and contraflow lanes comprising one percent. Today, concurrent flow HOV lanes represent 81 percent of operation projects, compared to 10 percent exclusive facilities, five percent busways, and four percent contraflow lanes.

The terms value pricing, managed lanes, and high-occupancy toll (HOT) lanes were not in the transportation vocabulary in 1987. Today, we have HOT projects in operation here in Houston and in San Diego. The I-394 MnPASS project in Minneapolis will be starting next month, and projects are being developed in other areas. Although many of the early HOV facilities started as bus-only lanes or had major bus components, the bus rapid transit (BRT) concept takes public transportation to another level.

There was no TRB HOV Systems Committee in 1987. The TRB HOV Task Force was just getting organized. We have come a long way since 1987. The Task Force became a full committee in 1989. With the help of many of you in this room, the HOV Systems Committee has been one of the more active TRB committees over the years.

In addition to 12 international conferences, the committee has sponsored numerous sessions at TRB annual meetings. After publishing a newsletter for many years, the committee moved into the Internet era, with a committee website. Committee members have developed numerous research problem statements over the years, which have resulted in the National Cooperative Highway Research Program (NCHRP) HOV Systems Manual, the FHWA HOV Marketing Manual, and the FHWA HOV Demand Estimation Procedures Manual. FHWA and numerous states are sponsoring additional projects through the HOV Pooled-Fund Study. The committee also started an awards program in 2000. The third set of awards will be presented at the luncheon today. The committee also took the lead in sponsoring the new Managed Lanes Joint Subcommittee.

What might we expect to see 18 years from now when Houston hosts the 2023 Intergalactic HOV Conference? Based on the past 18 years, we might anticipated that Jenna and Barbara Bush will be President and Vice President, that DVD Pods will be the hot electronic device, and that the Million Dollar Emperor will take the Best Picture Oscar. The Texans will of

course have won the Super Bowl and the Astros will be on their way to winning the World Series.

You will hear more about current trends and the future of HOV facilities over the next three days. As the conference theme indicates, I think HOV facilities – and managed lanes, value pricing, and BRT – will continue to play important roles in providing mobility options and helping address congestion issues in metropolitan areas throughout North America. I encourage you to actively participate in the conference and I hope you will find the sessions and speakers interesting and informative. Thank you.

Managing Mobility in Houston – State Department of Transportation Perspective
Gary Trietsch
Texas Department of Transportation

Thank you Katie. It is a pleasure to welcome you to this conference on behalf of the TxDOT. The Department is pleased to be a local co-sponsor of the conference.

While Katie provided highlights since the 1987 conference in Houston, let me start by going back to 1917, when legislation established the Texas Highway Department (THD). In 1975, the legislature merged the Texas Mass Transportation Commission into THD and we became the Texas State Department of Highways and Public Transportation (SDHPT). In 1991, the legislature added the Department of Aviation and the Texas Motor Vehicle Commission and we became the Texas Department of Transportation (TxDOT). The Texas Turnpike Authority was merged into TxDOT in the mid-1990s and in 2003 the legislature moved the Medicaid and non-emergency medical transportation programs into the Department.

This brief history provides an indication of the changing nature of the Department and transportation at the state level in Texas. As with other states, transportation in Texas is constantly evolving to keep pace with changing needs and expectations.

We have seen many changes within just the past few years. Legislation in 2003, specifically House Bill 3588, fundamentally changed transportation and the role of TxDOT. The bill provided significant changes in the way TxDOT operates and the funding options available in the Department. It also established the Trans Texas Corridor (TTC).

Managing mobility in the Houston area involves numerous components and partners. HOV facilities, toll roads, bus transit, light rail transit (LRT), freeways, arterial streets, intelligent transportation systems (ITS), TranStar, and traffic operations are all part of the approach. Also, the Houston TxDOT District is only one of two districts in the state that operates a ferry boat service.

I would like to provide a few examples of the coordination and cooperation that occurs among agencies and organizations in the Houston area to address critical transportation needs. We are working with Montgomery County, which is on the north side of the metropolitan area, on a shadow tolling or pass through tolling project. This approach allows the county to issue bonds to expedite construction of roadway projects. TxDOT will pay the county back on an agreed upon schedule based on forecast traffic volumes.

The I-10 West Freeway managed lanes represent the coordinated efforts of TxDOT, HCTRA, and Houston METRO. You will be hearing more about this project during the breakout sessions, but HCTRA is providing financial support for the managed lanes and will operate the lanes. Houston METRO buses will travel for free and 3+ carpools will not pay tolls during the morning and afternoon peak periods. We are also working with HCTRA and Houston METRO on possible improvements in the I-45 North Freeway corridor.

Many of you visited TranStar this morning on the tour. TranStar opened in 1996. The development and operation of TranStar represents the coordinated efforts of TxDOT, Houston METRO, Harris County, and the City of Houston. When TranStar opened, the control room was about half full. The control room is now at capacity and we are exploring options for expansion. Personnel from TxDOT, METRO, Harris County, and the City of Houston representing traffic operations, bus and rail operations, law enforcement and emergency services, flood control, and many other functions are all located in the control room. Space is also provided for commercial traffic reports.

TranStar has changed dramatically in nine years and it has had a positive influence on the way agencies work together in the Houston area. The City of Houston recently implemented a Safe Clear freeway towing program. Using a competitive procurement process, the City has exclusive contracts with towing companies for specific segments of the freeway system. Now, rather than having multiple tow trucks show up at a crash or other incident, one tow truck responds within a required time period. While there were some issues surrounding the program, other cities are looking at starting similar programs.

Finally, the railroad situation in Houston and other major cities in the state is an important issue. Railroads have played an important part in the development of Houston, as noted by the train on the city seal. Railroads continue to be a critical part of the transportation network in the region, serving the Port of Houston and other facilities. The railroad lines also cause potential operational and safety issues, however, as many cut through very developed parts of the city. TxDOT is working with the City of Houston, Harris County, other agencies, and the railroads to look at possible option for the railroad system in the region.

You will hear more about the Houston HOV lanes and related projects in the breakout sessions. I hope you have a very productive conference and an enjoyable stay in Houston. Thank you.

Managing Mobility in Houston – Transit Perspective
John Sedlak
Metropolitan Transit Authority of Harris County

Thank you, Katie. On behalf of the Metropolitan Transit Authority of Harris County (Houston METRO), our President Frank Wilson, and our Board of Directors, it is a pleasure to welcome you to this conference and to Houston. As a participant in the 1987 conference, it is also a pleasure to provide an overview of METRO's bus and LRT system. I hope you enjoyed the tour this morning and were able to see some of the major elements of the HOV system, including the park-and-ride lots and transit centers.

I hope the tour also gave you a good perspective on the partnership among agencies here in Houston. We know that no one agency can address all the transportation issues alone. As Gary noted, the agencies are working collaboratively to bring together a regional transportation system. METRO is pleased to be a partner in the development and operation of a holistic transportation system in the Houston area.

By way of background, Houston is the fourth largest city in the U.S. with a population of approximately 4.5 million. The population is forecast to grow to some 6.5 to 7 million. Houston is the energy capital of the country. Houston is also the largest city without zoning. The development patterns of the city have been influenced by the automobile and the freeway system. As Gary mentioned, there are currently 104 miles of HOV lanes in operation in six freeway corridors. Some 116,000 person trips and 37,400 vehicles use the HOV lanes on a daily basis.

When the previous HOV conference was held in Houston in 1987, the HOV system was in the early stages of development. The system is mature now, and it represents a major component of the public transportation system in Houston. METRO provides frequent express bus service from 22 park-and-ride lots. Four transit centers also serve the HOV system. Bus lanes on streets in the downtown and midtown areas provide another key element of the overall system.

The HOV system has attracted choice riders – people who could drive if they wanted – to transit. The Houston area is a difficult region to serve with public transportation due to low densities and spread-out development. By offering frequent service on the HOV lanes, often with over-the-road coaches, METRO has been able to attract commuters who previously drove alone.

The HOV system began with the contraflow demonstration project on the I-45 North Freeway. The initial focus of the system was on authorized vehicles – buses and vanpools – due to the design and operation of the contraflow lane. A barrier-separated median design was used on the I-10 West HOV project and carpoolers were allowed to use the lane. This design was used on other HOV projects. Due to high use levels, and the resulting congestion in the HOV lanes, the vehicle-occupancy requirements were increased to 3+ on the I-10 West HOV lane during the peak hours. This requirement was extended to the US 290 HOV lane during the morning peak hour.

The HOV system has been expanded to both provide a holistic transit system and to meet increasing demands. The I-10 West corridor provides a good example of this approach. The Addicks park-and-ride lot has been expanded over the years from 1,000 parking spaces to 2,500 spaces. Buses are provided direct access to the HOV lane by a flyover ramp. Bus service is oriented to downtown Houston and to other major activity centers through major transit centers. The transit centers also provide connections between buses using the HOV lanes and local service.

A significant part of the Regional Bus Plan has focused on improvements in the downtown area. METRO has been rebuilding major sections of streets in the downtown and mid-town areas. On some one-way streets, the right curb lane is reserved for buses and the first

travel lane is reserved for buses and carpools. Sidewalks have been widened in some areas to allow more space for passenger waiting areas and passenger shelters.

METRO first considered a rail system in 1979. After numerous studies and plans, involving a variety of technologies, the voters approved an initial LRT line in 1999. The seven-mile METRORail line from Reliant Stadium to downtown opened in January 2004. The line serves the midtown area and the Texas Medial Center (TMC).

There were some 7.7 million boardings on the LRT line in 2004. The line currently averages approximately 33,000 boardings a day. A January 2005 article in the *Houston Chronicle* noted that METRORail's 4,053 boardings per route mile was the best in the U.S. for a LRT system. The LRT line has also helped generate economic development and redevelopment in the Main Street corridor. METRO's new downtown transit center and administrative building are located along the METRORail line.

There are plans to expand both the LRT and the HOV network. Two-directional HOV lanes will be provided in some corridors. METRO looks forward to continuing the strong partnership with TxDOT, HCTRA, and local governments to develop and operate these additional elements.

Again, welcome to Houston and to the 12th International HOV Conference. I hope you find the conference to be very productive and I hope you enjoy your stay in Houston.

Managing Mobility in Houston – Toll Authority Perspective
Mike Strech
Harris County Toll Road Authority

Thank you, Katie. It is a pleasure to participate in this opening session and to talk with you about the Harris County Toll Road Authority (HCTRA). As Gary and John have noted, HCTRA is an important partner in addressing congestion and mobility issues in the Houston area. We are currently working with TxDOT and METRO on the I-10 West Freeway managed lanes and we are exploring other potential projects.

HCTRA was established in 1983 when voters in the country approved bonding authorization. By the late 1980s, 52 miles of toll roads had been opened. HCTRA currently operates approximately 100 center-line miles of toll roads and 270 toll lanes. These facilities include the Sam Houston Tollway, the Hardy Toll Road, the Hardy Airport Connector, and the Westpark Tollway. We also operate the Fort Bend Parkway Toll Road for the Fort Bend County Toll Road Authority.

Electronic toll collection (ETC), called EZ TAG, was introduced in 1992 to help address congestion at toll plazas. Two EZ TAG lanes are provided at toll plazas. Initially, 40,000 EZ TAGs were made available. EZ TAG accounts have grown by approximately 12 percent a year. Today, there are some 540,000 EZ TAG accounts and over one million EZ TAGs in use. In 2004, the HCTRA website accounted for 38 percent of the new accounts. Approximately 63 percent of all toll transactions are made with EZ TAGs and EZ TAG transactions account for 70 percent of all tolls paid during the morning and afternoon peak periods.

The Westpark Tollway represents HCTRA's first all electronic toll road and the first all-electronic toll road – or open road tolling – in the U.S. All vehicles must have EZ TAGs, as there are no toll booths. The facility is 16 miles in length and was constructed at a cost of approximately $400 million. A number of engineering challenges had to be addressed in the construction of the Westpark Tollway. These challenges included a very limited right-of-way, with four travel lanes in an 80 foot-wide cross section, and 20 major crossings. The project included complex utility relocations involving 19 utility companies, three municipal utility districts, and the City of Houston. A total of 20 separate construction contracts were used on the project.

The all-ETC system was necessitated by the limited right-of-way, as there was no space to accommodate toll booths. Elevated sections and depressed connecting ramps are also used due to the limited right-of-way. Automated vehicle identification (AVI), vehicle enforcement system (VES), and redundant lane controllers are used for toll collection and enforcement.

A public information effort was undertaken to introduce the facility and the all-EZ TAG payment method. HCTRA's public relations personnel coordinated with and relied on public media channels, including television news programs, newspapers, radio stations, and the EZ TAG store in the corridor to disseminate information on the Westpark Tollway. EZ TAG ONLY signs are used on connecting facilities. The Westpark Tollway has averaged 1.6 million transactions a month over the first nine months of operation. Violation rates averaged about 16 percent daily the first month, which is high for HCTRA operated toll roads. After five months of operation, the monthly violation rate declined to between 8 to 10 percent, or approximately three percent above the typical system-wide violation rate.

Although minor start-up issues were encountered, the overall project has been successful and the technical solutions have met expectations. The reactions from both EZ TAG customers and the surrounding communities have been positive. The response from the press and the public to the informational program has also been positive.

A direct connector ramp from the Sam Houston Tollway to SH 249 was opened in February 2005. Only EZ TAG payment is available on this connector. Toll revenues increased by some three percent with the opening of this connector, while there was no noticeable increase in the violation percentage over previous months.

HCTRA has plans for other toll roads in the area and we are working with TxDOT on managed lanes projects. The managed lanes on I-10 West will be EZ TAG-only and will use time of day or variable pricing. Managed lane projects are also being considered in other freeway corridors.

A Tri-Party Agreement among FHWA, TxDOT, and HCTRA and a Memorandum of Understanding among TxDOT, METRO, and HCTRA outline the development and operation of the managed lanes. A level of service (LOS) C will be maintained to ensure that METRO buses are not delayed due to traffic congestion. Houston METRO buses will not have to pay a toll. During the morning and the afternoon weekday peak-period, 3+ carpools will also not have to pay a toll. During other times of the day 3+ carpools will be charged, and 2+ person carpools

will be charged at all times. An option for adding rail at some point in the future is also provided.

The US 290 Freeway corridor is also being considered for managed lanes. There is a parallel railroad corridor along much of the route. HCTRA is considering a toll and managed lanes project using the railroad right-of-way.

Thank you again for the opportunity to participate in this session and for highlighting HCTRA projects. We value our working relationships with TxDOT and Houston METRO and look forward to working with them on future projects. I hope you have a very successful conference.

LUNCHEON SESSION

Dennis L. Christiansen, Texas Transportation Institute, Presiding

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New Financing Options in Texas
John W. Johnson
Texas Transportation Commissioner

Thank you for that gracious introduction and for the invitation to join you today. I would like to add a word of welcome to those of you who have traveled great distances to be here. The conference agenda and the opening session indicate that your journey will be worth the effort.

It has been said that life is too short for a long story –and I hasten to add, for a long speech – so you will be glad to know that my remarks will not impact your life expectancy to a great extent.

While my comments focus on Texas, I think the challenges we face are similar to the ones that you encounter in your state or country. I think it is fair to say that Texas has undergone some drastic changes recently.

Let me put that statement in perspective. Spindletop put Beaumont on the map and catapulted our state into the petroleum age. Texas is now home to at least four of the largest oil companies in the world.

The first military flight in a Wright Brothers plane was conducted at Fort Sam Houston in the early part of the last century. Now it is as common to talk of the National Aeronautic and Space Agency (NASA's) newest venture into space as it is to hear that Southwest is an airlines industry leader.

We have come a long way since the speed limit on Texas roads was set at 25 miles an hour. Going that speed on a freeway today could get you run over, or at the very least, saluted by your fellow drivers.

The first gasoline tax in Texas was established in 1923 – at a penny a gallon – with ¾ going to highways and the remainder to public schools. While the tax is higher today, we have not had a gas tax increase in Texas since the early 1990s.

In 1910, there were a little over 14,000 vehicles in the 180 counties in the state that registered automobiles. By the time the first statewide vehicle registration began seven years later, the number had grown to almost 200,000. Staggering at the time, yes, but consider that the current count is well over 18 million registered vehicles in Texas. In the past two decades alone, the number of vehicles registered in the state has increased 61 percent.

In the first half of the 20th century, Texans numbered about seven million. Some 20 million people now call the Lone Star State home, and 85 percent of the newcomers to Texas locate in already congested urban areas.

I look at my three young grandchildren; I wonder what their Texas will look like? What is on the horizon that will shape their lives? One thing I know for certain is that for them Texas and all that makes up this great state will look and be decidedly different that is it today.

We are at a crossroads. We can either choose to be as prepared as we can for the new Texas, or pretend that things will function as they always have. I do not advocate the "laissez faire" or "que sera sera" approach.

At TxDOT, we are preparing for the Texas of tomorrow. And with deference to David Letterman, here are our top ten reasons why the Department is preparing for the future.

Number 10. The 21st century Texas will require us to think big, plan large, and execute huge.

Number 9. There are 20 million Texans and 18 million registered vehicles – and those numbers are going to grow.

Number 8. That many Texans behind the wheel of that many automobiles is a recipe for congestion.

Number 7. Concrete has to live alongside rail and transit if we want to continue to move people and goods.

Number 6. There is only so much public money that is going to be available for construction, and no matter how much you try, you cannot get blood from a turnip.

Number 5. TxDOT is not an island. While we have been the builders and maintainers of the Interstate and roadway system for over 80 years, we need partners to keep the momentum going.

Number 4. Texans have come to expect an efficient and effective transportation system.

Number 3. Texans will not settle for anything less, nor should they.

Number 2. Texas is a gateway to the rest of the country, and transportation is an economic engine for this state.

Number 1. For all of our efforts to get Texans from Point A to Point B, it will be useless if they cannot do so safely.

When I was young, I was proud to be a Texan. I still am, but I do not believe that we can continue to do things the same way, and expect different results. We are, in fact, learning to think big, plan large, and execute huge. And to do that, we know that we cannot continue to only go to the public well for funding. It is running dry, and we will need to tap into new sources of revenues. Fortunately, TxDOT has been armed with a number of new methods to obtain some fresh water. I would like to discuss a few of those new ways in greater detail.

Current transportation dollars simply are insufficient to fund all the transportation needs in the state. Many citizens just do not understand the straits transportation is in. And that is understandable. Citizens look at the $2.00-a-gallon price tag at the pumps, and the connection to funding the transportation system is hard to make. Add the discussion of toll roads and toll fees to high gasoline prices, and there is a collective questioning of the wisdom of policy makers.

The basic truth is that the gasoline tax in the state of Texas is 20 cents a gallon, and has been since 1991. During the decade between 1994 and 2004, deposits of state gas tax to the State Highway Fund grew by 34 percent. During the same period, the number of miles driven on the state system grew by 42 percent.

The picture is bleaker when you consider that during that same decade, the purchasing price of the gas tax decreased by about 8 percent. True, there were more cars on the roadways, and that means more gallons of gasoline purchased, but that is not a great help when revenue from those gallons of gasoline does not go as far. If you drove 100 miles in 1994, your motor fuels taxes brought $1.36 in highway improvements. That figure is adjusted for inflation. Today, the purchasing power of that 100-mile drive is only $0.87.

In fiscal year 2003, gas tax revenue was actually less than the amount spent on maintaining the system. This means we are now spending more on the maintenance and preservation of the existing system than we are collecting – and that does not include expanding capacity. Add to this situation that we are only getting about $0.85 back for every dollar we are sending to Washington in federal gas taxes, and you can see the conundrum. Obviously, finding creative solutions to the transportation and related financial challenges we face is a priority.

Enter the Trans-Texas Corridor (TTC), which represents one of the biggest changes in the way we finance transportation in the state. The TTC is a long-term plan that addresses the state's future transportation needs. Based on projected demand, the immediate need is to provide a long-term solution to congestion on I-35 and along the proposed I-69 corridor. Both corridors connect to the state's busiest international bridges and play a vital role in moving commercial truck traffic through the state.

Last month, TxDOT and Cintra-Zachry, an international consortium of engineering, construction and financial firms, formalized a partnership to develop TTC-35. The TTC-35 route will generally parallel I-35. It is also the first element of the TTC from Oklahoma to Mexico.

The centerpiece of new financing tools is House Bill (HB) 3588, which was approved by the Texas Legislature in 2003. It included such innovative strategies as Regional Mobility Authorities (RMAs). A county or counties may establish an RMA and essentially set their own transportation priorities because they have the ability to build, operate, and maintain toll roads and other transportation projects. Another key addition is the concept of pass-through tolls, which work by allowing local communities to fund their projects, with the assurance that TxDOT will reimburse all or a portion of the project costs based on the number of vehicles which use the facility.

HB 3588 affectionately became known as MOAB, or the Mother of All Bills. This session, MOAB has a son or two. Bills have been filed to make some changes in the 2003 legislation. The bills are quite wide-ranging, and differ in some respects, but there are provisions for entering into Comprehensive Development Agreements (CDAs) for rail facilities, establishing CDAs for state highways in general, clarifying the type of non-tolled highway that can be converted to a toll road, and repealing both the toll equity cap and the cap on expenditures for rail facilities. Last we checked, the House bill is scheduled for a public hearing tomorrow, and the Senate bill has been left pending in committee.

Another approach is to allow TxDOT to invest its capital in toll projects. There are financial limitations or a not to exceed cap, however. Last week the House debated a separate bill to repeal the toll equity cap. That bill passed to third reading. It was, however, amended, to raise the current cap from $800 million to $1.5 billion. That bill could be up for third reading as early as today.

Using the tools created by HB 3588, the Texas Transportation Commission has already authorized the creation of five RMAs that literally spread across the state: Travis and Williamson counties in central Texas, Bexar County in the San Antonio area, Cameron County in the Rio Grande Valley, Grayson County in north Texas, and Smith and Gregg counties in east Texas. TxDOT has a new partner to work with in those counties in addressing transportation issues.

Last February, the Commission also approved the state's first pass-through toll agreement. The agreement is with Montgomery County, a rapidly growing area just north of Houston. Under the agreement, TxDOT will reimburse the county the construction costs for improvements to several state roadways. That is not just a good thing from the county's perspective, in that some needed projects are done faster, but part of the agreement includes the county's concurrence to reinvest a portion of those funds into other projects. I would call that a win for the state because now state dollars are spread a lot farther.

I do not want to overlook why we are gathered here. The use of HOV and HOT lanes is increasing in Texas. Although, I am not a fan of barricaded HOV lanes, HOV and HOT lanes are key parts of our transportation system as shown by their use in Dallas and Houston.

In Houston, there are a little over 100 miles of HOV lanes on six radial freeways. More than 116,000 passengers utilize the lanes daily, making approximately 37,500 vehicle trips. The QuickRide value pricing program, which allows two-person carpools during the 3+ period, is one option we are using on two of our local freeways; I-10 West, affectionately called the Katy parking lot, and US 290 or the Northwest Freeway.

Four freeway corridors in the Dallas area have HOV lanes, including the contraflow lanes on the East R. L. Thornton, which uses the movable barrier technology. But while the business of HOVs and HOT lanes is not about the dollars, but about saving time and moving people, the key is finding innovative ways to do so.

The state legislature has obviously given us some tools to creatively manage transportation. But as I said earlier, the transportation business is a partnership. Innovation

cannot begin and end at our state capital, it has to extend outside our borders to the nation's capital.

The House version of the reauthorization bill directs the secretary of transportation to take appropriate action "to preserve and enhance the Interstate system to meet the needs of the 21st Century." What those appropriate actions are, I can not say. I will leave the discussions up to the think tanks around the country to debate how to handle increased demand on the system, rising freight movements, road capacity challenges, and the interconnected roles of the state and federal governments.

I will offer one suggestion, however. That suggestion is that whatever actions we take we must take them with the view of making sure the difficulties we face in transportation today do not become the insurmountable challenges of tomorrow. We can and will take those necessary steps. Future generations are depending on it.

Thank you again for allowing me to share this time with you. I hope that by my remarks, you can get a sense of how important the work that you do is.

BREAKOUT SESSION – OPERATION UPDATES

Edward Mark, New York State Department of Transportation, Presiding

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I-95 HOV System-Wide Operations Study
Jeff Weidner, Florida Department of Transportation and Gregory Kyle, Kimley-Horn and Associates, Inc.

Jeff Weidner and Greg Kyle discussed the I-95 HOV lanes in southern Florida and recent efforts focusing on improving operations. They provided an overview of the I-95 HOV system-wide operations study, the current operating characteristics of the lanes, the strategies identified for enhancing operations, and the action plan for the improvements.

- The I-95 HOV system-wide operations study represented the joint efforts of the Florida Department of Transportation (FDOT) Districts Four and Six. The study included an analysis of existing traffic operations. Vehicle volumes, speeds, and LOS were examined. Vehicle-occupancy, person throughput, and violation rates were analyzed. The use of transit services and park-and-ride lots in the corridor were reviewed. Strategies for HOV system improvements were identified. These strategies focused on operational adjustments, signing and marking, and improved marketing and public information.
- There are a number of reasons why it is important to make the I-95 HOV lanes more effective. First, south Florida's population continues to grow, resulting in an increase in hours per day of congested conditions. Second, right-of-way in the corridor is limited and adding lanes is not an option. The HOV lanes provide capacity by moving more people in fewer vehicles. Third, the HOV lanes provide increased incentives to ride the bus or join a carpool. Finally, the HOV lanes provide community and environmental benefits from lowered vehicle emissions.
- The I-95 HOV lanes are concurrent flow, non-barrier separated lanes. A 2+ occupancy requirement is used. The lanes are marked by signs and painted diamonds in the pavement. The HOV lanes currently operate from SR 112 (Airport Expressway) to Palm Beach County. The future system will extend the lanes 84 miles and will be the longest HOV facility in country. This lane operates in the peak period from 7:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 6:00 p.m. In Miami-Dade County, the HOV lanes operate only in the peak-period, peak direction of travel.
- An HOV workshop was held early in the study. Part of the workshop focused on identifying possible action items to enhance HOV lane operations. Action item identified included increasing use of HOV lanes, considering other potential user groups, establishing policies and performance measures, improving interagency coordination, and reducing violation rates. The goals and objectives for the HOV system identified were to increase the person movement capacity of the congested I-95 corridor; to encourage carpooling, vanpooling, and bus use by providing mobility options and intermodal connections; to provide travel time savings to HOV lane users; and to enhance public support for alternative transportation modes.

- The strategies defined for HOV system improvements focus on seven general areas. These areas are operational adjustments, enhanced enforcement, signing and marking, improved marketing and public information, preferential treatments, ITS, and transit service.
- Seven Priority I HOV treatments were identified. The first improvement that was identified was to extend the HOV operating hours. The new operating hours will be 6:00 a.m. to 10:00 a.m. and 3:00 p.m. to 7:00 p.m. The second improvement was to develop a master signing and marking plan. The third improvement identified was to coordinate with local transit providers to expand express bus routes and service levels. The fourth improvement was to develop and execute a marketing and public information program. The fifth improvement was to initiate a peer-enforcement program like the HERO program in the Seattle area. The sixth improvement identified was to obtain additional funding for enforcement. The final improvement identified was to increase the fine for HOV violations.
- A number of Priority II HOV improvements were also identified in the study. The first recommendation was to implement a package of interrelated improvements, including enhancing the buffer separation and limiting access to the HOV lanes, adding and improving enforcement areas, and adding ITS features. A second recommendation was to add HOV-only lanes on exit ramps at congested interchanges.
- Priority III improvements focused on adding direct connection ramps between HOV facilities, at major park-and-ride lots, and at interchanges where high volumes of HOVs access system. Adding HOV bypass lanes at selected metered freeway entrance ramp locations represents another Priority III improvement.
- Obtaining approval from the technical committee was the first step in implementing the identified improvements. The committee was comprised of local MPO staff, local traffic operations staff, local transit staff, and FDOT District Four and Six staff. Approval was also needed from FDOT District Four and Six management personnel and management personnel at the FDOT Central Office in Tallahassee.
- The action plan is scheduled for implementation starting July 1, 2005. The main components of the plan focus on signs, enforcement, and public awareness. There are currently some 100 mainline HOV signs and 40 HOV ramp signs on the I-95 HOV lanes. The signs vary in size and structure. Elements of the action plan for signs include a complete inventory of signs and structures, incorporating Manual on Uniform Traffic Control Devices (MUTCD) recommendations to existing panels, and plan development. Information on new truck restrictions will also be added. A Request For Proposals will be developed and issued with a condensed schedule. The changes will be implemented in a contiguous format from north to south.
- The elements of the action plan for enforcement included providing additional funding for Florida Highway Patrol (FHP) officers during the expanded hours. A 75-day grace period will be provided. Tickets will not be issued to HOV lane violators during this period. Rather, violators will be given flyers explaining the HOV lanes and the new operating hours.

- The public awareness elements of the action plan are based on the model used by Florida's Turnpike with the recent toll increase. Elements included public official outreach, a public information and media program, an editorial board, and focus groups. The public awareness program will address the addition of ramp metering and truck restriction changes. There is a need to develop an umbrella public awareness program and to use multiple awareness efforts.
- In addition to the HOV lanes, ramp meters, and truck restrictions, the public awareness program will focus on the Road Rangers, 511 Travel Information, transit improvements, and an extended vanpool program. The SunGuide, including a traffic management center, variable message signs, and cameras will also be included.
- The schedule for implementing the priority improvements starts this month with letters to Metropolitan Planning Organization (MPO) boards and editorial board meetings. The state legislative session ends in May. The first signs will be installed by mid-May 15. No tickets will be issued during this time period. Billboards will be installed in June and radio advertisements will begin. The last sign is scheduled to be installed on June 23 and VMS indicating the July 1 start for the new regulations will start on June 28. The first day of the new regulations is July 1. The no-ticket grace period ends in August and FHP officers will begin issuing tickets.

High-Occupancy Vehicles Hours of Operation Pilot Project
Mark Hallenbeck, Washington State Transportation Center

Mark Hallenbeck discussed the HOV hours of operation pilot project in the Puget Sound Region. He described the background to the pilot program and the key elements of the one-year evaluation sponsored by the Washington State Department of Transportation (WSDOT).

- The HOV lanes in the Seattle area have traditionally been restricted to HOVs 24 hours a day, seven days a week (24/7). While there is strong public support for HOV lanes and heavy peak period use of HOV lanes, there has also been vocal public support for allowing single-occupant vehicles (SOVs) to use HOV lanes during off-peak periods.
- An analysis of existing general-purpose and HOV lane demand indicated that there is little unused HOV lane capacity in peak periods, but considerable excess capacity in evening periods. Concerns with opening the HOV lane to SOVs focused primarily on safety and transit reliability issues. Some HOV lanes were constructed with deviations from design standards, providing safety concerns. The HOV lanes are very important for bus on-time reliability. Even in the mid-day, buses need to get from bases to afternoon starting locations on time.
- A decision was made by WSDOT to open HOV lanes on the eastside of the Seattle metropolitan area at night – from 7:00 p.m. to 5:00 a.m. It was determined that this change would provide some congestion relief, should not impact transit reliability, and should not decrease safety significantly as long as specific roadway improvements are made.
- The one-year evaluation of the pilot program focused on five major elements. The elements were vehicle volumes in the general-purpose and the HOV lanes, roadway performance as defined by speeds and frequency of congestion, violation rates, accident

rates, and public perception. The I-90, I-405, and SR 167 HOV lane corridors were included in the assessment.

- The one year evaluation indicates that the overall changes in system performance have been very small. Late evening vehicle volumes increased slightly, but speeds remained basically unchanged. There were minor increases on a few of the general-purpose lanes in the late evening. Violation rates increased marginally. While it appears much of the public did not know about the change, the general public reaction was positive.
- Increases in HOV lane vehicle volumes occurred after 7:00 p.m. at most locations. The level of the increases varied, however. Some slight increases also occurred just prior to the 5:00 a.m. morning start of the HOV lane restrictions. Corresponding reductions in vehicle volumes in the general-purpose lanes occurred at some locations.
- Vehicle-occupancy levels decreased after 7:00 p.m. in those HOV lanes experiencing increases in vehicle volumes. This decrease was the result of increased SOVs using the HOV lanes. Vehicle volumes increases in the HOV lanes between 7:00 p.m. and 8:00 p.m. ranged from 89 to 589 vehicles.
- On freeways where congestion still exists at 7:00 p.m., some measurable changes have occurred with increases in total vehicle volumes. On freeways where congestion is minor or non-existent at 7:00 p.m., some shift in volumes from the general-purpose lanes to the HOV lane occurs, but the total facility vehicle volume has not changed significantly.
- The overall performance of the freeways changed very little as a result of the change in operational rules. The frequency of general-purpose roadway congestion did not change. The average general-purpose lane speeds on most congested roadways – SR 167 and southbound I-405 – increased slightly by 1-to-3 mph. HOV lane performance did not change. The analysis indicates that on a limited number of occasions and on a limited number of road segments, moderate numbers of general-purpose vehicles were able to avoid some general-purpose lane congestion by moving into the HOV lane. This shift does not appear to have changed the speed with which the congested general-purpose lane returned to normal operation, however.
- Violation of HOV requirements were monitored after the change. Violations generally increased only just prior to the 7:00 p.m. evening start time of the new access rules. The increases were generally small. The actual violation rates ranged from 0-to-9 percent, except for SR 167, in the afternoon southbound direction, which already had a high violation rate.
- Public opinion was measured after the change in operation through surveys of freeway users. Only 36 percent of the respondents knew about the change in operations. Many respondents were unable to respond to questions about perceived changes to facility performance. Those that did notice the new regulations generally reported positive changes.
- The safety concerns with the new operating hours related to the potential for increased vehicle volumes in the HOV lanes equating to an increased number of vehicles running

off the road. There was also concern that the change may significantly impact the operation of the planned HOV direct access ramps.

- The majority of the Eastside freeway HOV lanes are located adjacent to shoulders that are at least eight feet wide. Stopping sight distance is deficient along some segments, particularly on I-405, and a few unprotected fixed objects remain in place. Collision data indicates that the facilities have similar run-off-the road experience as urban Interstates statewide.
- An increase of up to 10 percent in run-off-the-road collisions was forecast. Projecting to 2007, the speed and reliability of the HOV lanes are not expected to be significantly compromised. The forecast change at direct access interchanges is significant, with a difference between a LOS A and a LOS C for northbound direction at both NE 6th and NE 128th. A LOS C is still acceptable operations, however.
- Safety enhancements were made at some locations. Over 75 lane-miles of ground-in rumble-strips and over 13 lane-miles of profiled edge stripe were added. On I-90 a small number of median trees were removed and an additional guardrail was installed.
- Before and after data for run-off-the-road accidents was nearly identical. No obvious trouble spots are apparent. Preliminary indications are that the number of King County freeway collisions dropped by approximately 9 percent from 2002 to 2003.

Safety Considerations in the Development of HOV Facilities and Managed Lanes in Houston Suhag Kansera and Ned Levine, Houston-Galveston Area Council

Suhag Kansera and Ned Levine discussed a recent study examining crash data for the Houston HOV lane. They discussed the purpose of the study, the data sources used, the preliminary results, and the areas for further research.

- The main objective of the project was to document crashes on the HOV lanes in Houston. A second objective was to compare the safety of HOV lanes with non-HOV freeway lanes. A third objective was to identify the characteristics of HOV crashes on the HOV lanes.
- Two data sources were used for the study. The first data source was Houston METRO's HOV crash records for 2001 through 2004. METRO police officers document crashes on the HOV lanes and maintain the crash records. The Texas Department of Public Safety (DPS) freeway crash data for 1999 through 2001 was the second source of information. Data from both sources were examined for the six freeway corridors in Houston with HOV lanes.
- According to the METRO database, there were slightly fewer than 100 crashes in the HOV lanes in 2001. The number of crashes in the HOV lanes declined to approximately 85 in 2002. In 2003, the number of crashes increased to approximately 125. The number of crashes declined slightly to 120 in 2004.
- The time-of-day the crashes in the HOV lanes occurred was examined. Crashes typically occurred during the congested periods in the morning and afternoon. The number of crashes in the HOV lanes appears to peak more than crashes in the freeway lanes.

- In 2001, the I-10 West HOV lane had one of the highest number of crashes, with 44. No other HOV lanes had 20 crashes during 2001. The Eastex HOV lane had the fewest recorded crashes with only two.
- A crash risk assessment was conducted comparing crashes per 100 million vehicle miles traveled (VMT) on the HOV and the freeway lanes. The locations with multiple crashes were also identified. A few problem spots were identified through this process.
- The problem spots include locations where the HOV lanes merge to the freeway lanes and locations where direct access ramps merge with HOV lanes from park-and-ride lots. Other problem locations include HOV sections where design compromises were made or shoulder widths are narrower.
- Factors contributing to the crashes were also examined. Single vehicle crashes accounted for 30 percent of the crashes on the HOV lanes and 24 percent on the freeways. Speeding was a contributing factor in 53 percent of the crashes on HOV lanes and 56 percent of the freeway crashes. Following too close was a contributing factor in 5 percent of the HOV lane crashes and 3 percent of the freeway crashes.
- Tentative conclusions from the analysis indicate that HOV lanes are safe. Design compromises can increase crash risks, however. There also appears to be a safety trade-off between barrier facilities versus concurrent flow lanes.
- Future research will include a comparison of barrier facilities with concurrent flow lanes. The characteristics of drivers involved in the crashes will also be explored. It appears that a disproportionate number of males are involved in crashes and a disproportionate number of persons in the 30 to 50 age group. Research will also consider if certain groups have more difficulty with barrier facility.

BREAKOUT SESSION – REGIONAL AND STATEWIDE HOV, HOT, AND VALUE PRICING PLANS

Melissa Williams, Maryland Transportation Authority, Presiding

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The First Step: Utah Statewide Managed Lanes Study
Jon Nepstad, Fehr & Peers Associates, Inc.

Jon Nepstad described the managed lanes study sponsored by the Utah Department of Transportation (UDOT). He summarized the need for the study, the study objectives, scope, and elements. He described the methodology used to screen candidate corridors and the current status of the study. He noted the assistance of John Thomas from UDOT in the project and the presentation.

- The population of Utah in 2003 was approximately 2.3 million. The population in the state is projected to increase to 3.7 million by 2030. The number of licensed drivers in Utah is expected to increase from 1.6 million 2003 to 2.6 million in 2030. Approximately 80 percent of the population lives in urban areas of the state.
- The study goal was to provide a primer on managed lanes. The study objectives were to raise awareness about managed lanes, to identify institutional issues associated with managed lanes, to create a planning document on managed lanes, and to identify potential managed lanes corridors in the state. The study elements included developing definitions, reviewing the state-of-the-practice, conducting a statewide review of potential managed lanes, developing a proactive plan, and identifying potential corridors.
- The UDOT managed lanes definition focuses on HOT, HOV, tolling, cordon pricing, and reversible operations. A core study team from UDOT helped oversee the project. The core study team included one region director and representatives from design and technical, public affairs, and legislative affairs.
- A state-of-the-practice review was conducted on projects throughout the U.S. A scanning tour, which included trips to San Diego, Houston, and Denver, provided detailed information on some of the current projects.
- The methodology developed for the study, which focused primarily on urban areas, used three levels of screening to identify and evaluate potential corridors for managed lanes. The first level of preliminary screening considered the Utah State Transportation System. Information from previous studies and the long-range plan, as well as current congestion levels and safety concerns, were examined. A total of 50 candidate corridors emerged from the phase one preliminary screening. These corridors were examined in more detail in the second phase, which included quantitative and qualitative assessments. A total of 14 candidate corridors were examined in the third phase.
- A number of questions still need to be addressed. These questions focus on the benefits of adding managed lanes versus adding general-purpose lanes and ensuring that there is adequate demand for managed lanes. A number of institutional issues may also need to be addressed.

- The study has raised awareness about managed lanes in the state. It also identified institutional issues that may need to be addressed with managed lanes. A planning document was developed and potential managed lanes corridors were identified. Developing a more detailed regional system plan represents the next step in the process.

Strategic Implementation Plan for the Atlanta Region
Carol Carter, Santec, Tommy Crochet, McGee Partners, and Joe Palladi, Georgia Department of Transportation

Joe Palladi, Carol Carter, and Tommy Crochet provided an overview of the HOV system implementation process in the Atlanta region. They described the implementation process, the HOV project prioritization process, and the HOV project implementation status. They also discussed HOV conceptual design issues and highlighted elements of the HOV monitoring plan and the arterial HOV guidelines.

- Provisions for HOV lanes were included in the design of downtown freeways reconstructed in the mid 1980s. No projects were immediately implemented, however. A total of 38 miles of two-way concurrent flow HOV lanes were implemented in preparation for 1996 Olympics on I-20, I-75 and I-85. The lanes on I-85 were later extended for 12 miles. Expansion of the HOV system was an integral part of the 2030 Regional Transportation Plan (RTP), approved in 2001.
- The implementation plan study started in the summer of 2001. A multi-city scanning tour was undertaken to explore HOV facilities. Guidelines for the HOV system were developed. Needed projects were identified and prioritized. Enforcement guidelines and arterial HOV guidelines were also developed. Finally, guidelines for HOV performance monitoring were developed.
- The HOV system guidelines contain seven goals for the HOV system. The first goal is to reduce and manage traffic congestion. The second goal is to improve air quality. The third goal is to maximize the use of carpools, vanpools, and transit. The fourth goal is to ensure integration with transit. The fifth goal is to attain positive public perception. The sixth goal is to plan for a complete HOV system that is integral and critical to the entire transportation network. The final goal is to maintain integrity of general use lanes.
- The HOV system guidelines also outline the key measures of effectiveness (MOEs), HOV warrants, typical section access treatments, and enforcement. The key MOEs address person throughput, travel time savings, and travel time reliability. HOV warrants focus on general use congestion, and providing reliable time savings. An LOS was established as the acceptable HOV lane operations. The preferred cross-section is a two-way, barrier-separated facility, with provisions for two-lanes in each direction. The desired HOV access treatment is direct ramps to provide separation from general use access. HOV enforcement should keep the violation rate at no higher than six percent.
- The HOV project analysis, ratings, and prioritization process was accomplished in partnership with the Georgia Department of Transportation (GDOT), FHWA, the Atlanta Regional Commission, and the Greater Atlanta Transportation Authority (GRTA). A total rating for each project was developed based on planning ratings, constructability ratings, and system connectivity. Project prioritization was defined by tiers.

- In April 2004, Georgia Governor Perdue introduced the Fast Forward Congestion Relief Program to advance transportation projects through the use of bonds. Included in the program were HOV projects, Atlanta area arterial improvements, Atlanta area signal timing upgrades, rural Interstate widenings, and rural developmental highways.
- The Atlanta area 2030 RTP was adopted by the Atlanta Regional Commission in December 2004. The RTP includes almost 200 centerline miles of new two-way HOV facilities. The lanes were modeled as barrier separated facilities, which provides better reliability over concurrent flow HOV lanes. The HOV system also allows for future expansion to two-lanes in each direction.
- GDOT is proceeding with preliminary engineering on several HOV facilities. The delivery of the HOV projects is a high priority of GDOT. The projects are being coordinated with BRT, express bus, and transit plans to ensure optimal transit operations on the HOV facilities. There is also coordination with the Georgia State Road and Tollway Authority (SRTA) on managed lane issues.
- The HOV conceptual design includes two-way, barrier separated one-lane and two-lane sections. Temporary barriers can be used to allow adjustment to a typical section. System-to-system ramps are included. Direct access treatments are coordinated with BRT and express bus operations and plans. Enforcement areas are included in the design.
- The HOV monitoring plan includes data collection, analysis, and reporting. The data collection program focuses on using existing facilities and programs, with additional data collection efforts as needed. Technical reports, management reports, and marketing and public reports will be prepared for different audiences.
- The arterial HOV guidelines address regional goals and strategies. The guidelines include a recommended screening process and evaluation criteria for project selection. The screening process can be used for regional planning and evaluation, corridor planning and evaluation, and facility planning and evaluation. The guidelines also provide an overview of arterial HOV treatments.
- ARC is initiating multi-modal corridor investment studies along arterials to address major transportation investments, environmental issues, and economic development and land use. GDOT is working with the City of Atlanta on the plans for Northside Drive Corridor, which parallels the congested I-75/85 corridor. The intent is to develop Northside Drive as a transit friendly corridor.

Recent Research on Managed Lanes: A Report from Texas
Beverly Kuhn, Texas Transportation Institute

Beverly Kuhn described a multi-year research project on managed lanes sponsored by TxDOT. She summarized the managed lanes definitions used in the study, the major tasks conducted, and available reports.

- The TxDOT managed lanes research project focuses on developing a better understanding of how managed lanes can improve mobility for people and freight. The

research project objectives are to investigate the complex and interrelated issues surrounding the safe and efficient operation of managed lanes and to develop a comprehensive manual to help TxDOT make informed decisions.

- One of the first tasks was to develop a definition of managed lanes. The definition TxDOT uses is: "A managed lane facility is one that increases freeway efficiency by packaging various operational and design actions. Lane management operations may be adjusted at any time to better match regional goals."
- A variety of approaches may be used with managed lanes based on management strategies and facility type. Management strategies include pricing, vehicle eligibility requirements, and access control. Examples of facility types include HOV lanes, HOT lanes, truck lanes, express lanes, and multifaceted managed lanes.
- The five-year research project includes a number of tasks addressing planning, designing, implementing, and operating managed lanes. A number of products have been developed to help provide guidance on different aspects of managed lanes. Reports and other documents are available addressing weaving and ramp issues, enforcement, traveler information, and incident management. Other topics that have been examined include concept marketing, legislative issues, financing options, traffic control devices, and interoperability. The results from work tasks addressing direct connector ramps, enforcement, and signing are being presented in other breakout sessions.
- One of the tasks examined effective techniques to communicate with the public. Using messages common to successful projects was identified as one approach. Other techniques were to determine public perception at the project level and to gain support through political champions. Addressing potential equity concerns through providing additional mobility options was also noted as important.
- Another task examined possible legal and legislative issues associated with managed lanes. It is important to ensure that all operational scenarios are legal for all involved entities. Enforcement may need to be simplified and making contracting and institutional arrangements easier may need to be addressed. In Texas, information from the research project has been used in legislation.
- Funding options for managed lanes were also examined in the research project. A variety of financing methods were identified for managed lanes. It is critical to match financing method to project goals. The potential to leverage different funding sources was also noted as important.
- A traveler information decision model was developed through the research project. The model identifies the information travelers need at different decision points associated with using different types of managed lanes.
- Techniques for responding to incidents in managed lanes were also examined as part of the research project. Elements considered included access for response vehicle and diversion between managed lanes and general-purpose lanes. Other factors include providing a safe work area and pre-positioned response vehicles. The need for multi-agency cooperation and public notification is also highlighted.

- Another work task examined the need for interoperability. Ensuring interoperability in planning, geometric design, traffic control devices, operations, incident management, surveillance and monitoring, and communications was identified as important.
- Future research tasks include examining staffing and training needs associated with planning, designing, and operating managed lanes. Considering interim and special use lanes is being examined. Developing approaches for monitoring and evaluating managed lanes represents another task. Finally, a managed lanes handbook will be developed.
- All reports, bulletins, and presentations are available from the research website, which is http://managed-lanes.tamu.edu. Go to the section on "Our Products" to obtain available documents.

BREAKOUT SESSION – PUBLIC PERCEPTIONS ABOUT HOV, HOT, BRT, AND MANAGED LANES

Jessie Yung, Federal Highway Administration, Presiding

A Comparison of Houston HOV Lane Users and Non-Users
Mark Burris, Texas A&M University

Mark Burris discussed the results of recent surveys of QuickRide program participants and HOV lane users in Houston. He described the development of the Houston HOV lane system and the implementation of the QuickRide program, which is a value pricing demonstration project. He also summarized the results of recent surveys of QuickRide participants, bus riders, and carpoolers.

- The HOV lanes on I-10 West opened in 1984. Initially, only buses and vanpools were allowed to use the lanes. The lanes were open to 4+ carpools and then to 3+ and 2+ carpools to use the available capacity. By 1988, the HOV lane was becoming congested at the 2+ occupancy levels. To address this congestion, the occupancy requirement was raised to 3+ from 6:45 a.m. to 8:00 a.m. The occupancy level was later increased to 3+ from 5:00 p.m. to 6:00 p.m. Congestion at the 2+ level also occurred on the US 290 HOV lane, and the occupancy requirement was increased to 3+ from 6:45 a.m. to 8:00 a.m.
- At the 3+ occupancy level, capacity exists in the lane. The QuickRide program allows two-person carpools to use the HOV lane during the 3+ period for a $2.00 toll. The QuickRide program was implemented on the I-10 West HOV lane in January 1998 and on the US 290 HOV lane in November 2000.
- Approximately 225 travelers a day use the QuickRide program on the I-10 West and US 290 HOV lanes. Information on traveler characteristics was obtained through a survey to provide a better idea of who takes advantage of the HOT program. This information can then be used to estimate the potential user of other Houston HOV lanes, the possible societal benefits, and the potential equity impacts. It also helps develop knowledge regarding this new travel choice. Most of the survey respondents indicated low levels of QuickRide use.
- Currently, travelers using the two freeways have a number of options. These options include driving alone in the general-purpose lanes at all times or being part of a two-person carpool in the general-purpose lanes at all times. Two-person carpools can use the HOV lanes during the 3+ time periods as part of the QuickRide program for a $2.00 fee or for free during other times. HOVs with at least three people and buses can use the HOV lanes at all operating times for free. Casual carpooling also occurs on some HOV lanes in Houston.
- Uses of the I-10 West HOV lane during the morning peak period from 6:00 a.m. to 9:30 a.m. includes 2+ carpools, QuickRide participants, 3+ carpools, buses, motorcycles, and SOV violators. There are three-to-four general-purpose lanes in each direction in the

section of I-10 West with the HOV lanes. The travel speeds and trip-time reliability in the general-purpose lanes are highly variable.

- A number of different travel groups were included in the surveys. License plates were recorded for vehicles using the general-purpose lanes and the HOV lanes and surveys were sent to the owners. On-board surveys were used to obtain information from bus riders. Participants in the QuickRide program were mailed surveys. Finally, surveys were distributed to casual carpoolers as they waited at transit stations.
- The majority of all user groups reported making commute trips. Bus riders and casual carpoolers reported the highest levels of commute trips, accounting for some 96 percent to 98 percent, respectively. Recreation and school travel represented the other reported trip purposes.
- Carpooling with an adult family member was the most frequently reported carpool arrangement for HOVs in the HOV lanes and the general-purpose lanes, as well as QuickRide participants. Carpooling with an adult family member was reported by between 35 percent and 48 percent of the respondents. Between 20 percent and 40 percent of the respondents reporting carpooling with a co-worker. Children accounted for between 20 to 28 percent of carpool partners.
- Between 39 percent to 60 percent of respondents to all the surveys reported annual household incomes of $100,000 or more. While a greater percentage of high income users were QuickRide participants, income was not correlated with frequently of QuickRide use.
- The QuickRide program offers travelers another choice. Having a high income, being on a school-related trip, and being over 65 years old increased the likelihood of selecting QuickRide. Being a single adult or male decreased the likelihood selecting QuickRide.

I-5 North Coast Managed Lanes Community Outreach Program
Heather Werdick, San Diego Association of Governments

Heather Werdick described the community outreach program associated with the I-5 North Coast managed lanes project in San Diego. She summarized the project background, highlighted the major elements of the community outreach program, discussed the key findings, and noted future activities.

- The section of the I-5 corridor included in the study is 26 miles in length. The corridor runs from San Diego on the south to Oceanside on the north. A number of alternatives are being considered, including different combinations of general-purpose lanes, HOV lanes, and managed lanes.
- The I-5 North Coast study included a number of components. These components included a traffic operations plan and forecast report, evaluation of pricing strategies, a community outreach program, a concept plan, and the selection of a preferred pricing scenario.
- The community outreach activities included stakeholder interviews, focus groups, a telephone survey, and an intercept survey. A total of 24 stakeholder interviews were conducted. Individuals interviewed included elected officials, transportation service

operators, community and user groups, environmental groups, and military and business representatives.

- The results from the stakeholder interviews indicated that all groups are desperate for mobility solutions. Stakeholders also indicated that value pricing was seen as fair, especially if the revenues are used for transit services or improvements in the corridor. Stakeholders preferred physical barrier separation to the lanes. Some stakeholders were unsure on the effectiveness of meeting project goals. Most stakeholders supported the need for ongoing outreach.
- Two focus groups were conducted in November 2004. The one group included seven participants and the other included nine participants. The participants were regular users of I-5. Additional focus groups will be held as the project moves forward.
- Focus group participants were open to the idea of improving I-5. Most participants voiced support for including general-purpose lanes as part of the improvements. Participants felt that improvements will not eliminate congestion and that congestion will probably get worse. They also expressed concern for the environment and for equity among user groups. Focus group participants favored painted lines or pylon separation for the managed lanes. They also preferred entrances spaced approximately three-to-five miles apart. Most preferred pay-as-you-go options. Participants also felt revenues should be used for more roads and alternative transportation services.
- A telephone survey was conducted to obtain more detailed information. A total of 804 surveys were completed. Some 70 percent of the respondents reported using I-5 at least five days a week. The average trip reported by respondents was less than 30 minutes. Approximately 62 percent of the respondents supported construction of 10 general-purpose lanes and four managed lanes alternative and 61 percent felt the project would reduce congestion. However, 23 percent felt the project would take too long.
- The telephone survey respondents indicated a preference for tolls rather than limiting access. Approximately 56 percent felt fixed tolling is fair and equitable. Survey respondents also prefer managed lanes to general-purpose lanes. Respondents also believed that managed lanes can help reduce congestion, although they were not optimistic of increased carpooling and sustaining traffic flow.
- The telephone survey results were consistent across demographic groups. Minorities were more likely to support managed lanes and fixed tolling, while low-income populations prefer general-purpose lanes or the use of access control.
- Intercept surveys were conducted at transit stations and park-and-ride lots. A total of 353 surveys were completed. Some 60 percent of the respondents supported construction of the 10 general-purpose lanes and four managed lanes option, with HOVs and vanpoolers most supportive.
- Intercept survey respondents felt that the use of reduced tolls for carpools and vanpools would encourage HOV use. Transit users supported using toll revenues for transit services, while HOVs and vanpools disagreed with this approach.
- The results from the different community outreach program elements highlight the need to build support for pricing at the local level. The results also support the need for

corridor-level public outreach and market research. Public/private partnerships offer key investment opportunities in developing and implementing an outreach program. Information and research sharing among all groups is also important for a successful program.

- The next steps in the I-5 North Coast managed lanes project include conducting a final set of focus groups and developing the draft concept plan. A preferred pricing strategy will be identified and the draft EIR/EIS will be completed.

Public Perceptions on Tolling in Texas
Sukumar Kalmanje, University of Texas at Austin

Sukumar Kalmanje discussed public perception related to toll roads and congestion pricing in Texas. He described the results of recent research projects conducted for TxDOT and other sponsors which included telephone surveys, on-line surveys, and focus groups. He recognized the assistance of Kara Kockelman, Kaethe Podgorski, and Michelle Bina of the University of Texas at Austin on the research and this presentation.

- There is an increasing need for transportation improvements in Texas. At the same time, there is a lack of funding for needed improvements. The expanded use of tolling is being considered in many parts of the state to bridge this funding gap. Recent state legislation provides more funding opportunities to TxDOT and other agencies. At the same time, federal and state policies require public involvement in the transportation planning and project development process. Statewide surveys can provide representative views on preferred policies. Recent research conducted for TxDOT and the Southwest University Transportation Center (SWUTC) included telephone surveys, on-line surveys, and focus groups on tolling and congestion pricing.
- A survey on credit-based congestion pricing was conducted using telephone, intercept, and on-line methods. A total of 480 responses were weighted for age, gender, and income. Approximately 47 percent of the respondents expressed support for pricing policies. These individuals tended to be longtime residents, younger persons, higher income groups, individuals with less work-schedule flexibility, and households with fewer vehicles. Approximately 25 percent of the respondents expressed support for credit-based value pricing, including those with prior pricing experience, those who perceived more congestion, and those with less work-schedule flexibility.
- A telephone survey was conducted of residents in seven areas in Texas. These areas were Austin, Lubbock, San Antonio, Houston, Dallas, Fort Worth, and communities in the Rio Grande Valley. An on-line follow-up survey was also used in these areas. The analysis considered respondent demographics, respondent location, and the order of the questions included in the survey.
- A total of 2,100 telephone surveys were completed, with 300 in each study area. The survey took approximately 13 minutes to complete. The results from the telephone survey indicated that over 70 percent of the respondents agreed that existing roads should be fixed first, existing roads should be toll-free, and tolls should be reduced after construction. Over 70 percent also agreed that toll revenues should be used within the

same region, that trucks should be charged higher tolls, and that the same toll rates should be used during rush-hours and non-rush hours with no variable pricing.

- The telephone survey results did vary by areas. Residents of large urban areas were more aware of toll projects and respondents in Austin were most supportive of new spending. Residents of smaller urban and rural areas were more supportive of exclusive toll tag use, but more concerned about toll tag privacy. Residents in the Rio Grande Valley region were the most opposed to raising the state gas tax and to public/private partnerships.
- The survey results also indicated that males, non-workers, and individuals with higher household incomes and higher education levels were more supportive of increasing transportation spending. Non-SOV commuters were also supportive of increasing transportation spending. Older individuals and new residents were more supportive of using tolls on new and existing roads, while retirees were less supportive.
- The telephone survey results also indicated that individuals with higher education levels and those aware of toll projects were more supportive of public/private partnerships. Retirees and males were less supportive of public/private partnerships. Older males, toll road commuters, and long distance commuters were more supportive of HOT lanes. Individuals who use toll roads often, but not for commuting, were less supportive of HOT lanes.
- A total of 324 complete responses were received through the mail out/mail back and online follow-up survey. This number included 183 mail out/mail back surveys and 141 online surveys based on 1,112 contacts. The results from these surveys indicated that among existing revenue sources, there was greatest support for increasing driver behavior fines. Among new revenue sources, there was greatest support for emissions fees, congestion pricing, and tolls. Over 70 percent agreed with the following statements: "higher tolls should be in place for heavier, more polluting vehicles and dedicated heavy-vehicle lanes should be added to highways."
- Frequent toll road users were more supportive of conversion of free lanes to tolled lanes, while new residents, those who saw slight traffic increases in their area in the past five years, long-distance commuters, and Austin residents were less supportive. Respondents who lived in more densely populated areas, Rio Grande Valley residents, full-time workers, students, and retirees were more supportive of alternative travel modes. Respondents with medium levels of education, longer-term residents, and males were less supportive of alternative travel modes.
- Focus groups were conducted in Lubbock, Houston, San Antonio, Brownsville, and Dallas. The number of participants in each focus group ranged from five to 10, with a total of 43 individuals participating in all five focus groups. The recruitment criteria included frequency of commute to work or school (preferably three-to-five times per week), proximity of residence to proposed toll-road locations (within five miles), and variability in age, education, employment status. The focus groups discussion guide included questions on local traffic conditions, perceptions of toll roads, and the best approaches to distribute information on toll projects. An informational video was shown to participants, along with test messages and information on toll projects.

- Results from the focus groups indicated that drivers are generally unaware of the severity of congestion and population growth, how transportation is funded, and the costs of highway construction and maintenance. The focus group results also indicated that opposition to toll roads may be linked to uninformed drivers and skepticism of state and local governments. The results indicated that drivers may be persuaded by toll users' positive experiences and that there is a need to better inform residents about toll road technology and policies.
- Frequent toll road users, toll road commuters, frequent rush-hour travelers, and those who have lived in their region for less than three years were more supportive of the TTC. Long-distance commuters were less supportive. Residents of the Rio Grande Valley and San Antonio, as well as older persons and full-time workers indicated they tend to drive less during rush hours. Residents in larger households indicated they would change their travel mode.

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BREAKOUT SESSION – ENVIRONMENTAL JUSTICE AND MANAGED LANES USERS

Tina Collier, Texas Transportation Institute, Presiding

Do HOT Lanes Service Women's Travel Needs?
Theresa Dau, Parsons Brinckerhoff

Theresa Dau discussed HOT lanes and the travel needs of women. She highlighted the key elements of women's transportation needs and the characteristics of HOT lanes. She described the experience to date with the 91 Express Lanes in Orange County and the I-15 FasTrak^{TM} lanes in San Diego, and surveys conducted on the proposed I-680 HOT lanes in Alameda County.

- Women's expectations for transportation encompass various needs and responsibilities. These needs may include commuting to and from work, managing child care duties, running household errands, and participating in social and recreational activities. HOT lanes provide an option for improved travel conditions, which may accommodate women's transportation needs related to reliability, flexibility, and safety.
- Features of existing HOT lanes include limited-access, barrier-separation, free or reduced cost access to qualifying HOVs, and tolled access by other vehicles not meeting passenger occupancy requirements. Possible benefits from HOT lanes include helping balance supply and demand for limited roadway capacity, generating revenues for needed transportation improvements, and providing more transportation options, particularly to those who have a high value of time, such as working mothers.
- The 91 Express Lanes in Orange County, California are located in the median of the Riverside or SR 91 Freeway. The facility is currently managed by the Orange County Transportation Authority (OCTA), with operational support by the California Public Transportation Company (CPTC). Tolls on the 91 Express Lanes range from $1.05 to $7.00, depending on the level of congestion. 3+ HOVs do not pay a toll, except during the Friday p.m. peak period when they pay 50 percent of the toll. Enforcement of the facility is provided by assigned California Highway Patrol (CHP) officers.
- A customer satisfaction survey was conducted by OCTA in June 2003. Approximately 400 people – half women and half men – were included in the interview. The survey results indicate that 37 percent of the women identified themselves as frequent users of the 91 Express Lanes during the a.m. peak period, compared to 28 percent of the men. During non-rush hours, 26 percent of the women identified themselves as frequent users, compared to 16 percent of the men. Approximately 91 percent of the women and 85 percent of the men indicated they were satisfied with their experience using the 91 Express Lanes.
- The I-15 HOT Lanes in San Diego are owned by Caltrans and operated by the San Diego Association of Governments (SANDAG). The two-lane reversible HOV lanes on I-15 were expanded to HOT lanes, allowing SOVs to use the facility for a fee. Dynamic pricing is used on the facility, with tolls varying by the level of congestion. The average

toll during the peak hours is $4.00. Enforcement is provided by CHP based on voluntary overtime. Current plans are to include the HOT option in the extension of I-15.

- A survey of I-15 HOT lane users was conducted by SANDAG in September and October of 2001. Approximately 800 individuals were included in the survey. Approximately 24 percent of the women and 21 percent of the men reported driving alone and paying the toll to use the HOT lanes. Some 74 percent of the women and 69 percent of the men indicated they approve of the HOT project. Approximately 73 percent of the women and 68 percent of the men reported supporting the time-saving option on I-15.
- HOT lanes are being proposed on I-680 in Alameda County. The HOT lanes were proposed by the Alameda County Congestion Management Agency (CMA) to ease congestion in the southbound HOV lane and to fund construction of the northbound HOV lane. The proposed I-680 HOT lanes would use the FasTrak™ toll collection, allow 2+ HOVs to travel for free, and use CHP enforcement. The HOV/HOT lanes are concurrent flow lanes with no physical barrier separation from the general-purpose lanes.
- The Alameda County CMA conducted a public opinion survey in August 2003. Approximately 450 individuals, including 225 women and 225 men, in Alameda County participated in the survey. Some 63 percent of the men and 60 percent of the women supported the choice to pay for faster commutes. Approximately 62 percent of the women and 55 percent of the men supported video and CHP enforcement. Finally, 73 percent of the women and 65 percent of the men supported the HOT lanes demonstration project.
- The results of these surveys indicate some general trends. First, women appear to use HOT lanes more frequently than men. Second, a large majority of both women and men perceive the HOT lanes to be safe. Third, both women and men perceive CHP enforcement to be effective. Fourth, based on the 91 Express Lanes survey results, 54 percent of women, would be willing to pay more to avoid congestion or delay compared to 46 percent of the men. Finally, all three surveys indicate high satisfaction and support for HOT lanes, especially among women.
- The results from these three surveys indicate that HOT lanes do serve women's travel needs. The survey results indicated that HOT lanes appeal to both women and men, with more frequent use and higher satisfaction and support for HOT lanes among women.
- Additional research would be beneficial to further explore the relationship between HOT lanes and the travel needs of women. First, it would be of benefit to review survey data from outside California and overseas to determine if the trends found in California hold true. Second, research is needed to explore equity issues, such as working mothers and their ability to pay. Third, investigating possible differences in the use of HOT lanes among women by race and ethnicity is needed. Finally, conducting a detailed survey to explore differences in why women and men use HOT lanes is needed.

Beyond Lexus Lanes: Addressing the Equity Implications of HOT Lanes
Gian-Claudia Sciara, University of California, Berkeley and Asha Weinstein, San Jose State University

Asha Weinstein and Gian–Claudia Sciara discussed the results of recent research examining equity implications associated with HOT lanes. They described the research goals, methods, findings, and assessment of planned strategies.

- The research goals were to develop materials and tools that can inform community members, elected officials, and agency staff in assessing the equity of a HOT lane project. The research method included in-depth interviews with key stakeholders on 11 operating HOT, HOV, and toll projects, reviews of newspaper articles, and a review of the professional literature on equity and value pricing.
- A first issue to be considered is how equity is defined. For this research an equitable HOT lane project was one that distributed costs and benefits in an acceptable fashion across all relevant groups of people.
- One of the research findings was that equity concerns are omnipresent but varied. Equity issues have been raised in every project studied except Houston. Concerns over equity were raised in different forms and by different groups.
- Three primary concerns related to equity were identified. The most common concern was the low-income drivers. Stakeholders in some regions also raised concerns about geographic and modal equity. Equity concerns were addressed in the media. Newspapers frequently addressed equity, but usually in a superficial sensationalist way.
- The responses from transportation agencies to equity concerns were diverse. Approaches included educational efforts, integrating equity analysis into project planning, and designating the project as a pilot.
- The results from the interviews and the review of newspaper articles and available literature were used to identify five assessments strategies for addressing equity concerns. The first assessment strategy is to evaluation each project individually.
- The second assessment strategy is to sustain the evaluation of equity over time. This approach includes fostering community dialogue on equity during initial project conception, assessing likely equity impacts during planning phases, and continuing evaluations as needed after initial implementation.
- The third assessment strategy is to explore the multiple dimensions of equity. In addition to concerns related to low-income drivers, potential geographic and modal equity issues should be examined.
- The fourth assessment strategy is to evaluate income equity in detail. This evaluation should examine if low-income individuals will benefit as solo drivers. Potential barriers for low-income drivers are the ability to acquire a transponder and the ability to pay the toll. The potential for low-income individuals to benefit as users of modes other than solo driving, such as transit and carpools, should also be examined.

- The fifth assessment strategy is to compare HOT lanes to alternative strategies and projects. This assessment might compare the equity implications of a HOT lane project with those of reasonable policy alternatives, such as sales or fuel taxes as alternative revenue sources.

Results of HOV Lane Attitude Surveys in Southern California
John Billheimer, Consultant

John Billheimer discussed the results of surveys of HOV lane users and non-users conducted in different metropolitan areas in California from 1978 to 2003. He highlighted some of the key findings from the surveys and described trends in use and perceptions related to HOV lanes.

- The following surveys of HOV lanes users and non-users were examined:
  - Santa Monica Diamond Lane Evaluation (1978), carpoolers and general-purpose lane drivers, Southern California;
  - Transportation System Management (TSM) Project Violation Rates (1981), carpoolers and general-purpose lane drivers, Northern and Southern California;
  - HOV Lane Violation Rates (1990), carpoolers and general-purpose lane drivers, Northern and Southern California;
  - San Francisco Bay Area HOV Lane User Study (1990), carpoolers, Northern California;
  - Origin/Destination Studies in Six Bay Area Corridors (1995), carpoolers and general-purpose lane drivers, Northern California;
  - Origin/Destination Studies on Three Bay Area Bridges (1997), carpoolers and general-purpose lane drivers, Northern California;
  - Origin/Destination Studies in Eight Bay Area Corridors (1997), carpoolers and general-purpose lane drivers, Northern California; and
  - Regional HOV System Performance Study (2003), carpoolers and general-purpose lane drivers, Southern California.
- There was a good deal of negative reaction among drivers, the public, and the media to the Santa Monica diamond lane project in 1978. This project, which converted an existing general-purpose lane to an HOV lane, was terminated after only about 10 weeks of operation.
- A summary of the findings from the various surveys indicates that HOV lane support has grown over time. In southern California only about 14 percent of survey respondents supported the Santa Monica diamond lanes in 1978. Surveys in 2003 indicated some 75 percent of respondents supported the HOV lanes on I-405, SR 55, and SR 55/I-5. In northern California, 31 percent of the 1981 survey respondents supported the HOV lanes on Alameda 580 and some 60 percent of the respondents supported the HOV lanes in the San Francisco Bay Area.

- The surveys conducted in 2003 in southern California indicated strong support for HOV lanes. Over three-quarters of drivers express support or strong support (43 percent) for bus/carpool lanes in southern California. Only 5 percent strongly opposed the lanes, while 6 percent opposed the lanes.
- The 1997 survey conducted in northern California found that many carpool lane users and non-users overestimated HOV lane time savings. Similar results were recorded in the 2003 surveys in southern California.
- The 2003 surveys in southern California identified a number of characteristics about carpoolers. First, most carpools, 54 percent, are formed with family members, while 36 percent are formed with co-workers. Second, carpoolers have longer trip lengths, an average of 23.8 miles, than SOV drivers, who average 19.8 miles. Third, carpool longevity has more than doubled from pre-HOV lane reports. Current carpoolers have been ridesharing regularly for 4.5 years. Before the HOV lanes were opened, drivers reported carpools existed for 2.0 years. Fourth, carpoolers sometimes drive alone and SOV drivers sometimes carpool. Only 41 percent of self-reported carpoolers share a ride every working day. Self-described solo drivers carpool roughly one day every two months.
- The 1997 survey results from northern California indicate that carpoolers reflect a diverse mix of people. Only 62 percent of self-reported carpoolers shared rides more than half the time. Self-described solo drivers carpooled about one day every two months. Roughly 10 percent to 20 percent of HOV lane users are self-proclaimed solo drivers who just happened to be carrying a passenger that day.
- A 1981 statewide survey provides information related to perceptions of occupancy violations. First, the results indicate that drivers tend to overestimate low violation rates and underestimate high rates. Second, drivers are likely to be insensitive to changes in violation rates between 10 percent and 20 percent. Third, drivers consider occupancy violations to be a minor problem, but over 70 percent of drivers perceive a need for more enforcement.
- The findings from the 2003 survey in southern California highlighted the impact of the HOV lanes on driving patterns. Approximately 10 percent of solo drivers and 43 percent of carpoolers said that the HOV lanes had caused them to change their driving patterns in some way. Approximately 7 percent reported changing the time they drove and 6 percent reporting changing their travel route.
- The 1995 and 1997 survey results in northern California also indicated that the HOV lanes have had an impact on driving patterns. Some 18 percent of solo drivers and 52 percent of current carpoolers said the HOV lanes had caused them to change their driving patterns in some way. Changing the time they traveled was reported by 11 percent of the solo drivers, while forming a regular carpool was the predominant change for carpoolers.
- Results from focus groups conducted in southern California in 2003 provide an indication of perceptions related to HOV lanes. Perceptions from the focus groups included that the lanes have had positive impact on carpool formation and save time for carpoolers. Other perceptions were that the HOV lanes have caused mainline breakdown at key exit point, and the HOV lanes make trips scarier and more dangerous. Other perceptions included

the HOV lanes cost solo driver time, the barrier-free lanes are unsafe, and illegal entries and exits are more prevalent and dangerous. Additional perceptions were that the HOV lanes were fair and that illegal use by solo drivers is minimal.

BREAKOUT SESSION – HOV AND TOLL FORECASTING – WHAT'S IN THE BLACK BOX?

Don Samdahl, Mirai Transportation Planning and Engineering, Presiding

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Traffic and Revenue Analysis: I-10 Managed Lanes in Houston and I-635 Managed Lanes in Dallas

Cissy Szeto, Wilbur Smith Associates and Stacey Falzarano, Resource System Group, Inc.

Cissy Szeto and Stacey Falzarano described the traffic and revenue analysis conducted for the I-10West managed lanes in Houston and the I-635 managed lanes in Dallas. They summarized the key characteristics of each project, the objectives of the study and the results of different tasks. The study was conducted for TxDOT and HCTRA.

- The I-10West managed lanes are just over 11 miles in length. The managed lanes are part of a larger freeway widening project. An additional general-purpose lane is being added and the frontage roads are being widened. The existing reversible HOV lane will be expanded to four managed lanes – with two lanes in each direction of travel and with four access points.
- The operational characteristics of the I-10 West managed lanes will allow buses to travel for free and 3+ HOVs to travel for free during the peak-periods. SOVs and two-person carpools will have to pay a toll. Pricing levels will be used to manage demand to maintain freeflow speeds.
- The I-635 managed lanes are just over 18 miles. Some improvements are being made to the general-purpose lanes and the frontage roads as part of the project. The concurrent flow HOV lanes will be converted to managed lanes. The number of managed lanes will vary from six-to-four-to-two lanes.
- The operational characteristics of the I-635 managed lanes will allow buses and 3+ carpools to travel for free. Allowing two-person carpools to travel for free and requiring them to pay a toll were both tested. SOVs will be tolled. Pricing will be used to manage demand to maintain freeflow speeds.
- The first study objective was to evaluate the projects under a range of scenarios. The scenarios evaluated included different configurations with varying access and capacity and varying HOV definitions. The second objective was to evaluate each alternative for six time periods. These time periods were 6:00 a.m. to 8:00 a.m., 8:00 a.m. to 9:00 a.m., 9:00 am. to 3:00 p.m., 3:00 p.m. to 4:00 p.m., 4:00 p.m. to 6:00 p.m., and 6:00 p.m. to 7:00 p.m. The third objective was to provide estimates of transactions and toll revenues. The fourth objective was to aid in determining potential project phasing. The final objective was to provide a traffic and revenue report suitable for use in project financing.
- The study methodology focused on determining the current demand in the corridors, the growth in demand, the base market share, and the reaction to different toll levels. The process also included a pricing analysis, traffic estimates, and revenue estimates.

- Estimating the demand for managed lanes is different from estimating the demand for toll facilities. Managed lanes are different in that they are in direct competition with the adjacent free lanes. Managed lanes are highly sensitive to changes in global demand. Managed lanes attract a small share of overall demand and it appears that travelers do not use them every day.
- Stated preference surveys were conducted to test different pricing and operation scenarios. More than 1,000 corridor travelers were surveyed about actual trips. An adaptive computer-based survey technique was used with laptop and Internet administration. Individuals were intercepted at activity center and surveys were e-mailed to workers at major employers.
- The computerized survey technique obtained information on a recent trip, including frequency, time of travel, travel time, delays, route, and occupancy levels. A description of the project was provided and participants were asked to answer a series of stated preference questions which focused on travel time and toll cost trade-offs. Questions also tested the impact of alternative concepts such as single-lane verses two-lane managed lanes, tunnels, and allowing trucks.
- The survey results indicated that in terms of value of time, the median was lower than the mean and the distribution had a very long tail. In addition, the one-lane option was less attractive by about 20 percent, a tunnel was less attractive by about 7 percent, and allowing trucks was less attractive by 22 percent.
- Pricing and operational considerations included managing demand in the managed lanes to maintain freeflow speeds, revenue maximization, and optimizing speeds in the general-purpose lanes.

Evaluating Pricing Strategies for Managed Lanes
Jianling Li, University of Texas, Arlington

Jianling Li described a recent research project conducted for TxDOT, which developed a pricing evaluation model for managed lanes. She noted the assistance of Sia Ardekani and Shekhar Govind from the University of Texas at Arlington with the project.

- The definition of managed lanes used in the study focused on a freeway corridor served by two types of travel lanes – general-purpose lanes and lanes that are managed by vehicle-occupancy, tolling, or some other strategy. Managed lanes are being implemented in specific freeway corridors in Houston and Dallas. Managed lanes are being considered in other freeway corridors in those cities and other areas in Texas. Managed lanes are also being implemented and considered in cities throughout the country.
- Price model theory suggests that the price or toll a traveler pays should be directly related to the time saved by using the facility. Thus, tolls should be higher when significant travel time savings are realized and lower when the time savings are smaller. The usage function should be related to the number of users based on different toll levels. More users can be expected to use a managed lane when the tolls are low. The number of anticipated users declines as toll charges increase. The flow model examined the anticipated time savings compared to the number of users.

- A web-based model was developed in the research project. The model can be found at the website http://transresearch.uta.edu/MLTollModel/. The model was designed to be user friendly, providing step-by-step data entry. Project specific information related to the facility characteristics, the user groups, and traffic conditions is entered first. The objectives of a managed lane project can be used to establish a toll price to maintain the speed on the managed lanes at a specific mph, to maintain the traffic flow on the managed lane at no more than a specific percentage of capacity, and to establish a desired LOS in the managed lane. For a specific objective, the model calculates the recommended toll, the projected traffic flow in the managed lane, the number of HOVs allowed to use the managed lane for free, the managed lane speed, the number of SOVs in the managed lane, and the speed and traffic in the general-purpose lanes.
- The model features include information on various user groups. The model is applicable to various geographic locations. It allows for the evaluation of toll options based on demand and desired performance. The model outputs include recommended optimal pricing policies, highlighted network performance in terms of speed and flow in general-purpose lanes and managed lanes, and estimated revenue.
- There are a number of issues that should be considered in using this model or any other model. First, a model is only as good as the input values. If bad input data is used, the model results will not be very good. Allowance also needs to be made for diversion of vehicles to alternate routes. Revealed preferences may also need to be considered. Other issues that may need to be addressed include multiple use eligibility, air quality impacts, and interoperability with other programs.
- There are also a number of implementation issues that may influence the use of different types of managed lanes. These implementation issues include the use of all electronic toll collection, the frequency of toll changes, and how drivers are informed of toll levels. Other potential issues include monitoring demand in real-time and enforcement methods. Finally, questions about social justice with different approaches may exist in some areas.

Development of a Toll Revenue Estimating Tool
Bill Stockton, Texas Transportation Institute

Bill Stockton discussed the development and use of a sketch planning level tool for estimating toll revenues funded through a TxDOT research project. He summarized the basic elements of estimating toll revenues, the assumptions behind the estimates, and the development of the toll revenue estimating tool.

- At the basic level, toll revenues can be estimated by multiplying the number of toll facility users by the toll. There are numerous assumptions or factors that may influence the demand or use of a toll facility, however. These assumptions include the total corridor traffic, the toll road traffic share, and the projected traffic growth rates. The anticipated traffic mix, which might include SOVs, HOVs, and buses, will also influence toll revenue generation. Other factors to be considered include the annual revenue days, toll rates, price elasticity, and willingness to pay.
- The toll revenue-estimating tool is a sketch-planning-level model. It is an Excel-based spreadsheet model that allows users to estimate toll revenues based on different

assumptions and factors. It is not a detailed traffic and revenue study model. The toll revenue estimating tool provides transportation professionals with a better understanding of the reasonableness of revenue estimates and the assumptions used with the forecast. It also provides policy makers with an idea of the confidence intervals on revenue estimates.

- The toll revenue estimating tool can simulate a range of scenarios. The assumptions are random variables. The tool provides reasonable estimates of revenues and identifies the most critical assumptions.
- Outputs from the toll revenue estimating tool can be displayed in different ways, including bar charts and graphs. The tool allows users to run a sensitivity analysis on different assumptions. The assumptions can be modified and the analysis rerun to identify the potential impacts on revenue generation.
- The toll revenue estimating tool is currently in the final stages of review. It should be available soon for use by all interested groups.

BREAKOUT SESSION – MORE ON HOV, HOT, AND MANAGED LANES IN TEXAS

Delvin Dennis, Texas Department of Transportation, Presiding

Managed Lanes on I-10 West and Other Houston Projects

Sally Wegmann, Texas Department of Transportation, Houston District

Sally Wegmann described a number of HOV and managed lane projects underway in Houston. She summarized the current HOV system and the QuickRide Value Pricing project. She discussed the managed lanes on I-10 West, which are under construction.

- The Houston HOV system is recognized as a one of most extensive networks of HOV lanes in the country. The system includes 104 miles of barrier-separated lanes on six freeways. The HOV system has been developed over the past 25 years and includes HOV lanes, park-and-ride and park-and-pool lots, transit centers, and direct access ramps. Planning, designing, funding, operating, maintaining, and enforcing the HOV lanes represent the joint efforts of TxDOT and Houston METRO.
- The QuickRide Value Pricing program is in operation on the I-10 West HOV lane during the morning and evening peak hours and on the U.S. 290 HOV lane during the morning peak hour. The QuickRide program allows registered two-person carpools to use the HOV lanes during the 3+ peak hours for a $2.00 per trip fee. Participants must enroll in the QuickRide program, have an AVI transponder, and maintain a balance in their account.
- The QuickRide program on the I-10 West HOV lane was implemented in January 1998 and the U.S. 290 HOV lane was added to the program in November 2000. Additional enhancements to the value pricing program have been examined recently. The goals of these enhancements are to improve ridership, to increase revenues, and to improve enforcement.
- Enforcement of QuickRide the program involves a number of elements. These elements include manual verification of occupancy levels by METRO police officers, ensuring that vehicles have valid AVI transponders, and ensuring that the AVI transponders are read and the accounts are charged. The AVI system was in place on the HOV lanes as part of the real-time traffic speed map.
- A test was recently conducted on the I-10 West HOV lane to better ensure that valid AVI tags are being used. Equipment was added at one location to read AVI tags. A green light was illuminated for valid tags. A hand-held device, which officers could use to scan AVI tags, was also developed. This device will be tested on the US 290 HOV lane in the future. Other program enhancements on the US 290 HOV lane include wireless detectors to monitor lane volumes and speeds, dynamic message signs (DMS) to display the QuickRide fee, and updated program signs.
- The I-10 West managed lane project is under construction. A 23-mile section of the I-10 West Freeway from I-610 to the Fort Bend County line is being reconstructed. The current HOV lane operates in most of the section. The new cross-section from I-610 to

SH 6 will include two managed lanes, four general-purpose lanes, and a three-lane frontage road in each direction. The cross-section from SH 6 to SH 99 will include one managed lane, four general-purpose freeway lanes, and a three-lane frontage road in each direction. The cross-section from SH 99 to the Fort Bend County line includes four general-purpose freeway lanes and a three-lane frontage road in each direction. To date, eight of nine project segments have been let. The total construction cost is approximately $1.44 billion and the estimated completion date is the spring of 2009.

- Development of the managed lane concept involved TxDOT, METRO, HCTRA, and FHWA. A memorandum of understanding (MOU) among TxDOT, METRO, and Harris County, acting for HCTRA outlines the roles and responsibilities of the three groups and the basic elements of the operating agreement. Under the operating agreement, 3+ carpools may travel toll-free during the morning and afternoon peak periods, METRO may operate up to 65 buses an hour toll-free, and METRO may operate METROLift and support vehicles toll-free. In addition, a LOS C will be maintained. A tri-party agreement between TxDOT, FHWA, and Harris County was also signed outlining responsibilities for design, construction, and operation of the managed lanes. HCTRA is providing a $250 million contribution and will operate the toll elements of the lanes. TxDOT and HCTRA are examining the potential of managed lanes on other freeways.

Update on HOV Lanes in the Dallas Area
Koorosh Olyai, Dallas Area Rapid Transit and Scott Cooner, Texas Transportation Institute

Koorosh Olyai and Scott Cooner discussed the HOV lanes in the Dallas area. They described the current HOV lanes, use levels, and other performance indicators. They summarized the planned managed lanes projects in the Dallas area.

- The HOV lanes in the Dallas area represent the coordinated effort of Dallas Area Rapid Transit (DART) and TxDOT. Each agency has different roles and responsibilities related to the facilities. Both agencies share planning and design activities. TxDOT is responsible for construction. DART is responsible for operation and enforcement, and both agencies support maintenance. TTI also assists with operations planning.
- HOV lanes are currently in operation on I-30, I-35W, I-635, and I-35E/US 67. According to the 2000 Census, Dallas had the highest percentage of work trip carpoolers in the country. Some 18 percent of workers in Dallas carpool. The HOV lanes are a key reason for this high level of carpooling.
- The HOV lanes are a key part of the overall transportation system in the Dallas area. Other elements of the system include the TxDOT/DART ITS Control Center, the motorist assistance program, the DART bus and LRT system, commuter rail, the freeway system, and the toll roads operated by the North Texas Tollway Authority (NTTA).
- The important role the HOV lanes play in the Dallas area can be seen through a number of measures. DART monitors key performance indicators including subsidy per passenger and mode share. The HOV lanes have the lowest subsidy per passenger, $0.15, of the modes operated by DART. By comparison, the subsidy per passenger for LRT is $3.24 and for buses is $3.91. The HOV lanes have a mode share of some 38 percent, which is second to only the bus system, which has a mode share of 41 percent.

- HOV lanes and managed lanes are an important part of the future transportation system in the Dallas area. TxDOT, DART, and NTTA are working together on a number of managed lane projects. In developing these projects, the proposed roles and responsibilities for TxDOT are right-of-way purchase and ownership, construction management, and maintenance. DART will be responsible for HOV design, congestion pricing, enforcement, and daily operations of the HOV element. NTTA will be responsible for toll collections and enforcement of the toll elements through cameras and other technologies.
- HOV lane system ridership was approximately 33.4 million in FY 03 and 34.9 million in FY 04. The average travel speeds in the HOV lanes and the general-purpose freeway lanes improved from before and after the opening of the HOV lanes. The average travel time savings for travelers using the four HOV lanes in FY 04 ranged from 12 minutes on the I-30 HOV lanes to almost 14 minutes on I-35E. Peak hour vehicle volumes ranged from 950 vehicles on the I-35E HOV lanes to 1,400 vehicles on both I-30 and I-35E/US 67 HOV lanes.
- Violation rates on the HOV lanes are in the range of 6 percent to 7 percent. Peak hour automobile-occupancy rates range from 2.2 to 2.9 on the four HOV lanes. The overall automobile-occupancy rates for freeway corridors with HOV lanes increased with the addition of the HOV lanes. The automobile-occupancy rate on I-30 increased from 1.33 to 1.37 and the rate on I-35 increased from 1.12 to 1.26.
- The North Central Texas Council of Governments (NTCOG) has estimated the air quality benefits of the HOV lanes. These estimates include a reduction in volatile organic compounds (VOC) of 51 pounds per day on I-30, 100 pounds per day on I-35E, and 237 pounds per day on I-635. The HOV lanes also have resulted in an estimated reduction in oxides of nitrogen (NOx) of 190 pounds per day.
- The objectives of the HOV lanes are to increase vehicle occupancy levels, to increase person-movement capacity, to provide a cost-effective transportation improvement, and to generate public support. Other objectives include improving air quality and reducing fuel consumption. A final objective is that HOV lanes should not adversely impact the freeway general-purpose lanes. These objectives have generally been met. The person-movement capacity of the freeways has been increased. The HOV lanes are cost-effective. Public support for the HOV lanes in I-30 has been quantified through surveys. NTCOG estimates indicate decreased fuel consumption. There has been no adverse impacts on freeway speeds.
- A recently completed research project indicates that crash rates on I-35E and I-635 increased after the HOV lanes began operation. The research project examined the injury crash characteristics from 1,150 crash reports during the period from 1997 to 2000 on I-35E and I-635. Only crashes occurring in HOV lane or the inside general purpose lane were included in the assessment. The results indicate that crash rates increased after HOV lanes opened on I-35E and I-635. Speed differentials and difficulties with merging due to congestion appear to be the major contributing factor to this increase. No increases in crashes were documented on the I-30 HOV lane, which uses a movable barrier. As a result of this research, a minimum cross-section which includes a four-foot buffer between the HOV lane and the general-purpose lane was recommended.

Houston METRO HOV Traffic Control Devices – Inventory Management System
Muhammad Tahir Masood, Metropolitan Transit Authority of Harris County

Muhammad Tahir Masood discussed the Houston METRO HOV lane traffic control devices inventory management system. He provided an overview of the HOV system in Houston and the development and use of the traffic control devices inventory management system.

- Houston METRO is one of the largest public transportation agencies in the country. Currently, there are approximately 104 miles of primarily barrier-separated HOV lanes in operation in six freeway corridors in Houston. A concurrent flow HOV lane in the I-10 West corridor connects to the barrier-separated lane. The Houston HOV lanes carry approximately 116,000 person trips and 37,433 vehicles trips daily. The HOV lanes provide priority to buses, vanpools, and carpools.
- In 2003, METRO contracted with TransCore to collect data on 3,709 traffic control devices located along the six HOV lane corridors. This information was integrated into a database that is linked to a dynamic global information system (GIS)-based map of the Houston metropolitan area.
- The objective of the HOV lane devices inventory database is to create a tool that can be used by METRO staff to look up, review, query, and manage the traffic control devices along the six HOV lanes. Based on current industry practices, a GIS-based map was used to plot the location of each device. Device location was obtained in the form of latitude and longitude coordinates using global positioning system (GPS) equipment. Each device located on the map consists of a dynamic link to a datasheet of attributes for the device, as well as a digital picture.
- Both static and dynamic traffic control devices are included in the inventory. Static devices consist of plywood and aluminum signs, vehicle impact attenuators, farm gates, and pavement markings. Approximately 80 percent, or 3,050 out of the 3,709 devices, are static. Dynamic devices include changeable and DMS, rotating drum signs, lane control and traffic signals, and vertical barrier gates and swing gates. Dynamic devices account for about 20 percent of the total devices.
- The static or dynamic devices in the inventory are classified as either signs, gates, or signals. The data is further classified by device class, location, sheeting and mounting, size, and condition. A digital picture of each device is included in the database.
- The attribute data was input directly in the field into a Microsoft Access database which minimized data input time at the office. After all the data was input into the Microsoft Access database, ArcView was used to plot the devices on a GIS map of the Houston metropolitan area. To ensure an open architecture and industry-accepted standards, Microsoft Access was used for the database software and ArcView was used as the GIS application. The result is a powerful data management tool that is user friendly and utilizes open architecture.
- Latitude and longitude data was collected on each device. A backpack GPS Trimble Receiver was used to record the latitude and longitude coordinates. This receiver provided an accuracy of about 3-10 feet.

- When the first phase of the HOV lane devices inventory database was completed, additional steps were taken to expand the system and to ensure that all potential user groups within METRO were involved. Meetings were held with staff from different departments including HOV operations and information technology. The database was migrated to a METRO server for better accessibility by staff. A second phase provided an inventory of the remaining devices, such as trailblazer signs and controller cabinets. These devices were added to the database and the ArcGIS map.
- Some 3,478 devices were added to the database in the second phase. This total included 56 in-lane devices, 36 park-and-ride lot devices, 36 slip ramp devices, 3,346 trailblazer signs, and four t-ramp devices. The locations of the trailblazer signs are very dispersed as they provide directions on accessing METRO facilities and HOV Lanes.
- Information in the database can be displayed and used in different ways. Data can be listed in an attribute table and mapped. The digital photos can also be displayed. Users can zoom in on any location to obtain an aerial photo map.
- There are three forms used for the data entry. Users can edit or add inventory items to the database relatively easily. Selecting "view a report" from the main menu opens the report criteria dialog box, which gives the user flexibility in selecting the appropriate criteria for a report. The dialog box is equipped with drop-down selection lists for easier use.
- The HOV lane devices inventory database provides an important tool for many users within METRO. It provides a centralized database of the HOV lane devices. It allows tracking of device upgrades and replacements. It generates GIS-based maps of HOV lanes, park-and-ride lots, and transit centers with the locations of different devices. The database generates reports of existing HOV lane devices including location, condition, size, and other attributes.
- The inventory database has provided a number of benefits. The database provides time savings from unneeded site visits. Staff can now respond quickly to concerns or complaints from bus riders, HOV lane users, community staff, and policy makers. The database easily generates reports and queries. It provides a centralized database that is easily updated and revised. Data is available to all levels of METRO staff from operations to management. When a police officer or HOV staff calls a project manager or other staff in the office from the field, staff can pull up the inventory map and discuss the situation on the phone. The updated database will help METRO fix HOV devices quickly and will contribute to the safe and efficient operation of the HOV facilities in Houston.

BREAKOUT SESSION – BUSES, BRT, HOV, AND MANAGED LANES

William Finger, City of Charlotte, Presiding

The Lincoln Tunnel Exclusive Bus Lane: The Nation's Most Productive Managed Lane
Mark Muriello, The Port Authority of New York and New Jersey

Mark Muriello discussed the Exclusive Bus Lane (XBL) in New York City. He described the tunnels and bridges operated by the Port Authority of New York and New Jersey, the operation of the Lincoln Tunnel, and the XBL. He also highlighted recent studies examining options for enhancing operation of the tunnel and increasing capacity.

- The Port Authority of New York and New Jersey operates a number of bridges, tunnels, and terminals in the New York City area. These facilities include the George Washington Bridge, the Bayonne Bridge, the Goethals Bridge, the Holland Tunnel, and the Lincoln Tunnel.
- The Lincoln tunnel serves the midtown corridor into and out of Manhattan. The tunnel includes three tubes, each with two traffic lanes. In the morning, two tubes, or four traffic lanes operate in-bound toward Manhattan. In the midday, the middle tube operates with one lane in each direction of travel, providing a total of three lanes inbound and three lanes outbound. In the afternoon, two tubes or four traffic lanes, operate outbound from Manhattan.
- The XBL provides priority for buses approaching the Lincoln Tunnel in the morning, inbound direction. The XBL is a contraflow lane for buses only on I-495. The XBL uses the inside lane of the westbound freeway for buses. The configuration provides for three general-purpose lanes and the XBL lane in the eastbound direction and two general-purpose lanes in the westbound direction.
- The XBL is the busiest bus lane in the U.S. Some 1,700 buses use the lanes on a daily basis. These buses serve 62,000 weekday commuters. The XBL serves more commuters to Midtown than PATH, Ferries, or Penn Station commuter rail. The XBL saves commuters 15-20 minutes each day compared to traveling in personal vehicles.
- The Lincoln Tunnel and the XBL are significant parts of the mass transit system in the New York City area. Buses carry nearly 80 percent of all trips through the Lincoln Tunnel during the 6:00 a.m.-to-10:00 a.m. time period. The XBL alone carries over 50 percent of these commuters. Approximately 55 percent of all bus commuters to the Manhattan CBD arrive via the Lincoln Tunnel.
- The number of buses using the XBL has increased significantly over the past 25 years. A number of operational improvements have been made to deal with these increases and to enhance bus operations. A new acceleration lane was added to help maintain travel speeds and traffic flow at merge points. The acceleration lane helped increase throughput of the XBL.
- Capacity shortfalls have also been addressed with operational changes to enhance efficiency. Examples of these operation changes include prohibiting charter buses prior to 9:00 a.m. and prohibiting empty buses at all times. Other examples include the

requirement that all XBL buses have E-Z Pass electronic toll payment tags and opening the XBL 15 minutes earlier.

- Planning is also underway examining the long-term transportation needs in the corridor. A range of options for the corridor are being assessed in partnership with an array of partners. These partners include federal, state, regional, and local agencies. Planning activities include a simulation of the Lincoln Tunnel corridor, and XBL expansion feasibility study, and a West Midtown bus parking and staging study. Other efforts include the Lincoln Tunnel HOT/express bus lane options study and the Lincoln Tunnel HOT/commercial vehicle priority lane options study.
- The Federal Transit Administration (FTA) is sponsoring a study to evaluate the feasibility of creating a second priority bus lane. The objective of the study is to increase the passenger throughput of the corridor and to enhance the reliability of the XBL. A full array of options are being explored. These options include operational alternatives to improve traffic flow and safety, physical alternatives for lane separation and ramp connections, and capital options to expand capacity. Capital options include the potential of widening the roadway, removing the center piers in the tunnel, and an elevated roadway scheme. Very limited right-of-way and the geometry of the existing facility provides significant challenges for many of the options.
- The FHWA's Value Pricing Pilot Program is sponsoring a study of pricing options to manage demand on the XBL with HOT lanes. A second XBL lane would be underutilized initially, so the study is examining the potential to fill some of the available capacity with non-bus HOVs or with non-HOV vehicles. The study is exploring pricing options that balance traffic demand with non-HOVs. Stated preference surveys of motorist are being conducted to help determine the tradeoffs between price and LOS variables, including travel time savings and trip-time reliability.
- The Lincoln Tunnel HOT lane study will help quantify and address concerns with potential lane conversion. The study will examine the LOS and delay in the remaining two regular travel lanes. It will also assess traffic queuing in the remaining regular travel lanes and the residual impacts on the local street network. The study will consider the need to balance demand for a new managed lane to ensure bus priority treatment and effective capacity utilization.
- The HOT commercial vehicle priority options study will explore the potential for commercial vehicles to receive priority treatment in a new special-use lane during the shoulders of the morning peak-period. The objective of this study is to find ways to take advantage of the presence of a separated lane to create travel time advantages and reliability improvements for small package and local delivery trucks.

The Evolution of Houston's Express Bus System
Jeff Arndt, Texas Transportation Institute

Jeff Arndt discussed the evolution of the express bus services in Houston associated with the development of the HOV lanes. He described the initial bus services operated with the I-45 contraflow HOV lane demonstration project, the implementation of more extensive services as the HOV lane system developed, and the integrated bus system in operation today.

- The I-45 North contraflow lane demonstration project was implemented in 1979. The bus service initiated with the contraflow lane focused on downtown Houston. Bus service was constrained by very limited access. There was no direct access to and from park-and-ride lots, which limited service flexibility. The concept of premium service, which included over-the-road coaches and other enhancements, was initiated with the contraflow lane. This initial authorized vehicle lane (AVL) concept with a focus on downtown Houston evolved into an HOV systems approach.
- Bus services were expanded as other HOV lanes were implemented. The design of the HOV lanes included direct connector ramps from major park-and-ride lots and transit centers. Service was expanded to non-downtown destinations, such as Uptown and Greenway Plaza. Direct service to these areas was provided from some park-and-ride lots, while connecting service from downtown or other transit centers was used in other cases.
- The continued development of the HOV lane system provided more flexibility in service. Direct non-CBD services continued to be expanded. Commuter route connections at transit centers were also implemented. In addition, a few two-way ramps were developed. Limited off-peak service was provided on some routes.
- The Houston experience highlights some lessons to be shared with other areas. First, the 2+ occupancy level caused some of the HOV lanes to become congested, degrading the travel time savings and trip-time reliability for buses and bus riders. Second, the system changed from trained and tested users to any traveler meeting the occupancy requirement. Over time there has been some erosion of transit incentives and vanpooling has diminished. Recently, there has been a focus on new users. The QuickRide program, which allows two-person carpools to use the I-10 West and the US 290 HOV lanes during the 3+ period for a fee, has been in operation for approximately five years.
- The current transit system in Houston represents a maturing service network. Transit centers provide connections for shuttle services, neighborhood circulation services, and commuter routes using the HOV lanes. There is also a connection to MetroRail, the new LRT line.
- Currently, some 104 miles of HOV lanes are in operation in six freeway corridors in Houston. The system also includes 25 park-and-ride lots and 17 transit centers. In December 2004, some 37,400 daily vehicle trips were made on the HOV lanes accounting for approximately 116,000 person trips. A total of 32,415 parking spaces were available at the park-and-ride lots, with approximately 17,126 parked vehicles on a daily basis.

Bus Rapid Transit Studies in the State of Maryland
Robert Boot, Jr., Parsons Brinckerhoff

Robert Boot discussed BRT studies and projects in Maryland. He described the main characteristics of BRT, summarized current BRT studies and projects in Maryland, and identified potential issues with implementing BRT.

- There are a number of factors influencing the consideration of BRT in communities throughout the world. BRT has lower upfront costs than other fixed guideway modes and can be implemented relatively quickly. BRT provides the opportunity to take advantage of underutilized rights-of-way. BRT provides operating flexibility and a way to increase transit ridership in select corridors. Local busways can also use portions of the dedicated BRT transitway.
- BRT is being considered in Maryland to help respond to increases in travel demand, limited resources, and transportation needs. The new governor and his administration examined future transportation needs and options. The study, Bus Rapid Transit: Flexibility by Design, Offering Mobility Options for Maryland, completed by the Maryland Department of Transportation (MDOT) notes that BRT combines the service and quality of rail with the flexibility of buses.
- The 2004 Maryland Transportation Plan focuses on the goals of efficiency, mobility, safety and security, productivity and quality. The plan includes numerous strategies for addressing mobility needs. Consideration is given to BRT as a viable alternative to provide realistic solutions to customer needs in corridors throughout the state. It includes active consideration of BRT on managed highway lanes to lower vehicle-related emissions and to improve regional air quality while providing viable new transportation alternatives to Maryland's commuters.
- BRT projects in Maryland include the Red Line in Baltimore, the Green Line in Baltimore, the I-270/US 15 Corridor, and the Bi-County Transitway. Planning for the Red Line in Baltimore started in 2000. The project originated from the first comprehensive planning effort in nearly 40 years. In March 2003, the Baltimore Region Transit Plan was completed and adopted. The plan serves as a guide for the expansion of the Baltimore transit system.
- A number of issues had to be addressed with the Red Line project. There was community sensitivity related to possible impacts on property values and environmental concerns. Available right-of-way was limited in many parts of the corridor. There were also concerns about operating BRT in downtown Baltimore without taking an existing traffic lane.
- The Green Line in Baltimore also originated from the 2003 Baltimore Region Transit Plan. Potential issues with the Green Line included the preservation of green space along the roadway, as an existing grass median is the proposed location for the BRT. Determining potential station locations and existing density and ridership are other potential issues.
- The Corridor Cities Transitway (CCT) is proposed in the I-270/US 15 corridor. The corridor stretches from the Shady Grove Metro Station in the south to Briggs Ford Road

in the north. The corridor includes both Montgomery and Frederick Counties. The CCT alignment was identified in county master plans in the 1970s. In 1994, a Major Investment Study (MIS) was initiated. Public meetings and workshops were held in 1995 through 1997 as part of this process. The MIS recommended alternatives for a detailed planning study. Informational public workshops were held in 2001 and focus group meetings were conducted in 2001 and 2002. The Draft Environmental Impact Statement (DEIS) was completed in 2002 and location/design public hearings were held. Public information meetings on express toll lanes (ETLs) were held in 2004 and minimization options refinements were completed.

- The Bi-County Transitway project was first identified in the Montgomery County Feasibility Studies in the 1980s related to the County's purchase of the Georgetown Branch railroad right-of-way. A transitway/trail was included in the County Master Plans. In 1996 the MTA completed the Georgetown Branch Transitway/Trail MIS/DEIS and the 2002 Capital Beltway/Purple Line Study was conducted. Possible issues with the Bi-County Transitway include potential community and environmental impacts. The jurisdiction in the area has different preferences. Connections with existing Metrorail service may also be a concern.
- There are some general issues that may need to be addressed with all the BRT projects. The first issue is the public perception of buses, which still seems to be lower than other transit modes. A second potential issue is balancing a quality system with possible impacts, including community impacts related to limited right-of-way. Third, there may be a perception that BRT is not conducive to transit oriented development. There may also be short-term and long-term implementation concerns.

Virtual Exclusive Busways (VEBs)
Robert Poole, Reason Foundation

Robert Poole described the virtual exclusive busway concept. He reviewed the early development of HOV lanes, which included a major focus on buses. He discussed how managed lanes and pricing can provide a virtual exclusive busway. He recognized the assistance of Ted Balaker of the Reason Foundation with the study and the presentation.

- Value pricing makes it feasible to realize the promise of exclusive busways by providing high-speed, high-frequency bus service that is sustainable on a long-term basis. In the real world of limited funding, however, there is a need to re-think how special-purpose lanes are used.
- Some HOV lanes began as busways. FHWA/UMTA policy in the 1970s supported busways. There are only a few exclusive busways today, however. These facilities include the Lincoln Tunnel XBL, the Pittsburgh busways, the Miami busway, the Seattle bus tunnel, and surface-street busways in Las Vegas and Orlando.
- Concerns about low use with bus-only lanes led to allowing HOVs. The Shirley Highway busway demonstration project started as buses, vanpools, and 4+ HOVs in 1973. The occupancy requirement was lowered to 3+ in 1989. The Los Angeles El Monte Busway on the San Bernardino Freeway in Los Angeles was opened to 3+ carpools in 1976. The I-10 West HOV lane in Houston began with a carpool definition

of 4+. This requirement was lowered to 3+ and then to 2+. Nationwide, the percentage of commuters who carpool has declined since 1980. The lane miles of HOV facilities have increased during this same time period.

- A significant percentage of carpools are formed with family members. This trend was identified in *Commuting in America II*. Recent surveys in San Francisco, southern California, southeast Wisconsin, and Minneapolis-St. Paul, indicate that family-based carpools account for between 33 percent and 67 percent of total carpools.
- It appears that vanpooling has been hurt by carpool preference. The time-savings realized by HOVs is reduced when the lanes are filled with 2+ carpools. Also a larger time savings is needed to offset the time cost of assembling a vanpool. Vanpooling is a highly cost-effective mode. The cost recovery ratio of vanpools sponsored by public transportation agencies throughout the country range from a low of 30 percent to a high of 117 percent. The overall average of nine vanpool programs was 80 percent. Vanpools are also energy-efficient. Vanpools have the lowest British Thermal Unit (BTU) per passenger mile of transit modes and personal automobiles.
- BRT in HOV lanes is not sustainable. At the 2+ vehicle-occupancy level HOV lanes become congested and travel time savings and trip time reliability to transit is lost. There may not be enough demand at a 3+ vehicle-occupancy level and an HOV lane may suffer from the empty-lane syndrome. There is no way to fine tune occupancy as you cannot have a 2.7 vehicle-occupancy requirement.
- Value pricing offers precise control. The I-15 HOT lane uses quasi-real-time variable pricing. The 91 Express Lanes use a fine-tuned rate schedule, with periodic adjustments. The Express Lanes carry 49 percent of peak traffic with 33 percent of the lane capacity. Both facilities offer reliable high speeds during rush hours.
- The virtual exclusive busway (VEB) concept would use value-priced lanes or networks. Pre-defined capacity would be reserved for buses and super-HOVs. The remaining capacity would be sold through value pricing.
- An example of VEB capacity highlights how the concept would work. First, the capacity of a lane is approximately 1,700 vehicles per lane per hour. Second, space would be allocated for 60 buses per hour, which is the equivalent of 120 personal vehicles an hour. The remaining available capacity in the lane is 1,580 vehicles an hour. A percentage of this capacity would be allocated to vanpools and super-HOVs. The remaining capacity would be allocated to paying customers.
- The managed lanes project on I-10 West in Houston provides a VEB prototype. The project represents a partnership among Houston METRO, TxDOT, and HCTRA. The four new managed lanes in the center of the expanded freeway will use value pricing. HCTRA is helping the fund the lanes and will operate them. METRO is guaranteed 65 buses and hour and 25 percent of capacity for buses and HOVs. A LOS C will be maintained using pricing and occupancy controls.
- The I-10 West managed lanes highlight the benefits to transit of this approach. Although METRO will not receive any toll revenues, it will be able to operate 65 buses an hour, which is above current service levels. FTA approval was granted based on maintaining a

LOS C. A 3+ occupancy requirement will be used for carpools to travel for free. All of these elements are covered in a MOU. A VEB can facilitate region-wide express bus/BRT service. A regional network would require construction of new lanes and flyovers. These major capital costs would be paid out of toll revenues.

- A VEB network provides a cost-effective approach. The cost of a 500-lane-mile VEB network has been estimated at $2 billion-to-$3 billion in the Reason Foundation studies. In comparison, FTA data indicates the cost of a 250 route-mile light rail system is $31 billion and the cost of a 250 route-mile heavy rail system is $38 billion. In addition, the VEB guideway would not depend on FTA funding.
- Managed lanes are being considered in a number of metropolitan areas through the country. Some changes in policies are needed for VEB networks. First, there must be clear FTA policy approving HOV to HOT conversions. Second, managed lanes need to be defined as "guideways" in Section 5302 of Title 49. Third, VEB or VEB networks need to be considered an alternative in new starts evaluations. Finally, VEBs should be made eligible for New Starts funding for buses, stations, and park-and-ride facilities.
- Exclusive busways are key to competitive express bus/BRT. Exclusive busways are too costly and are wasteful of capacity. VEB is feasible with value pricing and with agency cooperation. VEB can provide a win-win situation for transit agencies, motorists, and state departments of transportation.

BREAKOUT SESSION –PLANNING/MODELING FOR MULTIPLE USER GROUPS

Managed Lanes Modeling Process
Gustavo Baez, Wilber Smith Associates

Gustavo Baez discussed the modeling process for managed lanes. He provided a definition of managed lanes and presented the goals of the modeling process. He described the types of modeling studies typically conducted in Texas and illustrated issues that may be encountered in the modeling process.

- A managed-lane facility is defined as one that increases freeway efficiency by packaging various operational freeway efficiency and design actions. Managed lanes operations may be adjusted at any time to better match regional goals. The goal of the modeling process is to provide a set of tools to allow decision makers to select operational alternatives which optimize capacity, speed and/or speed, and revenue.
- Three types of modeling studies are typically conducted in Texas. A Level 1 or sketch-level evaluation takes approximately two-to-four weeks to conduct. A limited amount of information is needed for a sketch-level analysis, which provides a gross estimation of use levels and revenues.
- A Level 2 or preliminary study involves a greater level of detail. Level 2 studies take six-to-eight months to conduct. Data needed for a preliminary evaluation includes the existing and future highway configuration, speed and delay, traffic counts, and demographic and trip tables provided by the local metropolitan planning organization.
- The Level 3 or investment grade study is the most detailed evaluation, typically taking 10-to-12 months to conduct. Data needed for a Level 3 evaluation includes the existing and future highway configuration, speed and delay, traffic counts, and demographic and trip tables. In addition, an independent review of the demographic data is conducted. Stated preference surveys are also conducted to obtain a value of time distribution.
- A number of factors are important to consider in forecasting demand for a toll road. Examples of these factors include competing facilities, length of the facility, the level of congestion, and travel time savings. Other factors to consider include forecasted growth, the value of time, and willingness to pay. The inclusion or exclusion of a truck component will also need to be examined.
- A number of factors are also important to consider in forecasting demand for a managed lane. These factors are similar to those considered with a toll road. A significant difference with most managed-lane projects is that they are adjacent to or part of a freeway. As a result, for a managed-lane project, the freeway must be very congested and must be failing. An essential element of managed-lane projects is providing a travel time savings over the general-purpose freeway lanes. Time of day modeling is critical with managed lanes; especially examining the shoulders of the peak period versus the peak hour.

- Three levels can be studied when examining global demand. The maximum assumes the HOV or managed lane is free and available to anyone. The optimum is based on a toll rate and HOV class allows toll-free. The minimum assumes the HOV and managed lanes is very expensive for SOVs and toll-free only for HOV drivers. The global demand is not static, however, and will be influenced by the time-of-day and the direction of travel.
- The travel demand model can be run with different trip tables. The traffic simulation model estimate traffic operations. The models should be run for different time periods, the shoulders of the peak periods, and by directionality.
- Other elements may need to be considered in the modeling process. Short trips versus long trips and the minimum toll and the maximum toll should be considered. The current and projected transit use in the HOV lane should be explored. The toll rate variation and the use of a flat toll rate or a dynamic toll rate represent other considerations.

Estimating the Benefits from BRT/Managed Lane Alternatives Using SMITE-ML 2.0
Patrick DeCorla-Souza, Federal Highway Administration

Patrick DeCorla-Souza discussed the use of SMITE-ML to estimate the potential benefits of BRT and managed lane alternatives. He described the purpose of sketch planning, the features of SMITE-ML, and the use of the model. He also presented a case study application.

- Sketch planning can be used with BRT and managed lanes for a number of purposes. First, it can be used to compare managed lane concepts in terms of performance, social benefits, financial feasibility, and revenue cost. Sketch planning provides a quick response and typically needs only minimal data. Sketch planning provides a screening-level evaluation. It also provides an understanding of the trade-offs associated with various project components.
- SMITE-ML can be used with a variety of alternatives. These alternatives include conventional approaches, such as free general-purpose lanes and HOV lanes. It can also be used with pricing options, including HOT lanes, fast and interwined regular (FAIR) lanes, and FAIR highways.
- SMITE-ML requires a number of inputs. The first inputs are daily traffic volumes and hourly capacities for the freeway and arterials. The base mode shares and travel time and cost changes are other inputs. The travel time and cost changes can be checked against output time and toll rates.
- The first step uses the no-build forecasts and the time and cost changes as input values into the Pivot Point Logit Model. The output from this step is an estimate of vehicle trips by mode. In the second step vehicle trips by mode and road capacities are input into the equilibration to estimate induced and diverted traffic. If a toll lane is being considered, a toll factor would be added in this step. In the third step, traffic estimates and road capacities are input into the impacts estimation element. The results of this step are estimates of speeds, delays, revenues, user benefits, and social costs.
- SMITE-ML provides a number of outputs. These outputs include estimates of travel demand, speeds, and delays. Other outputs include estimates of toll revenues and

external costs. SMITE-ML also provides an estimate of performance in terms of economic efficiency and cost-effectiveness.

- The case study application included five alternatives – 10 general-purpose lanes, four express toll lanes and six general-purpose lanes and moderate transit, four express toll lanes and six general-purpose lanes and BRT, four HOT lanes and six general-purpose lanes with moderate transit, and four HOT lanes and six general-purpose lanes with BRT. The model provides an estimate of the change in HOV and daily transit person trips, hours of delay, toll revenues versus costs, and present value of benefits versus costs for the different alternatives.
- The results of the case study application indicate that express toll scenarios increase revenues and financial feasibility. The HOT lane scenarios increase benefits and net present value, but reduce revenues. The alternative with BRT increase benefits and net present value but reduces financial feasibility. The result of an additional sensitivity analysis indicates that demand elasticity has a small effect on revenue and benefits, and the value of time has a large effect on revenue and benefits.
- SMITE-ML can provide quick response estimates of impacts for pricing policies. SMITE-ML is available at http://www.fhwa.dot.gov/steam/ – go to related links.

Management of Special Use Lanes: SUL Model Development and Analysis
Yuko Nakanishi, Nakanishi Research and Consulting

Yuko Nakanishi discussed the application of simulation and mathematical models with special use lanes. She described some of the benefits and issues associated with the use of simulation and mathematical models, as well as the methodology for applying them with special use lanes.

- There is an irony associated with special use lanes. During ideal conditions, the demand for special lanes is low. During congested conditions, however, special use lane demand is high, but may be difficult to access. Thus, a problem may be that while special use lane capacity is available, drivers who want to use it cannot. This means that the expected benefits of special use lanes will not occur.
- A potential problem with HOV facilities relates to the cost of constructing the lanes. The cost of constructing HOV lanes on an existing right-of-way may range from a low of $30,000 per lane mile to a high of $2 million per lane mile depending on a variety of circumstances. Construction costs for HOV lanes in an exclusive right-of-way may be as much as $25 million per lane mile.
- Models can be used to help assess different special use lane alternatives, origin and destination patterns, hot spots, and transfer lanes. Models can estimate the demand for various strategies.
- Examples of simulation models may include microscopic models, mesoscopic models, and macroscopic models. Examples of microscopic models include CORSIM and WATSIM. TRANSIMS is an example of a mesoscopic model and Freq12 is an example of a macroscopic model.

- Mathematical models include the attributes of ability to estimate capacity and the ability to incorporate demand scenarios. Extensive field observations are not needed with mathematical models. It would also not be feasible to collect the data at the necessary level of detail.
- There are potential issues that should be considered with the use of mathematical models. Examples of these issues include the need to consider vehicle type, driver characteristics, and gap acceptance. The visualization capability of mathematical models may also be limited.
- In a methodology flow chart, selecting objective functions and establishing major constraint sets feed into the process to estimate dimensionality, which feeds into formulating the equation set. The next steps are to select user friendly software and then to run the model and display the results.
- A number of key issues should be examined in applying models with special use lanes. It is first important to define the objective and perspective for a project. This step may be considered as defining the project objective function. A second issue is to identify the highway segment, including how long it is and how many lanes it has.
- There are more mundane issues associated with computer capacities and budget. The size of the segment, and speed, memory, and spreadsheet capabilities of a microcomputer may limit the models that can be used and the analysis techniques. Issues to consider include processing time per run, the availability of computers, and researchers available to perform the runs. The amount of available funding should also be considered. The desired graphical output and the potential need for programming staff may also be issues.
- While mathematical models do not simulate individual vehicles and track their movements over time as microscopic models do, they provide the ability to incorporate elements such as driver demand characteristics and gap acceptance parameters. Graphics of capacity utilization and visualizations of hot spots are possible. Also, visualization of the impacts of origin and destination patterns and conflicting flow patterns is possible. When combined with actual geometric data, the mathematical models can be a useful planning tool in determining the effects of different origin and destination patterns. This approach is possible without the significant data requirements by other models.

Coding BRT, Park-and-Ride Lots and Transit in the Context of a Dynamic and Interactive Regional Traffic Model at the Atlanta Regional Commission
Guy Rousseau, Atlanta Regional Commission

Guy Rousseau discussed the process of coding BRT, park-and-ride lots, and public transportation services in the regional traffic model at the Atlanta Regional Commission (ARC). He described the regional traffic model, the definitions and coding requirements of different transit elements, and some of the issues encountered with use of the model.

- The definition of the Atlanta region varies. There are 10 counties included in the planning area. However, 19 counties contain a portion of the 2000 Atlanta urban area boundary. The ARC expands to 20 counties. A total of 13 counties were classified as serious ozone nonattainment areas by the Clean Air Act Amendments of 1990. These

counties were reclassified to severe nonattainment in January 2004, and 20 counties are included in the eight-hour nonattainment area.

- Accommodating the projected growth in population represents a major challenge for the region. The forecast of 2.3 million by 2030 people is equivalent to adding the metro area of a city the size of Portland, or two cities the size of Jacksonville, or four cities the size of Chattanooga. The region's employment level in 2030 is estimated at 1.7 million.
- Three different types of freeway interchange are coded in the system. These interchange types are freeway to local, three-legged freeway-to-freeway, and a legged freeway-to-freeway. All ramps are coded with two lanes for all interim interchanges. The capacity of a freeway to local interchanges is 1,200 vehicles per lane with a speed of 25 mph. The capacity of a freeway-to-freeway interchange of 1,800 vehicles per lane with a speed of 40 mph.
- There are five transit files. These files are premium transit, non-premium transit, rail network, premium park-ride lot, and non premium park-ride lot. The premium transit file includes very reliable service, prepaid boardings, and MARTA rail type stations. The non-premium transit file includes buses operating in traffic where reliability of service is dependent on highway congestion.
- The rail network file is used for coding premium transit links that are not part of the highway network. The text file contains link attributes for mode, station-to-station distances, speeds, and directionality. The premium park-and-ride lot file allows for drive times of up to 60 minutes. The non-premium park-and-ride lots file provides for shorter drive times of up to 15 minutes.
- Local bus service is provided at stops along the majority of the routes and operates primarily on arterials, collectors, and local roads. Express buses provide limited stops along routes and generally operate from bus stations or park-ride lots with alignments along interstates and freeways. The coding requirements include peak and off-peak headways and route alignment for non-premium transit. Bus speeds are calculated based on the highway speeds during the model run. For local bus service, the stops should be coded so that all zones along route have walk access to transit unless otherwise specified. For express bus service, stops should only be coded at specified locations, such as park-and-ride lots or bus stations
- The fixed-guideway file is defined as transit operating in its own right-of-way with permanent boarding station, such as the MARTA rail system. Coding requirements include station locations, station-to-station distances, station-to-station speeds, and peak and off-peak headways. Coding rail stations involves connecting rail lines to station nodes and routing buses to the feeder bus node to allow people to transfer at the rail station.
- Three types of BRT facilities are included. The first type of BRT in a busway operated in bus-only lanes at fixed speeds with stations and pre-paid boardings. The second type of BRT in HOV lanes operates with buses in the HOV lanes with on-line stations and pre-paid boardings. The third type, arterial BRT, operates on arterials with queue jumping lanes, signal preemption, and pre-paid boardings. The requirement coding information

includes station locations, route alignments, BRT stop patterns, BRT and feeder bus headways, and station-to-station run speeds and distances.

- Examples of coding the different networks highlight how the process is used. Ensuring that each alternative is coded correctly is critical to valid models and model outputs.

BREAKOUT SESSION – UPDATES ON DIFFERENT USER GROUPS

Darren Henderson, Parsons Brinckerhoff, Inc., Presiding

A Systems Approach for a Metropolitan HOT Network: The Case of Atlanta
Daniel Drake, State Road and Tollway Authority

Daniel Drake described the assessment of a potential HOT lane network for the metropolitan Atlanta area. He recognized the assistance of Michael Meyer in the study. He summarized the background of the assessment, the analysis process, and the study results.

- Georgia Senate Resolution 575 acknowledged the worsening traffic conditions in the Atlanta metropolitan area and requested the GDOT to study the feasibility of HOT lanes in the region. The study scope included the Atlanta region and the GA 400 corridor.
- A number of activities have been completed in response to Senate Resolution 575. First, a multi-agency steering committee was established to help oversee the various efforts. Second, market research was conducted to obtain a better idea of preferences for different options. Third, the impacts of managed lane operations were modeled. Fourth, the costs and revenues of different managed lane alternatives were estimated. Finally, the most promising corridors for further study were identified.
- As with most metropolitan areas, traffic congestion is a major problem on the freeway network in the Atlanta region. HOT and managed lanes represent one approach to addressing traffic congestion. HOT and managed lanes can achieve better utilization of limited highway capacity and increase the number of options to travelers. HOT lanes can enhance trip time reliability for transit vehicles, carpoolers, emergency management vehicles, special events traffic, and SOV drivers willing to pay a toll. HOT and managed lanes also provide another source of transportation revenue.
- The HOT corridor evaluation process included consideration of both long-term and near-term alternatives. Long-term evaluation scenario model runs for the year 2030 and near-term evaluation scenario model runs for the year 2015 were conducted and analyzed. A set of HOT corridor evaluation criteria were used in both the long-term and near-term analysis. The steering committee reviewed the results of the analysis and helped define the feasible HOT lane corridors. A report was prepared for the Georgia General Assembly, along with an HOT study final report.
- The market research results indicated that travelers would be willing to pay for a congestion-free toll lane on their way to work. The willingness to pay was highest when potential toll rates per trip were $0.50 to $1.00. The willingness to pay declined as toll reached $2.00 and above.
- The corridor screening methodology included a number of steps. Base HOV and HOT lane model runs were conducted first. Corridors with general-purpose lanes operating at LOS C or worse were examined further. Corridors with HOV-only volumes of less than 80 percent of the operating thresholds were examined and corridors with HOV and HOT lanes that carry greater than 500 trips per hour per lane were identified. The results from this analysis were used to define potential HOT lane corridors.

- For the 2030 analysis, HOT 2+, HOT 3+ and HOT 4+ alternatives were examined. Only HOT 2+ was considered in the 2015 analysis. The number of HOV and HOT corridors varied with each of the alternatives, as did the applicable fee assumptions. The VMT, trip time savings, weekday vehicle and person trips, and congestion levels were estimated for the different alternatives. The costs and revenues associated with the various options were estimated.
- The study results indicate that almost all of the freeway corridors in the region will be congested by 2030. Further, many of the proposed HOV lanes will be congested at bottleneck locations by 2030. Increasing vehicle-occupancy levels to 3+ will not resolve the congestion on some of the HOV lanes. As a result, some form of HOV lane management will be needed by 2030. Tolling of all vehicles, except transit, will likely be necessary by 2030 to keep the HOV lanes congestion free.
- The study results indicate that available capacity for HOT vehicles exists on all existing HOV lanes, with the exception of the I-75/I-85 downtown connector, in the short-term to 2015. The only corridors where new HOV lanes might exist by 2015 are already under design or will be shortly. These corridors generally correspond to the most promising corridors for HOT lane application. Most of these corridors are outside I-285 or are on I-285.

Role of Managed Lanes in Disaster Management
Raman Patel, Polytechnic University

Raman Patel discussed the role managed lanes can play in managing traffic during natural and man-made disasters. He reviewed both the traditional transportation requirements and disaster management transportation requirements. He also highlighted the emergency transportation response after the attacks of September 11.

- Traditionally, highways and roadways have served community needs. Goals of the transportation system have focused on mobility, community, and financial needs. More recently, homeland security goals have also become important.
- Potential user groups for managed lanes include HOVs, toll-paying motorists, buses and BRT vehicles, trucks, motorcycles, taxis, shuttles, vanpools, and inherently low-emission vehicles (ILEVs). When considering disaster management, however, other user groups include emergency vehicles, debris removal and repair vehicles, evacuation patrol vehicles, rescue vehicles, and military vehicles.
- Emergency management and transportation represent two separate communities, each with their own agencies and technology. Emergency management agencies include police, fire, medical-911, hazmat, the Office of Emergency Management (OEM), public safety, the Department of Homeland Security – Federal Emergency Management Agency (DHS-FEMA), and the Center for Disease Control (CDC). Transportation agencies include state and local departments of transportation, toll authorities, and transit agencies. Managed lanes can help bring these two communities together.
- Traditional transportation requirements focus on mobility, access, safety, and interoperability. These requirements may be addressed through demand management, additional capacity, traffic management, and providing information.

- Examples of traditional managed lanes user groups include HOV, HOT, BRT, trucks, ILEVs, taxis, vans, and motorcycles. Examples of potential benefits include trip time savings, trip time reliability, and improved safety.
- The nature and the level of response will depend on the type and the magnitude of a disaster. The larger and more far reaching a disaster, the more extensive the transportation response will need to be. The three dimensions of a disaster are space, magnitude, and time. Transportation response should anticipate disaster behavior.
- Managed lanes can help in responding to disasters. The size of the affected area will influence the type of response needed. Resources are brought to the site from all parts of the region. The type of emergency influences the magnitude of the situation. Loss of lives, damaged to property, restoration of infrastructure, and social and economic needs are all based on the magnitude dimension of a disaster. More resources and potentially different types of resources will be needed as an emergency progresses. More victims are transported and treated and the after effects may continue for days or weeks.
- Emergency transportation requirements include responders' access, unimpeded paths for emergency vehicles, and evacuation routes. Safety and security provisions will need to be provided, and information will need to be communicated to different user groups. Highway repairs may be needed in some cases, depending on the type of disaster.
- There is often a surge in transportation need and demand following a disaster. There may also be loss of transportation routes and closures of roads, bridges, and tunnels. Recovery and supply chain management will be needed.
- Emergency management focuses on providing access for a variety of vehicles. These types of vehicles may include first responders', repair and contractors, evacuation teams, rescue, and debris removal. Military vehicles may also need access.
- The traditional transportation planning objectives for managed lane projects have focused on corridor conditions, performance measures, and policy, legislative, partnership, and institutional issues. Considering the use of managed lanes in managing traffic during disasters introduces a new set of objectives focusing on homeland security, first responders, evacuation, and recovery and supply chain.
- Considering access, diversion, and evacuation issues in planning for the use of managed lanes in the event of disasters is important. Elements to consider include planning and design opportunities, evacuation routes, connectivity to centers, and operating policies with emergency management agencies. Considering how information will be shared among the various agencies, as well as the public, is also important.
- Consideration should be given to the potential needs of emergency vehicles in the design of managed lanes. Design modifications may be needed with existing managed lane facilities. The width of lanes, the turning radius at access points, and other design elements may need to be examined.
- The transportation response to the attacks of September 11 in New York City and Washington, D.C. point out the importance of planning and the role managed lanes can play in responding to disasters. While addressing efficiency, mobility, and accessibility

have been the major goals of managed lanes, homeland security has become another important goal.

ILEVs, Hybrids, and HOVs
Katherine Turnbull, Texas Transportation Institute

Katherine Turnbull discussed research sponsored by FHWA examining the use of HOV lanes by ILEVs and hybrids without meeting the occupancy requirements. She summarized the federal legislation authorizing ILEV access, the states currently allowing ILEVs to use HOV lanes, and current utilization levels. She described California and Virginia case studies in more detail.

- The 1990 Clean Air Act Amendments outlined the clean-fuel vehicle program, the specific requirements for ILEVs, and incentives for the purchase of ILEVs. Fleet vehicle ILEVs were authorized to use HOV facilities without meeting vehicle-occupancy requirements as one way of encouraging the purchase and use of these vehicles. The Transportation Equity Act for the 21st Century (TEA-21) allowed states to expand this authorization to include individually owned ILEVs. This provision was scheduled expired on September 30, 2003, with the expiration of TEA-21. This date has been extended with the extension of TEA-21.
- ILEVs were defined by the EPA in 1993 as vehicles meeting specific low-emission vehicle exhaust emissions standards and having low levels of evaporative emissions. Qualifying vehicles are primarily those powered by compressed natural gas (CNG), liquid petroleum gas (LPG), liquefied natural gas (LNG), hydrogen, ethane, methane, solar, and battery-electricity. To date, no gasoline-powered vehicle has qualified as an ILEV. The ILEV program is no longer an active EPA initiative. Hybrid vehicles have a propulsion system that operates on both an alternative fuel, including electricity, and a traditional fuel, typically gasoline.
- At least 10 states – Arizona, California, Colorado, Florida, Georgia, Hawaii, Maryland, Texas, Utah, and Virginia – approved legislation allowing ILEVs to use HOV lanes without meeting minimum-occupancy requirements. Although the terminology differs, most descriptions of ILEVs in the legislation either reference federal guidelines or appear to be in keeping with federal requirements. The legislation in Texas has not been implemented. Thus, nine of the 20 states with freeway HOV lanes currently allow ILEVs to use the HOV facilities without meeting minimum-occupancy requirements.
- Subsequent legislation in five states – Arizona, California, Colorado, Florida, and Georgia – added hybrids to the list of vehicles allowed to use HOV lanes without meeting minimum-occupancy levels if allowed or approved by federal law or federal agency regulations.
- In Virginia, legislation in 1993 established a clean special fuel license plate and defined the types of vehicles qualified to obtain the special plates. Legislation in 1994 allowed vehicles with the special fuel license plates to use HOV lanes in the state without meeting the minimum-occupancy requirements. The Virginia Department of Motor Vehicles, in consultation with the Virginia Department of Environmental Quality, allowed owners of hybrid vehicles to obtain special clean fuel license plates when hybrid vehicles became

available in the early 2000s. Contrary to federal legislation, Virginia is the only state currently allowing hybrid vehicles to access HOV lanes.

- Information from the 10 states with legislation allowing ILEVs to use HOV lanes without meeting occupancy requirements indicates that the registration of ILEVs and the use of HOV lanes by ILEVs is low. In Maryland in 2003, only nine of 500 registered ILEVs had a permit to use the HOV lanes. In Utah there were approximately 650 active clean fuel license plates in 2004.
- The number of clean special fuel license plates issued annually in Virginia increased significantly once hybrids were allowed to use the HOV lanes. In the six years from 1994 and 1999, a total of 78 clean special fuel license plates were issued. In the almost five years from 2000 to October 2004, with hybrids qualifying for the HOV exemption, a total of 10,335 clean special fuel license plates were issued.
- Hybrid vehicles comprise the vast majority of the license plates issued, accounting for almost 95 percent of the total. Some 93 percent of the clean special fuel vehicle plates were issued in counties and cities in northern Virginia, which are served by the I-95, I-395, I-66, and Dulles Toll Road HOV lanes.
- The Metropolitan Washington Council of Governments (WASHCOG) has an ongoing program for monitoring and reporting on the use of HOV facilities in northern Virginia. Since the fall of 2003, the number of vehicles with clean special fuel license plates has been included in the counts. Counts from October, 2004 indicate that clean special fuel vehicles accounted for some 844 and 1,422 vehicles or between 11 percent and 17 percent of the vehicles in the HOV lanes on I-95 during the 6:00 a.m. to 9:00 a.m. peak-period in the northbound direction.
- An HOV Enforcement Task Force was established in 2003 by the Virginia Secretaries of Transportation and Public Safety in response to growing concerns from numerous groups related to enforcement of the HOV lane restrictions in northern Virginia. The Task Force issued reports in 2003 and 2005 examining a number of issues associated with the HOV lanes in northern Virginia. The 2005 report indicated that the number of clean special fuel vehicles using the I-95 HOV lanes was causing the lanes to operate at unacceptable levels of service. The report contains both short-term and long-term recommendations for the use of HOV lanes by vehicles with clean special fuel license plates. Short-term recommendations included adopting the super-ultra low-emission vehicle (SULEV) standard for eligible hybrid vehicles, opposing any extension after the July 1, 2006 expiration of Virginia's clean special fuel license plate HOV occupancy exemption, and allowing clean special fuel vehicles license registrations to be valid for one year only.
- The California Air Resources Board (CARB) first adopted low-emission vehicle (LEV) regulations in 1990. The SULEV standards became effective in 1999. Legislation approved in 1999, allows SULEVs to use HOV lanes without meeting minimum-occupancy requirements. Approximately 5,371 vehicles registered for the SULEV decal between July, 2000 and May, 2004. The majority of these vehicles are located in counties in the large urban areas of the state, with over half in Los Angeles County. These counties are also those with HOV lanes in the state. No major studies have been conducted on the use of HOV lanes by SULEVs in the state.

- Legislation approved in September 2004, extends the HOV exemption to hybrid and other alternative fuel vehicles meeting the state's Partial Zero Emission Vehicle (AT PZEV) standard and have a 45 mph or greater fuel economy highway rating. Extending the exemption to hybrid and other vehicles meeting these criteria would only occur if the federal government acts to approve use by these types of vehicles.
- The legislation directs Caltrans to examine the HOV lanes when 50,000 decals have been issued to hybrid-related vehicles. Elements to be examined include reduction in level of service, sustained stop-and-go service, slower than average speed than the adjacent mixed flow lanes and consistent increase in travel time.
- The Administration's 2004 SAFETEA reauthorization proposal would provide responsible state and local agencies with the option of allowing low-emission and fuel-efficient vehicles to use HOV facilities under specific conditions. Low-emission and energy-efficient vehicles are defined as vehicles that both meet EPA's Tier II standards for light-duty vehicles and have an EPA fuel efficiency rating of at least 45 mpg on highways. Agencies are required to establish programs that define how qualifying vehicles will be selected, certified, and labeled. The program must also include ongoing monitoring, evaluation, and reporting on the performance of the HOV lane and procedures to limit use by these vehicles to ensure operation of the lane does not become degraded. An HOV lane is defined as seriously degraded if it fails to maintain a peak-period minimum average operating speed of at least 45 miles per hour (mph) 90 percent of the time over a consecutive six-month period.

BREAKOUT SESSION – DON'T FORGET TDM AND SUPPORT ELEMENTS

Heidi Stamm, HS Public Affairs, Presiding

Integrating Ridesharing Promotion and Incentives into HOV Lane Projects: Current Experience and Future Needs

Eric Schreffler, Eric Schreffler Transportation Consultant

Eric Schreffler discussed potential approaches for increasing the use of HOT lanes by HOVs. He provided an overview of the I-15 FasTrak™ project in San Diego, including the promotion of alternative modes. He also described a potential approach using revenues for user choice subsidies to help encourage the use of HOV modes.

- The I-15 FasTrak™ project uses the eight-mile reversible HOV facility in San Diego. Carpools and vanpools with two persons or more can use the lane for free. SOVs pay a toll of between $0.50 – $4.00 per trip. The toll varies with volumes in the HOV lanes. FasTrak™ accounts are debited monthly. The revenue from the project is used to pay for operations of the facility and transit services. FasTrack is transitioning to a managed lanes project.
- Results from ongoing monitoring and evaluation activities highlighted some key findings from the project. First, the FasTrak™ program has improved the efficiency of the HOV lanes. Second, pricing is an option, not an imposition. Third, people who use FasTrak™ love it; while non-users do not really care. Fourth, carpoolers did not revolt when the program was implemented. Finally, FasTrak™ cross-subsidizes transit in the corridor.
- Transit ridership in the corridor has not grown as fast as the rest of the region, however. Many riders on the new Inland Breeze Bus Service previously rode the bus. HOV volumes have decreased during FasTrak™ in both the HOV lanes and the main lanes. The FasTrak™ project did not really integrate new HOV promotions.
- Some enhancements have been made to try to address many of these concerns. Additional commuter runs were added to the Island Breeze Bus Service. The Island Breeze is now averaging approximately 140,000 annual boardings or 550 boardings per day. Approximately 770 riders or 1,522 boardings a day are on all commuter express routes using the HOV lanes.
- In addition, some 420 vanpools operate in the region, serving 3,800 commuters daily. Approximately 175 vans use the I-15 corridor, which equates to 1,500 vanpoolers per day. Also, telework is increasing in the area.
- There is a need to rethink the role of HOVs in HOT and managed lane projects. Actively promoting HOVs should be a priority. Employers and commuters in a corridor can be targeted and a full range of alternatives should be marketed and promoted. There is also a need to provide incentives for using HOV lanes beyond travel time savings.
- One approach would be to promote user choice subsidies. This strategy would let commuters make choices among paying a toll and receiving a carpool subsidy, a vanpool

subsidy, a bus rider subsidy, a bicycle subsidy, and a telework subsidy. A voucher system could be used and incentives could be provided to encourage people to try different modes.

- If the goal is still to move people in fewer vehicles, maximizing the use of HOV lanes by HOVs should be a priority. Efforts should focus on increasing rideshare mode shares and increasing toll, not occupancy restrictions. Consideration should be given to using some toll revenue for user choice subsidies.

An Analysis of Casual Carpool Passenger Behavior in Houston
Justin Winn, Wilbur Smith Associates

Justin Winn discussed the use of casual carpooling on the Houston HOV lanes. He provided an overview of casual carpooling with HOV lanes in the U.S. and described the results of surveys of Houston casual carpoolers conducted as part of the QuickRide value pricing project.

- Casual carpooling has existed for over 30 years. Casual carpooling involves people meeting in public areas to be picked up by drivers so they can use the HOV lanes. The drivers are known as "bodysnatchers," while the people waiting to be picked up are known as "slugs." Three known locations where casual carpooling currently occurs are northern Virginia, San Francisco, and Houston.
- The study of casual carpooling in Houston had four objectives. The first objective was to review current practices associated with casual carpooling in the U.S. The second objective was to determine the time savings realized by casual carpool passengers in Houston. The third objective was to determine the characteristics of casual carpool passengers in Houston. The fourth objective was to identify factors that significantly influence travelers' decision to choose casual carpooling over other modes.
- Casual carpooling occurs on the Bay Bridge crossing in the San Francisco/Oakland area. Commuters use casual carpooling in the morning, and take transit in the evening for their return trip. It appears that some individuals use casual carpooling on a regular basis on the Bay Bridge.
- Casual carpooling also occurs on the I-95/I-395 HOV lanes in northern Virginia. There area at least 20 locations where people gather for rides. Casual carpooling is used in both the morning and evening, and previous studies have indicated that casual carpooling accounts for approximately 10 percent of the person movement in the morning peak hour.
- Surveys were conducted of casual carpoolers in November 2003, as part of the Houston Value Pricing project. Surveys were also conducted of travelers in the freeway general-purpose lanes, carpoolers in the HOV lanes, and bus riders. The surveys included questions on trip purpose, trip time, and socioeconomic information. A total of 538 casual carpoolers were given surveys at three park-and-ride lots. Two of the lots were on the I-10 West HOV lane and one lot was on the US 290 HOV lane. A total of 216 surveys were returned for a 40 percent response rate.

- In addition to the survey results, travel speed data for the HOV lane and the freeway general-purpose lanes on I-10 West and US 290 were obtained from Houston TranStar. Visual observations were made of the casual carpooling formation process. Observers recorded the walk time to the casual carpooling queue and the time spent waiting in the queue before a ride was obtained.
- The travel time savings associated with using the HOV lanes was computed from the travel speed data obtained from TranStar. The travel time differential was computed as the difference between the travel time on the general-purpose lanes and the travel time on the HOV lane. The total travel time savings was computed as the differential in drive time plus the access walk time and the time spent in the queue. Based on this analysis, it appears that during the 7:00 a.m. and 8:30 a.m. time period, casual carpooling saves between one minute and a little over six minutes.
- Four traveler groups were examined in the surveys. These four travel groups were drivers in the general-purpose freeway lanes, carpool drivers in the HOV lanes, bus riders, and casual carpool passengers. The survey results were tested for significant difference in travel and socio-economic characteristics.
- Approximately 96 percent of the casual carpoolers were making a commute trip, compared to 89 percent of the bus riders, 85 percent of the freeway drivers, and 80 percent of the carpool drivers. Some 28 percent of the casual carpoolers were in the 25 to 34 age group and 68 percent reported professional/managerial occupations.
- Additional questions were asked of casual carpoolers. The results from these questions indicated that 75 percent of casual carpool passengers use this mode at least three times per week and that over half have been casual carpooling for more than a year. Saving time and saving money were the two major reasons identified for casual carpooling. Almost 70 percent of the respondents reporting using transit for their return trip, while 13 percent said they used casual carpooling on their return trip.
- A discrete choice logit model was used to analyze some of the results. Two scenarios were examined. The first scenario examined casual carpooling and transit. The second scenario examined casual carpooling, freeway drivers, carpool drivers, and bus riders.
- The analysis results indicate that individuals making commute trips, those making higher total trips per week, and those in the 25 to 34 age group were more likely to use casual carpooling. In addition, individuals in the professional/managerial and the administrative/clerical job categories were more likely to use casual carpooling. Individuals with incomes between $25,000 and $35,000 and those in the 55 to 64 age group were less like to use casual carpooling.
- The survey results indicate that casual carpool passengers are more likely to be on a commute trip, to be young, and to have professional or administrative occupations. Additional research is needed to examine the characteristics of the evening return trips, casual carpool drivers, and stated preference data.

Reservation-Based ITS Systems: Real-Time Variable Congestion Pricing on the Proposed I-75 HOV/BRT Facility

Weimin Huang, Georgia Tech University

Weimin Huang discussed the potential of using real-time variable congestion pricing on the proposed I-75 HOV/BRT facility in Atlanta. He recognized Randy Guensler, Michael Hunter, Seung Kook Wu, and Joonhoo Ko at the Georgia Institute of Technology for their assistance on the project.

- The proposed I-75 HOV/BRT project would include construction of new barrier-separated HOV lanes and BRT stations on I-75 from I-285 to I-575. It would also include HOV access points at new HOV interchanges. Continuous HOV and BRT operations on I-75 between downtown and I-575 would be in operation by 2011.
- The area examined in the study for possible real-time congestion pricing is south of the existing HOV segment on I-75 from I-285. It is approximately seven miles in length. Recurring congestion occurs on weekday mornings. The proposed project would include four-to-five general-purpose lanes, and one dedicated HOT lane. It would also include five interchanges and two access points.
- The reservation system concept was identified as one way to address first-come first-serve queues in the general-purpose lanes, which are not as efficient as priority-based queues. Priority-based queues would include HOV/HOT lanes and ramp metering. HOT benefits include travel reliability, time savings, and revenue generation. A reservation system further improves the efficiency of priority-based queues.
- The goals of the research project were to present a proof-of-concept for a reservation-based HOT operation and to use a toll elasticity mechanism to maximize the HOT lane utility while maintaining the LOS on the HOT lane.
- The reservation-based ITS system includes two concepts. Regular HOT operations, where drivers pay tolls at HOT access points and a reservation component. The reservation component would allow drivers to pay a certain percentage, 25 percent was used in the analysis, of the access-point toll price in advance, thereby securing their rights to use the HOT lanes. When these drivers pass HOT access points, they are charged the remaining toll price. If a driver does not use the lane, the deposit is forfeited. The anticipated no-show rate can be computed based on elasticity.
- The operation of a reservation-based system would monitor HOV use of the HOT lanes. The available capacity in the lanes would be identified. Pricing for access points/reservations on the HOT lanes would be established, the numbers of reservations on HOT lanes and the number of no-shows would be monitored, along with the numbers of drivers using HOT lanes without reservations. The system would continually monitor and update available capacity, pricing, and space available for reservations.
- The Atlanta Regional Commission (ARC) travel demand model was used as the base travel demand model for assessing the reservation-based ITS program. The future model includes adding one lane and imposing turn restrictions to HOVs. The four-step model was rerun with these changes. The origin/destination table for the I-75 sub-network was extracted from the model.

- The traffic simulation development used the VISSIM model. VISSIM uses various vehicle classes depending on vehicle types and their routes. Traffic volumes in the general lanes were increased until congestion started. The maximum numbers of vehicles that can be moved from general lanes to HOT lanes while maintaining freeflow conditions on the HOT lane was determined.
- The demand simulation results indicated that with HOV only using the HOT lane, speeds on general-purpose lanes were 29 mph. Speed on the HOT lane with HOV only was 64 mph and the travel time difference was 7.4 minutes. The simulation moved vehicles from general-purpose lanes to the HOT lane when the speed in the general-purpose lanes was 33 mph. Speed on the HOT lane was 55 mph and the travel time difference was 4.7 minutes.
- The assumptions used for pricing included a reservation price of 25 percent of the access-point price, a constant elasticity of 0.569, and a willingness-to-pay of $30 per hour saved. The access-point price varied from $2.35 to $3.70. An initial toll of $3.70 at access points and $0.93 for reservations was set. At this price, the model shifted 780 vehicles into the HOT lane based on elasticity. The model was rerun with 780 vehicles shifted. The time difference was 5.45 minutes, the new toll was $2.70, which leads to 940 vehicles shifted. If the 940 shifted vehicles causes congestion on the HOT lane, the $2.70 toll would be rejected and the $3.70 toll price would be kept.
- Based on the demand simulation the suggested allowed vehicles and tolls were 400 vehicles at $3.70 at the access point, 380 vehicles at $0.93 for reservations, and a no-show rate of 15 percent at $0.93. The reservation concept ensures travel time reliability for reservation customers and maximizes HOT lane utility. Future research is needed to determine the exact reservation demand.

BREAKOUT SESSION – TOLL TECHNOLOGY – WHAT'S AVAILABLE, WHAT'S COMING

Mark Muriello, Port Authority of New York and New Jersey, Presiding

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Georgia State Road and Tollway Authority Transition to eGO
Erik Steavens, State Road and Tollway Authority

Erik Steavens discussed the Georgia State Road and Tollway Authority (SRTA). He described the roles and responsibilities of SRTA, the Georgia 400 Toll Road, and the eGO electronic toll collection (ETC) cards.

- SRTA is governed by a five-member board of directors. The Governor serves as the chairman. Two members are appointed by Speaker of the House and two by the Lieutenant Governor. SRTA is responsible for operating tollways in the state. Currently, SRTA operates the state's only toll facility, the GA 400. SRTA also provides debt financing for transportation projects, completes toll revenue studies, and maintains a transportation revenue forecast.
- The GA 400 is a 6.2 mile toll facility located in Atlanta. The GA 400 carries approximately 120,000 vehicles per day. The toll is $0.50. The GA 400 includes cruise lanes with ETC. The two ETC lanes in each direction allow users to travel at regular, driving speed. Approximately 35 percent of all traffic on the GA 400 uses the cruise lanes.
- The ETC system has evolved since 1993 with the deployment of a read-only, single protocol system. In 1996, a read-write, in-vehicle feedback single protocol system was implemented. The system was further enhanced in 1998.
- The transition to eGO began with discussions with TransCore in 2004. Other options, including doing nothing and changing to new technology, were considered. After a site visit to the manufacturing and test facility in July 2004, the decision was made to upgrade to eGO and a contract was signed with TransCore in October 2004. The first eGO Cards were delivered in February 2005. Installation and testing of the first lane conversion began in March 2005. Implementation of the eGO system will begin in late June or early July.
- The eGO cards operate in the 902-928 MHz radio frequency. They are flexible stickers and are battery-less. The eGO readers are a multi-protocol 915 MHz RFID reader system. A phasing-in of the new toll cards is being used.
- There were numerous benefits to SRTA from the change to the eGO system. First, operating costs are reduced. Fewer toll card recalls due to battery problems are anticipated and the cost of an eGO card is lower than the current product. The eGO system also provides opportunities for growth in attracting new users to the toll system. Market research has shown a preference for tags. There are also new markets, such as parking, for eGO to use. A retail tag program is also possible.

Forecasting and Policy Dimensions of ETC Systems Adoption
C. M. Brown and P. J. Pezzotta, Wilbur Smith Associates

Paul Pezzotta and Colby Brown discussed forecasting and policy dimensions of ETC adoption. They summarized the role of ETC systems, ETC system characteristics, and operational issues. They described forecasting ETC adoption dimensions and models.

- ETC facilitates transactions in conventional toll road systems and on HOT and managed lanes. Configuration options include transponder-based systems and video tolling. Examples of transponder-based systems include EZ-Tag and E-Z Pass. Video tolling is used in Toronto, Canada and Melbourne, Australia.
- A number of factors should be considered in forecasting ETC participation. First, all existing ETC programs are voluntary. Second, there are two distinct, through related decisions for system users – transponder acquisition and toll facility use. Program participation determines user eligibility. In differential pricing contexts, participation also affects revenues.
- ETC program participation is affected by basic system characteristics and by policy decisions. The extent of service, including lane-miles and coverage, and the quality of service in terms of lane configuration, will influence participation. The pricing structure, including the use of differential, variable, and dynamic pricing will also influence participation. Other factors that will influence participation include transponder availability, marketing, and account and payment options.
- There are a number of potential sources of expansion for ETC participation. First, interoperability effectively expands coverage. The E-Z Pass consortium provides one example of interoperability. Second, new systems and standards, such as the state distribution concepts in Texas and the emerging national standards, will influence participation. Finally, future system expansions may increase participation rates.
- Operations issues that may need to be considered in forecasting ETC participation include toll collection and enforcement. Elements to consider in toll collection include the need for registration and account set-up, which will affect access and fees. Enforcement elements include verification of occupancy levels, video enforcement, coordination with local law enforcement agencies, and coordination with DMV databases. With increasing adoption of ETC, enforcement issues will become collection issues.
- The HCTRA system uses a mix of cash and ETC payment options. Currently, ETC payments account for approximately 65 percent of HCTRA toll transactions. The Westpark Tollway, opened in 2004, is operated by HCTRA. It represents Houston's first all-electronic toll road. No discounts for HOVs are provided. The I-10 West managed lanes will be operated by HCTRA. Buses and 3+ carpools will travel at no charge. Variable pricing will be made possible by electronic tolling.
- Forecasting dimensions for ETC include considering the heterogeneity in the AVI market nationwide. Possible factors to consider include urban versus rural markets and mature versus new markets. Houston, with a well developed toll system, provides an example of a more mature market, while Minneapolis provides an example of a new toll market.

Extensive outreach is needed in new markets. Different traffic cohorts will also need to be considered. Examples of different traffic cohorts include two-person carpools, 3+ carpools, and commercial traffic.

- Forecasting dimensions will also need to be considered. Examples of potential dimensions include the diffusion of innovations, the importance of time savings, and household characteristics. Other elements include fixed and monthly costs, toll system proximity, economic conditions, system characteristics, and spatial factors.
- Examining the use of Houston EZ-Tag provides an example of the transition from cash to ETC that can be used to enhance forecast models. The Houston toll system is dynamic and incremental, spatially disaggregate, sensitive to expansion policies, and provides input to travel demand models. The use of EZ-Tags has increased over time. Using GIS, home locations of EZ-Tag participants can be compared to the proximity to tollway lane miles and household income.
- The ETC forecast model includes three key characteristics. First, use can be estimated based on historical zone-specific data on ETC participation, proximity, and income. Second, increases in either relative income or proximity to tollway lane miles produce an increased saturation of ETC participation rate. Third, growth in ETC participation in any given year is forecast based upon the prior year's participation level and current saturation rate.
- There are a number of items that need further study. These items include multi-modal issues and potential effects and commercial and freight ETC participation. Sensitivity to pricing and time savings also needs further study. Economic trends and non-stationarities may influence ETC participation. Regional and national systems expansion must also be considered. The development of forecasting models must be pursued in relationship to evolution of policy options. The robustness of the model is a key.

BREAKOUT SESSION – WHAT'S THE NEWS ACROSS THE NATION?

Rachel Clampffer, Capital Area Metropolitan Planning Organization, Presiding

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Maryland's Express Toll Lanes – An Alternative to Gridlock
George Walton, Parsons Brinckerhoff Quade and Douglas, Inc.

George Walton described recent studies and activities related to the consideration of express toll lanes in Maryland. He reviewed the value-pricing study conducted in 1999 and 2000, summarized the current efforts, and highlighted possible future activities. He noted the assistance and involvement of Michelle Martin from the Maryland Department of Transportation (MDOT) in developing the presentation and in many of the activities.

- The previous value-pricing study was funded through the FHWA Value Pricing Pilot Program. The 18-month regional study was initiated in 1999. The objective of the study was to determine the feasibility of a broad range of variable pricing strategies to develop a series of recommendations for implementation.
- HOT lanes were a new concept at the time of the previous study. The value-pricing study received a lot of negative press, mostly in the newspaper and on the radio. On June 21, 2001, the Governor issued a press release to "remove any proposals to study or implement HOT lanes." As a result of this action the study was stopped and a final report was not completed.
- A number of lessons were learned from the previous study. First, the large scope of the project made it difficult for the public and policy makers to understand the proposed concepts. Second, no project champion emerged among elected officials to promote the HOT lane concept. Finally, more emphasis on public outreach and education was needed.
- The response to the first study presented a number of challenges as the current effort examining express toll lanes was initiated. Addressing public opinions and perceptions, especially those related to equity, smart growth and double taxation, represented a major challenge. There were also technical concerns related to enforcement, right-of-way, and legal issues.
- Maryland remains interested in the FHWA Pilot Program, and recently supported the Metropolitan Washington Council of Government's proposal submitted by the Virginia Department of Transportation. The current interest in value pricing and HOT lanes is the result of numerous factors. These factors include a realization that mega-transportation projects require their own funding or supplemental funding arrangements. They cannot be paid for solely by the Transportation Trust Fund. MDOT believes express toll lanes can pay a portion of the mega-highway projects. A government commitment was made to refocus on much needed highway infrastructure and innovative financing to achieve a more mobile Maryland. It also appears that many elected officials now see the benefits of these approaches.
- Public outreach has been a major element of the express toll lanes initiative. Elements of the public outreach program include a brochure, a website

(http://www.marylandtransportation.com) and click on the express toll lanes icon), and public meetings, including hearings and open house workshops and on I-95, I-270, and I-495.

- MDOT is examining adding new express toll lanes and converting an existing general-purpose or HOV lane in combination with adding a new express toll lane. The express toll lanes concept is to provide Maryland's residents, employers, businesses, and visitors with an alternative. The express toll lanes allow travelers a choice of relatively congestion-free travel whenever it is needed the most. Toll rates would vary based on demand – either by time-of-day or based on actual traffic conditions. The tolls would increase when lanes are relatively full and decrease when there is extra capacity.
- A statewide express toll lane system is being considered. Express toll lanes are being considered wherever they make sense on controlled access highways experiencing chronic congestion during peak travel times. Project development studies are underway on I-270, I-495/I-95 (Capital Beltway), and I-95 north of Baltimore. BRT would be an important element of the express toll lanes. The express toll lanes would provide trip time reliability and operating efficiency for BRT.
- In general, the public is interested in more capacity as soon as possible. A number of concerns have been expressed with different approaches, however. There are some concerns about the right-of-way impacts of adding lanes and the impacts on the natural, social, and cultural environment. There are also concerns about double taxation, as well as environmental justice issues with HOT and value pricing projects. Concerns with converting general-purpose lanes and HOV lanes to tolled lanes have also been raised. Finally, there are concerns with increased commute costs and equity issues.
- Based on the national experience with different toll and value pricing projects some common themes seem to be emerging. First, motorists appear willing to pay for premium service. Second, the public seems more interested in eliminating toll plazas than eliminating tolls in many areas. Third, there is increased scrutiny of highway projects for toll financing opportunities in many areas. Fourth, pricing has led to the efficient use of existing and new capacity, reduced congestion, and increased choice for motorists. Finally, education of stakeholders is critical. There is a strong correlation between knowledge of and support for value pricing projects.
- The Washington Post recently conducted a survey of area highway users. Approximately 60 percent of the respondents favored tolls as a way to pay for highway expansion. Some 58 percent agreed with the concept of allowing SOVs to use the HOV lanes in the region for a fee. Approximately 48 percent supported adjusting tolls based on the level of congestion.
- Maryland's current express toll lane initiative would not allow HOVs to travel for free due to limitations in the ability to enforce lane restrictions and occupancy requirements, especially if there is limited right-of-way or no barrier. There is also a desire to maximize revenue projections. Carpoolers would still benefit from shared toll rates.
- The I-270 Multimodal Corridor Study is examining HOV conversion to express toll lanes. Issues being examined include lane separation, access, enforcement, and open road tolling. Options including a reversible lane system and two lanes in each direction

are being considered. The connections to the Capital Beltway are also being examined. Possible impacts on the Corridor Cities Transitway are being considered.

- The I-495/I-95 Capital Beltway Study is exploring general-purpose lane conversion to express toll lanes. Issues being examined in the study include connections to the radial roadway systems, open road tolling, lane separation, access, and enforcement.
- The study on I-95 north of Baltimore is examining adding new lanes in the freeway median. One section is currently under design and additional sections are under study to the north. Open-road tolling and lane separation are being explored.
- Design issues being examined include access points and weaves. Signing, traffic control, and open-road tolling are also being examined. Some of the key challenges of open-road tolling include the handling of non-express toll lane vehicles, a violation enforcement system, automatic vehicle classification, and vehicle positioning within a multi-lane tolling environment.
- A number of enforcement issues are also being examined. These issues include toll payment, vehicle eligibility, and occupancy requirements. Violation processing protocols are being determined. Legislative requirements needed for enforcement are being examined. Consideration is being given to dedicated versus incidental enforcement, facility design, facility safety, and toll levels.
- Other issues under examination include project ownership and coordination between the State Highway Agency and the Maryland Toll Authority. Access, enforcement, travel demand forecasting, and revenue forecasting are other issues. The potential for express toll lanes will be evaluated as part of normal project development process. Pilot project opportunities will be identified. Public outreach will be coordinated through ongoing projects.

MnPASS – Minnesota's I-394 HOT Lane Project
Marthand Nookala, Minnesota Department of Transportation

Marthand Nookala discussed the MnPASS program on the I-394 HOV lanes, which will allow SOVs to use the lanes for a fee. He highlighted the project background, objectives, and operation.

- The I-394 HOV lanes were opened in 1992. FHWA policies limit general purpose use of HOV lanes depending on the source of federal funding used for construction. The HOV lanes on I-394 and I-35W have available capacity, while the adjacent general-purpose lanes are chronically congested. In 2003, the state legislature, with bipartisan support, authorized HOV expansion to HOT lanes.
- Buses, carpools and vanpools, and single-occupant toll vehicles will be able to use the MnPASS Express Lanes on I-394. The HOV lanes connect to the Third Avenue Distributor (TAD) garages, which include an intermodal transfer facility, parking, and links to the downtown skyway system.
- The revenues for MnPASS will first be used to pay for the project infrastructure, administration, maintenance, and operations. By state law, any additional revenue must

be split 50 percent for transit improvements and 50 percent for corridor improvements. All improvements must be in the I-394 area.

- The MnPASS project has a number of objectives. The first objective is to improve the efficiency of I-394 by increasing the person and the vehicle-carrying capabilities of the HOV lanes. The second objective is to maintain freeflow speeds for transit and carpools in the HOV lanes. The third objective is to improve highways and transit in the corridor with the revenues generated from the project. The fourth objective is to deploy electronic toll collection, including tags, transponders, and readers to maintain travel speeds. The final objective is to employ new ITS technologies to facilitate dynamic pricing and in-vehicle electronic enforcement.
- An I-394 Express Lane Community Task Force was formed to help oversee the project. The Task Force includes 22 individuals appointed by the Governor, the Lieutenant Governor, and communities in the corridor. The Task Force represents a bipartisan and diverse group. The Task Force reviews express lane issues and provides input to Minnesota Department of Transportation (MnDOT). The Department also obtained input from other interested people and groups through a citizen Open House, which included staff answering citizen questions and taking testimony; focus groups of carpoolers, transit users, and solo drivers; and meetings with interested groups and public officials. The Task Force is also involved in the project evaluation.
- The I-394 HOV lanes are approximately 11 miles in length. They include a two-lane barrier-separated reversible section and one-lane-per-direction concurrent HOV lane in the middle of a four-lane freeway. There will be five eastbound and six westbound access points in concurrent flow lane section. HOVs and transit will be able to use the lanes for free. No heavy vehicles will be allowed.
- Dynamic pricing will be used. Tolls will be based on the level of congestion. Tolls during the peak periods will average between $1.00 to $4.00, with $8.00 the maximum. Tolls during off-peak periods will average $0.25.
- The concurrent flow lanes will operate on a 24/7 basis. The two-lane reversible section will operate eastbound from 5:00 a.m. to 1:00 p.m. and westbound from 2:00 p.m. to 4:00 a.m. The schedule on weekends will vary depending on special events in downtown Minneapolis.
- Enforcement will be essential to the success of MnPASS. There will be increased enforcement through partnerships with the Minneapolis Police Department, the Golden Valley Police Department, the Metro Transit Police, and the Minnesota State Patrol. Violating the MnPASS requirements is a petty misdemeanor with a $130 fine.
- The process to subscribe to the MnPASS program is relatively simple. An individual completes a transponder lease agreement and provides a credit card number. Subscribers receive a transponder and instructions on use. With the transponder, they can "get in and go," as the MnPASS slogan notes. Individuals can subscribe online, by telephone, or in person at the Customer Service Center.
- Construction of the toll elements and other features was completed at the end of March, 2005. Testing of the system is currently underway. The Customer Service Center

opened April 11. Lane striping will be completed in early May. The MnPASS program on I-394 will open the week of May 16.

- A comprehensive evaluation is being conducted on the project. The evaluation will provide the public and decision makers with valuable information on the observed impacts of the system. It will also provide information on the public's perceptions and attitudes regarding the system. The evaluation will provide Mn/DOT and the MnPASS team with feedback on the performance of the system. Information from the evaluation will provide a solid foundation for any future decisions regarding potential expansion of the system. Two separate, but coordinated, evaluation teams will be used. One team will conduct the technical system performance evaluation. A second team will conduct the attitudinal evaluation. On-going evaluation activities will be conducted over the next two years.
- More information is available at http://www.mnpass.org. The project manager, Nick Thompson, can be contacted at nick.thompson@dot.state.mn.us.

Seattle's SR 167 Pilot Project
Nytasha Sowers, Washington State Transportation Center

Nytasha Sowers discussed the State Route (SR) 167 HOT lane pilot project in the Puget Sound Region. She described the HOT lane concept, the HOV lanes in the region considered for the pilot project, and the proposed project on SR 167.

- The definition of HOT lanes used in the Puget Sound Region are carpool lanes which are free for 2+ HOVs and transit, but which allow solo drivers to pay a toll to use the HOT lane when space is available. Tolls for solo-drivers are set to ensure near freeflow conditions in the HOT lane, maintaining the Washington State Department of Transportation (WSDOT) HOV performance standard of 45 mph a minimum of 90 percent of time. HOT lanes are intended to improve the overall efficiency of congested freeway corridors. Freeflow speeds are maintained and drivers do not experience delay. The maximum vehicle throughput for a lane is reached between 45 mph and 50 mph with approximately 2,000 vehicles per lane per hour. When congestion resulting in reduced speeds and traffic backups occur, the capacity of the lane is reduced as much as 50 percent. Available capacity exists in some HOV lanes in the region for toll paying SOVs.
- Four different HOV lanes in the region were considered for the HOT pilot project. These facilities were I-405 from SR 520 to I-5 North, I-5 from the south end to I-90, I-90 from I-405 to Issaquah, and SR 167. SR 167 was selected due to the continuous availability of capacity, peak hour congestion on the freeway, and the ability to make minor roadway modifications. The state legislature provided approval for the four-year pilot project and an FHWA grant provides most of the needed funding. Changes will be made during the pilot project as needed.
- The existing SR 167 cross section includes two general-purpose lanes and an HOV lane in each direction of travel. The HOV lane is separated from the adjacent general-purpose lane by a solid white line. Ingress and egress is allowed at any point.

- An ETC system will be used on SR 167 HOT pilot project. Vehicles using the HOT lanes will have transponders. Readers located above the HOT lane will read transponders and toll charges will be deducted from pre-paid accounts. Electronic signs will display the toll rate.
- The conceptual HOT lane cross-section includes the addition of a double white line buffer separation. Vehicles will be able to enter the HOT lanes at the beginning of the lanes and at three midpoint access locations in the southbound direction and four midpoint access locations in the northbound direction. The final design and the location of the access points will be based on safety considerations. FHWA guidelines prescribe a 1,000 foot or larger opening. Overhead signs will display the toll rate, which will vary depending on traffic congestion in the corridor. The access points will include an overhead transponder reader and an enforcement light. An enforcement area will also be provided at each access point.
- Transit and HOV vehicles will continue to use the SR 167 HOV lanes for free. SOVs with pre-paid transponder accounts will be able to use the lane through electronic tolling. The tolls will be based on level of congestion and the space available in the HOT lane. Based on preliminary modeling it appears that the toll rates will range from $0.60 in the off-peak to $1.25 in the peak-period. Tolls may potentially be higher during periods of severe congestion. A toll charge will be assessed only once in corridor. The gross revenue during the first year of operation is estimated at $1.2 million. Revenues will be used to cover operation and maintenance costs first.
- Modeling results indicate that during peak periods 13 percent more vehicles will move through the corridor, while maintaining travel speeds and trip time reliability in the HOT lane. It is estimated that HOT lane usage will increases by 20 percent northbound and 56 percent southbound.
- The recently-approved state legislation provides tolling authority for the four-year pilot project. It also sets performance standards, allows dynamic tolling, requires an annual report, and provides direction on the use of toll revenues and privacy issues. Phase I of the pilot project will be implemented using a $1.18 million grant from FHWA. The scope of Phase I includes preliminary engineering, outreach, public opinion research, and National Environmental Policy Act (NEPA) analysis. The preliminary engineering includes the channelization plan and the operational concept for the overall tolling system.
- More information on the pilot project is available at http://www.wsdot.wa.gov/hov/sr167hotlanes.gov.

LUNCHEON SESSION

Tim Lomax, Texas Transportation Institute, Presiding

Working with the Business Community
John Breeding
Uptown Houston District

Thank you, Tim. It is pleasure to be asked to speak to you today. My comments will focus on how the Uptown Houston Association works with transportation agencies in the city. Transportation is a very important part of economic development in the Uptown area, and in all areas.

In the 1950s, what is now known as the Uptown area began with a shopping development following residential development. The Uptown area is approximately five miles to the west of downtown Houston. Today, the Uptown area is a third largest office market in the state, behind only downtown Houston and downtown Dallas. On a national level, the Uptown area is similar in size to downtown Pittsburgh and downtown Cleveland. The downtown areas in those cities are the focal point for the transportation system, while Uptown is just one of many major activity centers in Houston.

The Uptown area is the foremost retail center in Houston and in the southwest. It also has numerous restaurants. There are over 6,300 hotel rooms in the Uptown area and more are planned. The area is also undergoing a renaissance in residential development. Within the past five years, six residential towers have been constructed.

The Uptown area today provides a mixed-use environment. There are offices, hotels, restaurants, and residential developments in the area. Over the next 10 years, residential development may represent the highest value in the Uptown market. This mixed-use means that more people are coming in and out of the Uptown area on a 24-hour basis than downtown Houston. We face a number of transportation challenges in the Uptown area. The most significant challenges focus on providing mobility.

The private sector began working together in 1975 with the creation of a voluntary association called the Uptown Houston Association. The Association brought together developers, property owners, and other private sector groups in the area to address common issues. By working together, members of the Association were able to better address these concerns than if they would had been working alone. The members also found that they were much more effective in lobbying public agencies to move projects forward by working through the Association.

In 1986, 1987, and 1988, the Association created Harris County Improvement District One, the first improvement district in the state. An improvement district allows you to tax the land and the improvements within the area over and above city and county taxes. In the Uptown area, the tax is approximately $0.16 per $100 of assessed value. This tax is not an insignificant amount for the private sector to tax themselves to make improvements in the area. In 1999,

working with the City of Houston, the association created Tax Increment Reinvestment Zone (TIRZ) Number 16.

A TIRZ is similar to a tax increment financing (TIF) district or a business improvement zone. Over the next 25 years, the private sector will be making approximately $140 million in investments in the District, while the TIRZ will fund a $230 million capital improvement program for the District. The major elements of the capital program are improvements to roads, streets, pedestrian facilities, and some parking facilities. These projects all focus on improving mobility in the District. The capital improvement program funded through the TIRZ also enhances the District's ability to partner with public agencies on transportation projects.

The TIRZ and the Improvement District are separate entities. Both have their own board of directors. The two are located together, however. I am the Director of the Uptown Houston District, reporting to the District's board of directors. I am also the Administrator for the TIRZ and the Development Authority, which is overseen by a board of directors.

The District has very broad responsibilities. We have a very aggressive traffic management program. It is very important to our members that their employees are able to get to work and leave to go home without experiencing major traffic congestion. Managing traffic in the District is a daily challenge. We work very closely with TxDOT, because what happens on the freeway has a big impact on roads in the District.

The District has also undertaken some very interesting beautification and public space improvements. We also maintain the area, and conduct utility relocation and other needed infrastructure improvements. All of these efforts support economic development in the area.

The establishment of the TIRZ in 1999 has allowed the District to undertake a much more significant public improvement program. In the preceding 25 years, the City of Houston had invested $4 million in roads and streets in the Uptown area. In the past three years, we have invested $16 million in roads and streets in the area. We have been able to show the city the importance of infrastructure investments in the center city to counter developments moving to the urban fringe. There are now 22 TIRZs in the Houston area to help promote reinvestment in the central city.

The District and the TIRZ work together on projects. The District focuses on operations and maintenance, while the TIRZ and the Uptown Authority focus on building streets and other infrastructure elements.

Let me suggest a few ways that groups such as the Uptown Houston Association can expand interaction with transportation professionals and transportation agencies. There are many things we can offer you. First, we have knowledge of our area. We know our property owners and businesses, what their concerns are, and their future plans. It is to your benefit to meet and talk with business groups who can tell you what is going on in their area.

TxDOT has done a very good job of communicating with the Association and other groups about the West Loop (I-610) project. TxDOT has weekly meetings to review the construction schedule and other activities. We have been able to work with the Department on

some modifications, such as not closing a key exit ramp during the holiday shopping period. We can also help TxDOT disseminate information to employers, employees, residents, and shoppers. Communication is critical.

Associations such as ours are good partners to help lobby at the local, state, and national levels for needed transportation programs and projects. We also have ideas on projects and insights on what is important in the area. We have been fortunate to work with TxDOT, the City of Houston, Houston METRO, HCTRA, and other agencies on projects.

The Association has a very aggressive traffic management program, which requires coordination with TxDOT, the City, Houston METRO, and others. Using primarily local funds, we installed traffic cameras on buildings at strategic locations. These cameras are monitored in our office. Approximately 11 officers work key intersections during the peak periods. A police officer monitoring the cameras can communicate by cellular telephone to the officers in the field. This system is also used for incident response. It is very important to office building owners that employees of their tenants are able to get to and from work each day. The traffic management program represents another example of how the Association creates value for its members.

The traffic management program has been expanded through a $1.5 million grant from TxDOT and HGAC. The funding allowed for placement of additional cameras, greater integration with TranStar, and enhanced communication with the end user, including video monitors in lobbies and elevators and a website. While these approaches are not new, what is different is that the private sector is the catalyst to bringing all these elements together.

The West Loop (I-610) provides a good example of the private sector and a state department of transportation working together on a project. The West Loop (I-610) carries approximately 270,000 to 280,000 vehicles a day. The Association put a great deal of effort into ensuring that federal and state funding was available for the project.

We also worked with TxDOT on the concept design for the facility. Although we worked with the Department for a number of years, the Association Board had some concerns with the final design. We were able to bring these concerns to TxDOT and work out a revised design in some sections. We were also very concerned about the landscaping and aesthetic treatments in the underpasses. The Association wanted more lighting in the underpasses. The Association provided $1 million in a local match for enhanced treatments to help ensure that the freeway contributes to the livable urban form in the area.

Building a freeway is never easy. Building a freeway in a major office market is especially challenging. Reconstruction of the West Loop (I-610) has had a negative impact on the office market in the area, reducing office tower values by some 10 percent or $100 million. We want to make sure that construction goes smoothly and stays on schedule. The Association is playing a major role in marketing, public information, and team building on the project. We have made a special point of letting the construction workers know how much we appreciate the job they are doing by providing coffee and donuts and barbeque lunches periodically. We also celebrate small and major milestones, such as the opening of a ramp and all the southbound freeway lanes.

The Association has many unique communication methods available. For example, office cleaning crews can put public notices or other information on every desk in every office building in the area. We can send e-mails to all companies, who in turn distribute it to their employees.

We have also worked with Houston METRO on projects. A year ago METRO approached the Association to help administer construction of transit shelters in the area using unallocated funds from a capital grant.

It is important for you to remember that the private sector is constantly reinventing itself. To be effective, we are always looking at how we do business, what services we provide, and sometimes even what business we are in.

I think HOV facilities are an important element of the transportation system. You are to be commended for continuing to think about how to improve the system through managed lanes, pricing, and other strategies. Buses using the Houston HOV lanes provide a great service, primarily to the downtown area. The Uptown area is not served by the HOV lanes. We would like to see a change in this situation so that the Uptown area is a part of the regional transit system. Service to the area could be provided relatively easily by adding shuttle service from the Northwest Transit Center, which connects to the HOV lanes on the I-10 West and the US 290 Freeways. This type of service could open up new markets for transit.

The Association is actively promoting the implementation of this type of transit service. We worked with HCTRA during the reconstruction of the West Loop (I-610) to establish an envelope for a future transit link at an underpass in the Post Oak Boulevard area. The Association provided $1.72 million to widen the bridge structure and the underpass to provide a right-of-way for future service. We then worked with TxDOT to establish a similar link at the north end of the West Loop (I-610).

The Association is working with METRO, Harris County, and the local congressional delegation to develop a new transit center in the Westpark area. The Center would be a key part of a transit corridor in the core of the Uptown area. We realize it will take a number of years to develop these transit elements, but we also know we need to start now to meet the needs of the future.

Never be afraid to reinvent yourself or your agency. The private sector is constantly reinventing itself. It is important to remember that the projects you undertake creates value for someone and may reduce value for someone. It is also important to remember that timing is everything and that relationships are critical to getting things done. Strong working relationships do not happen overnight. It is critical to start early in developing relationships, and it is important to maintain frequent ongoing contact. The Association's working relationship with TxDOT started long before the reconstruction of the West Loop (I-610) and it will continue after the project is completed.

I appreciate the opportunity to tell you a little about the Uptown Association and our interaction with transportation agencies in the Houston area. I hope you enjoy the remainder of the conference and your time here in Houston. Thank you.

BREAKOUT SESSION – HOVS AND HOT AND MANAGED LANES

Chuck Fuhs, Parsons Brinckerhoff, Presiding

Is Occupancy Important
Bill Stockton, Texas Transportation Institute

Bill Stockton discussed the importance of carpooling and considering vehicle-occupancy levels with HOT and managed lanes. He described some of the factors influencing the consideration of other user groups and illustrated the impacts of different user groups and occupancy level scenarios. He noted the contributions of Hannah Wilner of TTI with the presentation.

- A number of factors may be contributing to the consideration of value pricing rather than occupancy in managed lane and HOT lane proposals. These factors may include the need to generate revenues, the difficulty and the expense of enforcing occupancy requirements, and the feeling that most carpools would exist with or without the HOV lanes.
- While revenue may be generated, it is important to consider that the actual excess revenue may be modest from HOT projects, that the benefit-to-cost ratio may also be modest, and that funding from other sources may be jeopardized. Further, while enforcement can be difficult, HOT lanes are not necessarily any easier to enforce. While some two-thirds of carpools in many areas may be formed with family members who are not likely to drive alone, HOT lanes do not necessarily offer any additional benefits to this user group.
- The potential impact of eliminating two-person and three-person carpools from an HOV lane can be examined through a number of hypothetical examples. Potential impacts of different scenarios include increasing vehicle volumes in the general-purpose lanes and reducing speeds in the general-purpose lanes. The increase in vehicle volumes may result from both displaced 2+ and 3+ carpools moving to the general-purpose lanes and more SOVs in the general-purpose lanes due to the break-up of carpools.
- There are other factors to consider in the discussion of providing priority based on occupancy levels. HOV lanes help reverse the trend in declining available vehicle occupancy (AVO). HOV lanes may provide a perception of increased safety. While HOV lanes may be positive or neutral on congestion, they provide one additional travel option and actually move more people in congested corridors. Considering changes in occupancy levels deserves careful examination. The travel groups that will be impacted, the nature of the impact, and public policy objectives should be examined as part of considering any change.

The Potential for HOT Lanes in the New York Region
Jeffrey Zupan, Regional Plan Association

Jeffrey Zupan discussed the potential applications of HOT lanes in the New York metropolitan region. He described the characteristics of the region and the existing transportation system. He identified some of the possible corridors for HOT projects in the area.

- The New York metropolitan region covers 12,700 square miles in three states and includes 31 counties. Approximately 21 million people live in the region. There are some 10 million jobs in the area. Approximately six million trips a day are made by rapid transit, three million trips a day are made by bus, and one million trips a day are made by commuter rail. There are 1,950 miles of limited access highways, 900 rail stations, and 90 lane miles of preferential treatment in the region.
- There has been little highway expansion in the region over the past 50 years. Few, if any, new limited access highways are likely to be built in the future due to costs and to community opposition. Over the past 25 years, numerous new or expanded expressways have been rejected by voters throughout the region. Examples include the Lower Manhattan Expressway and Cross Brooklyn Expressway in the 1960s, the Richmond Parkway in the 1970s, the Rye-Oyster Bay Bridge in the 1970s, and the Westway in the 1980s. Recently, improvements to I-95 in Connecticut and Route 92 in New Jersey were put on hold.
- Recent developments in the New York region indicate that managing traffic through pricing may be an option. ETC is accepted and is in widespread use on toll facilities throughout the region. Approximately 45 percent of the toll revenues in the U.S. are collected in New York and New Jersey, and about 70 percent are now collected electronically. This percentage is even higher in the peak periods. The New York region is the center of, and is an important travel corridor from Maine to Virginia. Variable pricing was introduced on the Tappan Zee Bridge for trucks, for all vehicles at six Port Authority crossings, and on the New Jersey Turnpike. High-speed toll lanes being are installed by four of five toll agencies in the region.
- The E-ZPass ETC is used throughout the region. It was introduced on the Tappan Zee Bridge in 1993 and was implemented on the entire New York State Thruway system in 1994. It was extended to MTA facilities in 1995 and to the Port Authority in 1997. In 2000, the New Jersey Turnpike and the Garden State Parkway implemented E-ZPass. It is now being used to pay for parking at a few locations and at a MacDonald's drive-thru window on Long Island.
- Variable time-of-day pricing is also being used in the New York region. Variable pricing was first introduced for trucks on the Tappan Zee Bridge in 1996. Variable time-of-day pricing was adopted on the New Jersey Turnpike in 2000 and at six Port Authority crossings in 2001. It is being considered on the Garden State Parkway and on MTA facilities.
- The E-ZPass system allows for high-speed travel through toll plazas. More plazas are being equipped with E-ZPass lanes. The MTA continues to use barriers with full stop arms at nine crossings.
- There are currently some 90 lane miles of HOV lanes in the New York region. There are a number of factors influencing the relatively limited application of HOV lanes in the region. The major factor is the extensive rail network in the region, which focuses on the core downtown area. Most access to Manhattan is now by rail, with 74 percent transit share. There has also been opposition to some HOV projects from drivers and in some cases environmental groups.

- There are seven preferential treatments in the region, accounting for the 90 lane miles of HOV lanes. The HOV lanes on the Long Island Expressway are 30 miles in length, accounting for 60 lane miles. The 10 miles or 20 lane miles on the New Jersey Turnpike represented the second longest HOV project in the region. The other five projects operate only in one direction and are all relatively short distances, although they carry high volumes of buses and other HOVs in some cases.
- The I-80 and I-287 HOV lanes in New Jersey were de-designated after significant public pressure. The proposed grade-separated I-287 HOV lanes in Westchester were rejected by the governor after protests by local communities and environmental groups. The long-range transportation plan includes 120 lane miles of freeway and 260 lane miles of arterial widening for proposed HOV lanes. It also includes the use of BRT on some lanes. The plan is currently in limbo with community and environmental groups objecting to the roadway widenings.
- Development patterns on Long Island also work against express bus lanes and HOV facilities. Residential densities needed for express buses are about 10,000 per square mile. Only limited areas in the southern and western parts of Nassau meet that criteria. Most of the express lanes proposed are not near these denser communities. New bus services are expensive, and the transit systems have difficulty maintaining some existing routes due to limited funding.
- There are both advantages and disadvantages to converting an existing general-purpose lane to a HOT lane. Advantages include familiarity with the E-ZPass system and potential high use. Opposition to widening existing facilities and funding limitations for capacity expansion may also make this alternative more attractive. Disadvantages include the reaction of drivers to the loss of a free travel lane and possible congestion in the general-purpose lanes and on roads with diverted traffic.
- There are also advantages and disadvantages to adding a HOT lane as new capacity. Advantages include familiarity with the E-ZPass system and potential high use. There is more support among drivers for adding a lane rather than converting an existing lane. Disadvantages include opposition to widening existing facilities, and funding limitations for new capacity. Some individuals and groups view adding a lane, even a HOT lane, as encouraging more sprawl development.
- One freeway corridor that appears to provide a good possibility for HOT lanes in the New York region is the I-287/Tappan Zee Bridge corridor. A study examining options for replacing the Tappan Zee Bridge is underway. Options being considered include a bus lane with HOVs and tolling. Densities may not support a rail option in the corridor. Toll charges are already used on the Tappan Zee Bridge and variable pricing is probably inevitable at some point in the future.
- Two other possible projects are the I-287 and I-80 corridors in New Jersey, where the HOV lanes were de-designated. The HOV lanes on I-80 were well utilized, with 1,000 to 1,400 HOVs in the peak hour and many New York-bound buses. There may be capacity for tolled SOVs on I-287. With only 330 to 650 HOVs during the peak hour, it may be a good candidate for 2+ HOVs with SOVs buying in.

- The southern corridor from the New Jersey Turnpike to the Long Island Expressway provides another possible candidate. Currently, there are six agencies, four toll policies, three preferential treatments, and two policies on toll payment methods in the corridor. A number of improvements are planned in the corridor. These improvements include the Goethals Bridge, extending the Staten Island Expressway bus lane, toll plaza reconstruction on the Verrazano-Narrows Bridge, the possible replacement of Gowanus Expressway, and the possible replacement of the Kosciuszko Bridge.
- A final possible HOT lane project is the HOV lanes on the Long Island Expressway. There is available capacity on these lanes, which operate through the length of Nassau County and into Suffolk County. Opposition to tolling is widespread on Long Island, however.

BRT/HOT Lanes – Something Everyone Can Support
Gary Groat, Fluor Virginia

Gary Groat discussed proposals for BRT/HOT lanes on the Capital Beltway and I-95/I-395 in northern Virginia. He described the BRT/HOT concept, the potential design and operation of both projects, and the public response to date.

- The BRT/HOT lane concept provides free travel for multiple passenger vehicles, including vanpools, BRT, and carpools with three or more persons. SOVs and double-occupancy vehicles would pay a toll. Electronic toll collection would be used and there would be no toll booths. The facility would be actively managed to ensure maximum use. No trucks would be allowed.
- The Capital Beltway proposal includes 12 miles of BRT/HOT lanes west of the Springfield interchange to south of the Georgetown Pike. There would be seven entries/exits and five intermediate entry/exit points. Direct ramp-to-ramp access would be provided at two locations – the Dulles Access and I-66. The potential for future expansion also exists. The project would be a prototype for the region. The estimated project cost of $694 million would be financed through tolls. The proposed BRT/HOT facility cross-section would include a total of 12 lanes. There would be four general-purpose lanes and two HOT lanes in each direction.
- VDOT held public hearings on alternatives for expanding the Capital Beltway in May 2002 and conducted public workshops in June 2004. Alternatives presented included no action, widening the Capital Beltway, and other options. Four widening alternatives were included in the 2002 public hearings. These alternatives were 10 lanes with concurrent flow HOV, 10 lanes with express/local HOV, 12 lanes with barrier-separated HOV, and 12 modified lanes with HOT operation. The modified 12 lanes with HOT operation were favored by some 36 percent of the workshop participants.
- The I-95/I-395 BRT/HOT lane proposal would provide a 56-mile system between Washington, D.C. and Spotsylvania County to the south. A major BRT component is included. The current HOV lanes would be extended 25 miles to the south. The facility would include all electronic tolling and would be actively managed. A total of 24 new entry/exit points would be included, with some exclusively for transit. The I-95/I-395

BRT/HOT lane would interconnect with Capital Beltway HOT lanes. The estimated capital cost of $1 billion would be self-financed.

- The BRT/HOT concept will help meet future travel needs. This approach provides a multi-modal facility for transit and automobile use. It provides travelers more choices and moves more people in fewer vehicles. It also creates a regional system connecting all modes. The project covers the five Virginia counties of Arlington, Fairfax, Prince William, Stafford, and Spotsylvania.
- The transit facilities improvement portion includes eight new express bus stations, four new bus stops, and five new park-and-ride lots. It also includes an integrated transit communications system. A $500 million transit subsidy is recommended.
- The BRT/HOT lanes would benefit numerous groups. First, BRT/HOT lane users would benefit, including carpoolers, vanpoolers, casual carpoolers, and BRT/express bus riders. General-purpose lane users would also benefit. Employers, employees, and the economy in the region would benefit from an improved regional transportation system.

BREAKOUT SESSION – DEPLOYMENT APPROACHES – MAKING PROJECTS HAPPEN

Robert Cady, Federal Highway Administration, Presiding

Xpress Lanes: Florida's Turnpike Enterprise Strategic Initiative to Managing Congestion
Jennifer Tsien, Florida's Turnpike Enterprise

Jennifer Tsien described the evolution of toll facilities and the use of electronic toll collection in Florida. She discussed the Xpress Lane concept, the partnership approach being used to implement the concept, current projects, and future initiatives.

- The toll payment methods used in Florida have evolved over time. Cash was the only form of payment when the first toll facilities were opened in the state in the 1950s. By the 1990s, toll plazas provided lanes for cash or electronic payment. In the late 1990s, dedicated lanes for electronic payment were in operation. In 2003, the Xpress Lanes concept was initiated. By 2008 open-road tolling is planned.
- Florida has a system-wide ETC program called Sun Pass. Approximately 54 percent of people using toll facilities in the state participate in Sun Pass. Some 1.75 million transponders have been sold. Approximately 45,000 transponders are sold per month. Sun Passes may be purchased from the toll authorities and retail partners.
- Florida's Turnpike Authority Strategy Number Four focuses on deploying Xpress Lanes. The mission is to pursue partnership opportunities to develop and build cost feasible Xpress Lane projects in congested urban areas of the state.
- The Xpress Lane concept utilizes all ETC with no toll plazas. The Xpress Lanes are optional, so non-Sun Pass users would still be able to access the toll roads. Variable pricing would be used. Emergency and public transportation vehicles would not pay a toll.
- The Turnpike Partnership focuses on investment to reduce costs and partnering to accelerate projects. The ridership and toll revenue risk are shared and reduced. Innovative toll management is used and there are opportunities for staff synergy.
- Xpress Lanes are being considered on a number of freeways in the state. Planning studies include examining design concepts, conducting traffic modeling, completing preliminary revenue estimates, and identifying construction costs.
- The Xpress 400 being considered is a 20-mile segment of I-4 through downtown Orlando. The estimated cost of the project is $2.1 billion. The Xpress 400 represents new user-financed capacity within the median of I-4. The project is being designed and right-of-way acquisition is underway. A public education campaign is being undertaken. The project is forecasted to open in 2012.
- The results from surveys and focus groups in the I-4 corridor indicate that 73 percent of the respondents believe congestion will increase in next 10 years. Approximately 85 percent support the Xpress Lanes to accelerate I-4 improvements. Some 78 percent of

the respondents indicated they would use the Xpress Lanes some of the time and 30 percent would routinely use the lanes.

MnPASS System Study
John Doan, Minnesota Department of Transportation and Jeffery Buxbaum, Cambridge Systematics, Inc.

John Doan and Jeffery Buxbaum discussed the MnPASS System study. They described the background to the study, the study process, the technical findings, and areas for further research. They acknowledged the involvement of Mike Subolewsky and Paul Czech with Mn/DOT in the study and the development of the presentation.

- MnPASS is envisioned to be a system of express toll lanes using ETC. HOT lanes allow SOVs to pay a toll to use an existing or proposed HOV lane. State legislation approved in 2003 allows conversion of the I-394 HOV lanes to HOT lanes. Express toll lanes, or FAST lanes, are usually defined as tolled lanes added as new capacity alongside existing, non-tolled, general-purpose lanes.
- The I-394 HOV lanes are 11 miles in length and include a three-mile barrier separated reversible section and eight miles of concurrent flow HOV lanes. For the MnPASS project there will be five eastbound and six westbound access points in the eight-mile concurrent flow section. Buses, carpools, vanpools, and motorcycles will continue to use the HOV lanes for free. SOVs will be able to use the lanes for a fee. MnPASS will be fully electronic and dynamically priced. It will open to paying SOVs on May 16, 2005.
- In early 2003, the Governor supported the idea of converting the I-394 HOV lanes to tolled lanes. Legislation was approved in the spring of 2003 allowing the HOT project on the I-394 HOV lanes. In December 2003, the Governor and Congressman Kennedy introduced the FAST lanes concept. The MnPASS System study was initiated in the summer of 2004 and the Study Steering Committee was formed. The study was completed in early 2005 and the opening of I-394 MnPASS Express Lanes is scheduled for May 16, 2005.
- There are a number of preconceived myths related to toll facilities and HOT lanes. Many of these myths had to be addressed in the MnPASS project. The first myth is that toll lanes pay for themselves and no additional public funding needed. The second myth is that tolls expire after a period of time. A third myth is that there is a great deal of private sector interest in owning and operating new toll lanes. Other myths are that toll lanes are a roads-only solution to congestion relief and that toll revenues reduce the need for additional gas tax revenues. There is also a perception that toll lanes only benefit rich people. A final myth is that toll booths are necessary despite their inconvenience.
- The goals of the MnPASS system study were to assess the feasibility of a MnPASS system concept in the Minneapolis-St. Paul metropolitan area, to identify and analyze potential systems of MnPASS lanes, and to identify associated policy and implementation issues. The study process included a technical analysis involving agency staff and consultants, and a policy analysis involving the MnPASS Study Steering Committee. A peer review process was also used with the study.

- The Mn/DOT Metropolitan District was responsible for overall management of the MnPASS system study. Consultants were used to conduct the technical analysis. A technical team, comprised of staff from Mn/DOT, the Metropolitan Council, FHWA, and the Transportation Advisory Board, provided technical oversight and quality control. The MnPASS Study Steering Committee, comprised of representatives from the Transportation Advisory Board, the Minnesota Senate and House of Representatives, the Humphrey Institute at the University of Minnesota, Mn/DOT, and the Metropolitan Council provided policy direction to the study.
- The technical analysis identified a potential toll lane system for the metropolitan area and associated implementation issues. Capital and operating costs were examined, along with the potential for revenue generation. Travel benefits focusing on changes in travel times, operational considerations, and the impacts on the existing transportation system and policy plans were assessed. The technical analysis included one round of initial screening and two rounds of increasingly detailed analysis.
- There were seven major technical findings that emerged from the study. The first finding was that public investment is required for new roadway capacity. New capacity segments were clustered in the 15-to-55 percent capital cost recovery range, with a system-wide average of 22 percent. The second finding was that MnPASS provides a congestion-free alternative. MnPASS users travel approximately 25 mph faster during peak periods than non-users, with a three-to-four mph speed gain for non-users.
- The third finding was that the transit system would benefit from MnPASS. Modeling MnPASS express bus service on TH 36 predicted a 6.2 percent increase in ridership. The implementation of BRT has design implications on access to MnPASS lanes, placement of transit stations, and operating speeds. The fourth finding was that a regional model shows that by 2030, little excess HOT lane capacity is available for SOVs, because 2+ HOVs fill up the lanes. This finding indicates the need for flexibility in HOV definitions.
- The fifth finding was that providing hybrid vehicles with free access supports an environmentally beneficial policy of encouraging hybrid utilization, but allowing hybrids into HOV lanes built with federal funds violates current federal law. Allowing hybrid vehicles also increases toll collection and enforcement challenges. The high cost-premium on hybrids raises equity issues. Virginia is considering discontinuing its hybrid-free policy due to high use of HOV lanes. Enforcement has also proved problematic in Virginia.
- The sixth finding was that many potential projects that might have ranked high are already under construction or committed, and thus are not eligible under current policy to be considered for the MnPASS system. The I-494 design build project represents one example of a project that is not eligible. Finally, potential projects that ranked high in the technical analysis are not in the Transportation Policy Plan (TPP).
- The 2030 MnPASS system concept includes approximately 120 miles of HOT lanes. This system is estimated to save some 176,000 daily vehicle hours in 2030. It would also result in higher travel speeds than the future base condition.
- The Steering Committee consisted of 15 members. The chair was the mayor of a suburban community in the corridor. Other members included three state legislators, five

local elected officials, and three Mn/DOT officials. The committee also included a representative from the Metropolitan Council, the University of Minnesota, the freight and business community, and the general public.

- The Steering Committee made a series of policy findings and recommendations. A first recommendation was that an interconnected system of MnPASS lanes should be pursued for the primary purpose of managing congestion in the area. A second recommendation was to establish transit and BRT routes on MnPASS lanes wherever feasible, and adequately fund an integrated transit system. A third recommendation was that the public sector should make decisions on when, where, and how MnPASS lanes are developed. A fourth recommendation was that public investment in the MnPASS system is necessary. A fifth recommendation was that MnPASS lanes should be identified, analyzed, financed, regulated, enforced, and owned by the public sector. A sixth recommendation was that MnPASS lanes should be fully-electronically tolled and variably priced. A seventh recommendation was that MnPASS lanes should be actively considered for future highway expansion projects, without threatening projects currently underway.
- A peer review panel assessed and validated the reasonableness of the technical and policy issues. The peer review panel consisted of three nationally recognized experts from FHWA, the Miami-Dade Expressway Authority, and Cal Poly State University. The peer review panel concluded that the technical analysis and findings were reasonable. They were also impressed by quality, depth, and soundness of the policy recommendations. The final reports incorporate the comments from the peer review panel.
- The MnPASS System study also identified issues for further study. These issues included evaluation of the I-394 MnPASS Express Lanes, conversion of existing free lanes, updating growth projections, and assessing the impact on transportation system needs. Other issues included examining the integration of MnPASS into the transportation planning and programming process, and exploring the potential treatment of HOVs and hybrids further.
- The next steps in the process focused on demonstrating and evaluating the MnPASS concept on I-394. Other activities included examining corridor-specific design and operational issues and addressing policy and institutional issues.

Implementing Road Pricing – European and North American Models
Jeffrey Casello, University of Waterloo

Jeffrey Casello provided a comparison of North American and European approaches to implementing road pricing projects. He described the evolution and goals related to road pricing and provided examples of successful projects. He reviewed the North American and European approaches and described opportunities and challenges in transferring these experiences. He noted the assistance of Christopher Martin Puchalsky and Mario Semmier, Ph.D. candidates at the University of Pennsylvania with the research for the presentation.

- The traditional toll road concept is based on using toll revenue to repay bonds or debt financing and maintenance of a facility. Tolls may influence demand and facility performance.

- The congestion-pricing concept modified this traditional approach. Congestion pricing is a function of network performance or the volume-to-capacity ratio. Variable tolls influence demand and roadway performance, which in turn influences demand and variable tolls. The revenue generated is used to create new highway capacity and to maintain and manage existing highway capacity.
- Contemporary congestion pricing focuses on generating revenue for existing and new highway capacity, modifying demand, improving the level of service, and stimulating market forces. Issues related to equity, public acceptance, and political feasibility may need to be considered.
- Recent examples of the successful implementation of congestion pricing in North America include the Leeway project in Lee County, Florida, the I-15 HOT lanes in San Diego, California, and 407 ETR in Toronto, Canada.
- A systems approach in transportation pricing takes the congestion-pricing concept a step further. The fundamental changes focus on revenue redistribution, facility pricing versus trip-based charges, and more broadly defined externalities. Examining the interrelationships of transportation, land use, and urban form and coordination with taxation policy are also important elements.
- North American examples of the systems approach include transit exemptions, revenue redistribution, and trip-based charges. Taxation policies provide another example of the systems approach in North America.
- European examples of the systems approach include complementary measures for public transportation enhancements and trip-based charges. Example of complementary measures for public transportation enhancements include the Swiss system of rail improvements partially funded by road revenue and the 1971 dedicated transport funding law in Germany, which provides a significant amount to transit. Examples of trip-based charges include the Dutch distance-based insurance and Norwich Union and Pfizer parking cash out programs in the United Kingdom.
- Examples of European externality pricing with the systems approach include the German fee based on the number of axles and emissions class, and the European Union (EU) white paper on transport policy in 2010. Some European pricing policies also attempt to address urban form, including examples in Durham and London in the United Kingdom and Rome in Italy.
- A number of benefits may be realized by the systems approach. Potential benefits include internalizing true external costs and realizing transportation as an economic good. Other possible benefits include improving safety, mitigating equity concerns, and promoting transportation's role in social, economic, and cultural contexts.
- There are a number of challenges in transferring the experiences in North America and Europe. The legacy of the North American automobile cost structure and the emphasis on market solutions represent two challenges. North America is also characterized by strong lobbying groups, the federal transportation policy, land use conditions and policies, and the lack of regionalism.

- The North American models appear to be successful in achieving congestion pricing goals, implementing technology, and engaging the private sector. Revenue redistribution occurs when fundamentally strong leadership exists, transit viable alternatives exist, and higher-tier governments are involved.
- European challenges include increasing vehicle kilometers of travel (VKT), dispersion of urban areas, and incidents of public opposition. European models appear more successful in understanding the interaction between transportation and urban form, implementing a wider set of trip-based pricing methods, and more broadly defining and pricing for externalities.

BREAKOUT SESSION – ENFORCEMENT FOR MULTIPLE USER GROUPS

Bill Eisele, Texas Transportation Institute, Presiding

Automated Occupancy Monitoring Systems for HOV/HOT Monitoring and Enforcement
Stephen Schijns, McCormick Rankin Corp.

Stephen Schijns discussed the issues associated with enforcing vehicle-occupancy requirements on HOV and HOT lanes. He presented a concept for an in-vehicle-occupancy detection system and described how this approach could be implemented with HOV and HOT facilities. The presentation was based on a study managed by the Ministry of Transportation of Ontario and funded by ENTERPRISE, a pooled-fund ITS research program.

- The need to count the number of people in a vehicle can be thought of as a problem or an opportunity. As a problem, it is difficult to accurately and inexpensively monitor vehicle-occupancy levels. Available technology provides the opportunity to monitor occupancy levels, with numerous benefits. Currently, the only available technique is to visually observe the number of people in a vehicle.
- There are a number of limitations with current enforcement practices. Providing ongoing enforcement is costly. Visual observations can be inaccurate due to weather, tinted windows, and the time-of-day. Enforcement is often limited to certain locations. Wide shoulders or special enforcement areas are needed to provide safe conditions for officers. Automated enforcement to date has been limited and current methods are difficult with non-barrier separated lanes and all-electronic HOT lanes. Arterial street HOV lanes are even more difficult to enforce.
- Additional enforcement personnel can help, but this approach requires substantial ongoing budget support. In many areas, HOV violations remain a key public concern. Fully-automated enforcement plans are currently not possible. Current enforcement practices limit potential support for more HOV/HOT projects.
- Enforcement and transportation agencies need an effective, cost-efficient, reliable, and targeted technique for observing vehicle occupancy levels. Current practices do not meet these requirements.
- There has been research examining automated HOV-occupancy detection for more than a decade. Both Caltrans and TxDOT/DART explored the potential use of video. GDOT examined digital infrared technologies and Mn/DOT tested infrared and video. Infrared and video was also explored in Leeds, United Kingdom.
- The results of these research projects showed promise, but the operating environment limits potential applications. Problems inherent with the operating environment include darkness, visibility to see all seats in all vehicles, and single-point monitoring versus network-wide needs. Other issues include the costs associated with field installations, the need for complete accuracy, and the functionality with concurrent flow HOV lanes.

- The approach taken in this effort was to consider detecting occupancy from outside the vehicle as inherently flawed. Rather, the approach started with systems inside the vehicle, and builds outwards.
- Occupancy detection could follow the same technique as that used with safety belts. The safety belt warning sign on vehicle dashboards light up because seat occupancy is being detected, with the warning sign cancelled only by use of the seat belt. The automobile industry has been detecting seat occupancy through the use of safety belts since the 1960s.
- Components of the safety belt system typically used today include the mechanical systems in the seatbelt closure and weight sensors. The weight sensors might include a strain gauge in the seat mount, a pressure sensor in the seat, and a gel bladder under the seat. Other available technologies that could be used include magneto-restrictive strain sensors, photography and video, thermal and infrared imaging, and ultrasonic radar sensors.
- The U.S. Federal Motor Vehicle Safety Occupant Crash Protection Standard 208 requires the use of smart air bags, or those with occupancy-detection systems in the front seats of new vehicles sold in the U.S. Approximately 20 percent of 2004 model vehicles had this feature and it is estimated that 65 percent of 2005 model vehicles will be equipped with smart air bags. By 2006 all new vehicles must have smart air bags. Occupancy sensing is estimated as a $3.6 billion industry in 2001 to 2006.
- An in-vehicle occupancy detection system creates simple electronic data that can be linked to available transmission systems. Possible approaches might include transponder and receiver systems, satellite-based systems or GPS, and wireless ground-based systems. Information could then be gathered in monitoring systems and used as appropriate.
- In terms of the citation process, all HOV lane users would have to have an occupancy-monitoring system (OMS) if the need for police in the field is to be eliminated. HOV lane users would have to be restricted to vehicles equipped with an OMS. Vehicles in an HOV lane without an OMS would be cited for an OMS violation. Vehicles in an HOV lane with an OMS and fewer than required occupants would be cited for an HOV violation. Enforcement personnel could use OMS in the field to reliably spot violators. Enforcement personnel could either stop the vehicle and issue a citation or note the vehicle license plate number and issue a ticket by mail. In a fully-automated system, tickets would be issued by mail.
- Vehicle-based occupancy detection is currently available and the needed technology is in use. It is a relatively low-cost approach that is capable of being 100 percent reliable. For example, air bags must work right every time. Vehicle-based occupancy detection is capable of addressing all the challenges facing out-of-vehicle systems and is capable of functioning everywhere, continuously.
- Vehicle-based occupancy detection could be used with HOV and HOT lanes, managed lanes, and value pricing projects. It could also be used for system-wide HOV tracking, data collection, and vehicle emissions monitoring and testing. Other possible uses include HOV traffic signal priority, vehicle identification, vehicle and operating

diagnostics, vehicle safety systems, emergency systems, and passenger security systems. Additional applications include transit monitoring and priority, HOV preferential parking, carpool incentives, insurance, and marketing.

- The vehicle-based occupancy detection approach was discussed with state transportation authorities, municipalities, enforcement agencies, automobile manufacturers, and other interested parties. Input was received on cost, privacy issues, possible technological problems and issues, and accuracy and reliability. Other topics discussed related to mandatory versus voluntary applications, timeframes for implementation, legal or legislative obstacles, and ticketing violators by mail. Other potential applications, benefits, and synergies were considered, along with partnership opportunities and commercial issues.
- Comments received suggested there may be a lack of public and political acceptance of automated enforcement. This concern may be triggered by privacy and civil liberty perceptions. The use of ticket-by-mail requires absolute proof and legal support. Questions were also raised about the capital costs, including competition for funding priority and motorist acceptance of additional in-vehicle costs. The practicality of implementing a vehicle-based occupancy detection system would require government and industry coordination and cooperation. The needs are immediate and this approach could take a long time. All HOV lane users need the system for it to be effective. Even with this type of system, police presence is still desirable. Conventional enforcement can be effective when supported by high fines and adequate funding.
- Even with these questions, there was positive response to the concept. There was general concurrence that it is technically feasible. The privacy issues might be resolved by applying them to a controlled environment of an HOV or HOT lane. An effective pilot project could set the scene for a large-scale rollout. Avoiding the use of photography could help reduce privacy issues. Cost could be viewed more positively if fine revenue is returned to the system. The expense of the system could be rationalized if additional benefits arise, such as automated and effective traffic counting. Many people felt the ticket-by-mail issues can be resolved.
- The in-vehicle costs of the system, which include the transponder and rear seat monitoring, are in the range of $200 to $400 per vehicle. The roadside equipment and costs would include the median antenna system, estimated at $100,000 per mile for a concurrent flow facility. The cost would be much less for a barrier-separated facility. The total cost for equipping all U.S. freeway HOV lanes would be in the range of $400 million. Other system costs would include the back office, computers, software, administration, customer service, mailing, and court expenses.
- It is important to remember that conventional HOV lane operation is also expensive. Enforcement costs range from $4,500 to $9,000 per freeway lane-mile per year or $12 million to $24 million per year across the U.S. Even with this level of enforcement, violation rates range from five percent to 10 percent, with arterial street HOV violations rates much higher. The capital cost for enforcement provisions, such as shoulders and observation areas also need to be considered.

- The current HOV enforcement revenue is estimated to be approximately $35 million to $70 million per year in the U.S. If 100 percent of violators were cited, the fines would amount to $2 billion to $4 billion per year. With automated enforcement, the fine revenue would be drastically reduced over time because all violators would be identified and fined. A one percent violation rate would result in annual revenue of approximately $375 million. The ultimate objective is to eliminate fine revenues. The benefits lie in more effective HOV and travel demand management programs.
- Implementing automated-occupancy monitoring is costly but could be paid back over time through a number of methods. These methods include users paying for the in-vehicle system, reduced HOV policing costs, reduced HOV lane construction costs, and increased ability to implement HOT lanes. The value of improved performance monitoring data and public and political support for expanded HOV and TDM programs would also yield benefits. A successful system will result in no violations and no fine revenue. Automated OMS unleashes many potential synergistic applications.
- A three-pronged action plan is suggested. The technical aspect would focus on developing a prototype and implementing a pilot project. The social-political element would focus on market research to better understand public and political views and to refine business plan and financing. The commercial aspect would include consulting with automobile industry on implementation.

Enforcement of Managed Lanes with HOV Preference
Ginger Goodin, Texas Transportation Institute

Ginger Goodin discussed enforcing managed lanes. She described some of the enforcement challenges with managed lanes and highlighted the experience with enforcing the QuickRide program on the I-10 West and US 290 HOV lanes in Houston. She also described alternative enforcement strategies, field tests of newly available technologies to enhance enforcement, and other possible operating strategies.

- With HOV facilities, enforcement focuses on verifying vehicle-occupancy levels and ensuring that basic traffic regulations are obeyed. With HOT lanes and managed lanes, enforcement must also verify toll payment and other exempt users.
- There are challenges with both occupancy verification and with transponder verification. Currently, occupancy checks must be performed by visual inspection, as there are no commercially available automated occupancy detection systems. While there have been limited tests of video recognition and infrared imaging to determine the number of occupants in a vehicle and discussion of possible in-vehicle technologies, none are currently available for use. Thus, manual verification of occupancy levels is required.
- Challenges also exist with transponder verification. Using a light-emitting diode (LED) indicator requires line of sight by the enforcement officer. Vehicles traveling at high speeds can create difficulties in matching a tag to a vehicle. Potential approaches to address these challenges include billing at enforcement zones and the use of a violation enforcement system (VES), which record license plate numbers.
- A number of supporting elements are needed for the successful enforcement of managed lanes. First, the operating agency must have the legal power and authority to enforce the

occupancy requirements and toll collection. Second, dedicated enforcement is needed. Third, account management is needed. Finally, citations must be upheld in court.

- The I-10 West and US 290 HOV lanes are one-lane reversible facilities. A 3+ vehicle-occupancy requirement is used on both lanes during the peak periods. Two person HOVs can use the lanes during these time periods for a flat fee of $2.00 a trip as part of the QuickRide project. The QuickRide program on the I-10 West HOV lane was implemented in January 1998. The program was implemented on the US 290 HOV lane in December 2000. QuickRide participants must register for the program, obtain a transponder and a QuickRide hangtag, and maintain a pre-paid balance in their QuickRide account. The transponder must be placed on the front facing side of the rear view mirror, with the hang tag suspended from the mirror.
- Visual observation surveys indicate that the violation rate with the program is high. HOV 2 violators and solo drivers appear to account for 55 percent to 65 percent of the vehicle volumes during the 3+ restricted period. One of the compliance vulnerabilities on the I-10 West HOV lane is that the transponder reader is located well before the enforcement area, which does not allow officers to check the validity of transponders.
- There appears to be a number of reasons for the high non-compliance rate. It appears that approximately 50 percent are willfully violating the program payment requirements. Another 15 percent appear to have masked tags at the billing reader on location. Another 15 percent appear to have tags from HCTRA, which are not valid with the QuickRide program. Faulty tags appear to account for another 15 percent of the violators, while lost or non-visible hang tags account for five percent.
- A number of options were examined to address the enforcement issues. The three options included strengthening existing procedures, adding technology support, and implementing a new operating strategy. The effectiveness, estimated cost, and estimated revenues of these approaches were examined.
- The first option focused on strengthening existing enforcement procedures. Elements of this approach included increasing enforcement levels, standardizing policing procedures to improve the efficiency of operations, and posting signs with the $200 maximum fine. Letters would also be sent to repeat violators. This option was estimated to reduce violation rates to a range of 40 to 55 percent.
- A second option focused on the use of technology support to enhance enforcement. A limited pilot test was conducted on the I-10 West HOV lane. An additional AVI tag reader was placed at one location. A greet light was illuminated when valid AVI tags were read. A hand-held AVI reader was also developed and should be tested in the near future.
- An analysis of the citation issued with the QuickRide program was conducted. A total of 4,863 cases that went to court over a two-year period were examined. Approximately 65 percent of the cases were dismissed. Some 70 percent of those dismissed were due to the police officer not being present in court. Of the cases that were not dismissed, 98 percent of the defendants plead no contest or guilty. Of the two percent of the defendants who plead non guilty, 96 percent were found guilty.

- Based on the assessment of the first two options, a number of recommendations were made for enhancing enforcement. These recommendations included providing consistent on-site law enforcement officers and installing supporting technology, including hand-held tag readers. Outreach efforts to the court system to better ensure that cases are not dismissed was also recommended. Other recommendations included improving toll account management, particularly violator processing and tracking, and enhancing signing and increasing public education efforts. Re-examining the operating strategy, especially if SOVs are allowed to use the HOV lanes was also recommended.
- The new operating strategy option focuses on the use of a self-declaration lane. Under this option all vehicles using the managed lanes would be required to have a transponder. HOVs would self-declare and would use a lane to receive a toll exemption under a separate reader. Visual verification would be performed by police officers at a low-speed location associated with this lane. A VES would be used to check tag status so the officer would not have to perform that task.

Enforcement on the 91 Express Lanes and I-394 MnPASS
Jon Ramirez, Cofiroute USA

Jon Ramirez described enforcement practices on the 91 Express Lanes in Orange County, California. He also summarized the planned enforcement approach for the I-394 MnPASS program in Minneapolis, Minnesota. He discussed ETC and some of the potential issues with enforcing HOT lane projects.

- With ETC, customers establish pre-paid toll accounts and receive transponders for their vehicles. Overhead antennas read the transponders and deduct the appropriate toll from a customer's pre-paid account. Accounts are replenished at established thresholds. Photo enforcement is used for toll violations and visual enforcement is used for HOV violations.
- The SR 91 Express Lanes use congestion pricing based on the time-of-day. Image-based violation enforcement is used by the operator, supported by on-site California Highway Patrol (CHP) officers. Since the lanes sell excess capacity, it is paramount for the agency to actively enforce violations.
- There are currently approximately 170,000 91 Express Lanes transponders and over 600,000 FasTrak™ transponders region-wide. Some 25 percent of Express Lanes traffic comes from other FasTrak™ agency customers, and approximately 20 percent is 3+ carpool traffic.
- Enforcement on the SR 91 Express Lanes is accomplished through photographing license plates and optical character recognition (OCR). A software programs allow approximately 1,000 images per hour to be processed manually. The license plate numbers are compared to the existing customer databases. Some 80 percent of violators are customers. There is an on-line link to the California Department of Motor Vehicles. A notice of violation is sent to the vehicle owner. The letter allows initial violators to become customers. A non-response initiates an additional letter and fees. The lack of response to a second letter results in civil judgments. The view is to treat violators as customers who have not chosen to pay properly.

- Civil judgment on the SR 91 Express Lanes began to be processed in September 2003. Since that time, some 435 cases have been assigned to an attorney. The total value of the cases assigned is approximately $9 million. To date, 209 cases have been settled and some $512,466 or $2,452 per case, has been collected. A total of 83 cases were settled on payment plans. The balance due on these payment plans is approximately $829,564. A total of 15 cases were settled for over $20,000. The largest settlement was $60,000. The largest pending judgment is $387,000, which involves 457 citations over 3 years.
- The I-394 MnPASS project represents the expansion of the HOV lanes to HOT lanes. It is a public/private partnership between Mn/DOT and a team led by Wilbur Smith that included Cofiroute. The partnership team was in charge of all the studies and installing all the HOT lanes toll equipment. The project includes five toll zones and dynamic pricing. Segment based tolling will be used. Mn/DOT is responsible for incident and traffic management, road maintenance, and winter maintenance.
- The MnPASS project is scheduled to open in mid-May, 2005. This schedule is within 18 months of contract award. Approximately 1,500 accounts were established during the first week the service center was opened. Cofiroute is responsible for the customer service center, the road toll system maintenance and operations, and the back office systems maintenance and operations. Mn/DOT is pursuing a plan of developing a network of HOT lanes as added capacity in the region.
- The MnPASS project includes a number of enforcement elements. The enforcement transponders are specially programmed to beep when other transponders are read. The mobile transponder readers allow officers to read transponders in their vehicle to check transactions. Enforcement beacons or lights on the overhead gantries will flash with a valid read. Visual enforcement will also be used with the transponders, readers, and beacons. The Minnesota State Patrol will provide enforcement leadership, with assistance from the City of Minneapolis Police Department, the City of Golden Valley Police Department, and the Metropolitan Transit Police.
- There are a number of potential enforcement issues with HOV and HOT lanes. Identifying occupants in HOVs is not always easy. Automated versions of passenger detection do not appear viable at this time due to technical and privacy issues. Using an HOV segregated lane in a toll zone to check occupancy requirements appears to be the best current approach. Law enforcement personnel only have to check occupancy levels in vehicles in that lane. This approach is easier to determine compliance by motorists and tolls can be calculated in as part of the back office function.
- Experience from current projects indicates that management of the customer account information database is critical. It is also important to incentivize customers to follow best business practices. Collecting minimal data at the toll lane and processing it in back office is also beneficial. Collaboration with law enforcement is essential for effective enforcement. In terms of toll collections, using state-of-the-art camera systems and state-of-the-industry software for tracking and customer conversions are important. Providing opportunities for non-paying violators to become paying customers is also critical. Having realistic expectations is also important. Do not anticipate that collections will be a profit center. Rather, focus on recouping costs.

- New technologies may provide improved enforcement and collection capabilities. Improved photographic technology may enhance enforcement capabilities. The next generation of systems may assist in determining the number of vehicle occupants. It may also be possible to rely on automakers for next generation of vehicles to use air bag sensors that will determine occupancy levels.

BREAKOUT SESSION – MONITORING, EVALUATING, AND REPORTING FOR MULTIPLE USER GROUPS

Neil Spiller, Federal Highway Administration, Presiding

Using Real-Time Data to Evaluate HOV and General-Purpose Lanes

Robert Benz, Texas Transportation Institute

Robert Benz discussed the use of real-time data to evaluate the HOV and general-purpose freeway lanes in Houston. He described the measures of effectiveness, data sources, and analysis techniques used in Houston. He also summarized the methods used to disseminate information and future activities.

- A number of measures of effectiveness (MOEs) can be used with HOV facilities. Potential MOEs address safety, vehicular volume, LOS, travel time and speed, and trip-time reliability. Other possible MOEs include modal shift, person movement, and environmental factors.
- A number of data sources are used in monitoring the Houston HOV lanes. Travel time and speed data are obtained through the AVI system. Incident and safety information is obtained from the Regional Incident Management System (RIMS). Historical data on vehicle volumes and vehicle occupancy is available and counts continue to be taken on a quarterly basis. Automated counts are also available from tubes, loops, and the Regional Transportation Management System (RTMS).
- The AVI system covers some 70 percent of area freeways. There are over 250 readers spaced every one-to-five miles. There are over one million tags in the area. Approximately 1.5 million tags are read per day. Approximately 72 percent of the general-purpose lanes and 36 percent of HOV lanes are covered by the AVI system.
- The AVI system includes the transponder tags in vehicles and the AVI reader stations. The stations include multiple antennas to cover all the travel lanes. Tags are read in a single direction.
- The process for data acquisition and data processing of travel times using the AVI system involves a number of steps. When a vehicle with a tag passes under an antenna the tag identification is read. The tag identification, location identification, and time stamp are transferred by modem to a central processor that contains the AVI tag database.
- The tag identification, the location, and the timestamp for each read are matched in the data processing system. The tags are matched, an error screening is conducted, and average travel times and speeds are calculated. The output includes a real-time dataset and a historical post-processed dataset.
- The RIMS monitors the motorists assistance program (MAP), traffic incidents, and major incidents, such as plant explosions and sporting events. Information collected includes the detection time, the time the incident was verified, the time it was cleared, and the number of lanes blocked.

- Historical data on the Houston HOV lanes includes manual vehicle occupancy counts, violation rates, and onboard bus surveys. Automated volume and classification counts are also included in the historical data.
- A quality assessment/quality control (QAQC) process is conducted on the AVI data. Travel times and volumes on the HOV lanes and general-purpose lanes are calculated, as are built-up travel times. The travel time difference for the HOV lanes and the general-purpose lanes is calculated and compared. A variety of summary tables and reports are generated.
- The data aggregation methodologies include a snapshot, which aggregates multiple segments with the same start time, and built-up, which aggregates multiple segments. The analysis process includes calculating differences between the general-purpose lanes and the HOV lanes. The savings by volume and occupancy can be expanded and road user costs computed. A variety of graphs, tables, and reports are prepared. Operational reports can be presented with daily, weekly, monthly, quarterly, and yearly data.
- A variety of methods are used to disseminate real-time information on the status of the HOV and general-purpose lanes. These methods include the real-time traffic map on the Internet, DMS, local radio, and portable devices. Mobile data dissemination applications include traffic alerts, which can be provided to individuals through cell phones, PDAs, and desktop computers.
- A number of enhancements to the AVI system are planned. These enhancements include expanding the AVI system to the entire freeway system, automating additional processes, and assessing dynamic routes versus line-haul routes. The ability to predict travel times based on incidents is also under study. Expanding the use of information for operational assessments and the potential use in value pricing are also being explored. Using the system for operating assessments, including examining clearance, enforcement, and geometrics is being considered.

Monitoring and Reporting on HOV Lanes in the Puget Sound Region
Mark Hallenbeck, Washington State Transportation Center

Mark Hallenbeck described the HOV lane performance monitoring program in the Puget Sound Region. He discussed the performance elements included in the monitoring program, the automated and manual data-collection techniques, and the data-analysis methods. He also provided examples of different methods and techniques for reporting the results of the monitoring program.

- The HOV lane monitoring program focuses on four major elements. These four elements are vehicle volumes in the HOV and general-purpose lanes, vehicle-occupancy levels, bus ridership, and travel times in the HOV and general-purpose lanes.
- The WSDOT freeway management system provided automated data collection for some of these performance indicators. Loop detectors used for controlling the ramp metering system provide data on vehicle volumes per lane and lane occupancy. Data for this system are combined to provide an estimate of average speed per lane every 20 seconds. Corridor travel times are estimated from average speeds. Weekday travel times are computed for a start time every five minutes.

- Manual data collection is used to obtain vehicle-occupancy and bus ridership information. Periodic surveys of HOV lane users, drivers in the general-purpose lanes, and the general public are also conducted.
- Vehicle-occupancy data is collected by visual inspection. There are 15 routine data collection sites. These sites cover all corridors with HOV lanes. The sites are selected so that staff can safely stand and sit. The sites must also have good sight lines into passing vehicles to count occupants. Data are collected in the morning and afternoon peak periods during times of the year when is it light enough to observe the number of occupants in a vehicle.
- Data are collected six times a year at each of the 15 primary locations and the six supplementary locations. Data for the HOV and general-purpose lanes are counted separately for the morning peak period and the afternoon peak period. A more limited number of midday counts are conducted at fewer locations.
- Bus ridership information is obtained from transit authority passenger counts. Ridership on specific routes at specific locations is requested. Four different transit agencies in the region provide this information. The transit authorities may use automated passenger counters or other methods to collect this information.
- Public opinion surveys are conducted on a periodic basis. Mail out/mail back surveys have been used with HOV users and motorists in the general-purpose lanes. Surveys of transit riders are conducted by handing out the questionnaires to passengers on buses and providing a pre-paid, return envelope. The response rate for these surveys typically averages around 20 percent or above.
- Data analysis of current conditions includes calculating person and vehicle volumes, travel times, and mode split. The travel times for the general-purpose lanes and the HOV lanes are compared and the 90th percentile speed is calculated for comparison against the performance policy.
- Examples of data analysis of current conditions include graphing daily HOV volumes, graphing weekday HOV and general-purpose volumes per lane, and graphing weekday volume, speed, and reliability conditions for the HOV and the general-purpose lanes. Comparisons are also made of the person and vehicle volumes per lane for the HOV and the general-purpose lanes. The AVO is calculated for the HOV and the general-purpose lanes.
- As an example, the travel time reliability versus policy standard analysis on the I-405 HOV and freeway lanes indicates that the speed reliability threshold of 45 mph is not met approximately 10 percent of the time. A comparison of HOV and general-purpose travel times on the southern half of I-405 in the northbound direction of travel indicates that the average travel time savings in the HOV lanes during the morning peak period is approximately 11 minutes.
- Trends in the different performance measures are also tracked. For example, trends in travel time and trip time reliability are monitored to identify any HOV lanes not meeting the performance measures.

- A variety of methods are used to report the results of the performance monitoring activities. Paper reports are prepared on current conditions and trends. Internet-based publishing of key statistics is being used more, however, to reduce the number of printed reports.
- Data sets are available on two websites – http://trac29.trac.washington.edu/tracmap/mapserver and http://trac29.trac.washington.edu/hov/. These websites provide a map showing the HOV lane segment and data collection sites, the basic characteristics of the site, and the number of data collection sessions at each site. The sites also provide the capability for users to analyze and map the data.
- These websites are still in the development stage and there are a few issues that need to be addressed with the use of the website. The first issue is spreading the word about the website's existence. Data quality represents a second issue. Meta data, including what data exists, how the data can and should be used and not be used, and how the exportable data files are organized represent other issues. The site usability may also be an issue.
- The current concept and status design concept includes two levels of data. The first level contains common summary statistics. The second level database provides access to raw statistics. Contact information is provided to help with learning about using the database and to help with learning about the data itself.
- Currently three databases are connected through TRACMap. These databases are the average car occupancy (ACO) database, the freeway operations or FLOW database, and commercial vehicle information system network (CVISN) tag-based travel time database. The ACO database is a working prototype. Currently, summary statistics are available. The user interface, summary statistics, and meta data need refinement, however. The FLOW database is also a working prototype, with summary statistics available. On-line access to raw data is not currently available, as the legacy system needs updating. The user interface also needs considerable work and the meta data are under refinement.
- The report website, which presents summary statistics via the Internet, rather than paper reports, is under development at http://www.depts.washington.edu/hov/. Summary statistics already exist, but an issue is how to highlight trends.

Eleven Things You Should Know about the Carpool Lanes in Los Angeles County
Darren Henderson, Parsons Brinkerhoff

Darren Henderson discussed the HOV Performance Monitoring Program sponsored by the Los Angeles County Metropolitan Transportation Authority (MTA). He described the major elements of the study and the executive summary, which is presented in a brochure highlighting the 11 key findings from the study. The executive summary has been distributed to policy makers, interest groups, and other key stakeholders.

- The MTA HOV Performance Program included four major elements. These elements were to define the HOV performance goals, to create a comprehensive database on the HOV lanes in the county, to evaluate the performance of the HOV lanes, and to assess the public support.

- The HOV system in Los Angeles County includes 382 lane miles on 14 freeways. Most of the HOV lanes are buffer separated with limited ingress and egress. A 2+ vehicle occupancy is used on all the HOV lanes, except the El Monte busway, which uses a 3+ requirement in the morning and afternoon peak periods. The HOV lanes operates on a 24/7 basis.
- The executive summary report for the HOV Performance Monitoring Program focused on the 11 things you should know about the HOV lanes in Los Angeles County. The 11 points are presented, along with graphics supporting the elements and providing additional information.
- First, nearly everyone supports the HOV lanes. A total of 89 percent of the respondents in the general public survey indicated they supported having HOV lanes on Los Angeles County freeways.
- Second, all carpool lanes save time, and the time savings can add up. The actual time savings varies by HOV lane, with the greatest time savings provided by HOV lanes on very congested freeways.
- Third, carpool lanes do not have to look full to be effective. Even with capacity constraints and fewer vehicles, an HOV on a congested freeway carries one to three times more people than an adjacent general-purpose lane.
- Fourth, carpool lanes are used all day, everyday. The use of the HOV lanes is highest during the morning and afternoon peak periods, but travelers use the lanes throughout the day and on weekends. Approximately 40 percent of daily HOV lane use occurs outside the peak periods.
- Fifth, carpool lanes encourage people to switch from driving alone. Survey results indicate that approximately 50 percent of current carpoolers using the HOV lanes formerly drove alone on the same freeway. An additional 9 percent reported driving alone on a parallel street or another freeway.
- Sixth, carpool lanes are a good public investment. Considering only the benefit of time savings, approximately half of the HOV lanes in the county have proven their economic benefit.
- Seventh, many carpool lanes are full and have no capacity to sell. Approximately 10 of the 16 HOV lanes in the county carry between 1,200 and 1,600 vehicles per hour during the morning and afternoon peak periods. Thus, there is little or no capacity available for other potential user groups.
- Eighth, carpool lanes are important to bus transit. The El Monte Busway and the Harbor Freeway Transitway carry significant volumes of buses and bus riders. Some 24,000 daily passengers ride buses on the El Monte Busway and the Harbor Transitway carries approximately 5,000 daily riders. Further, some 83 percent of the bus passengers surveyed indicted the availability of the HOV lanes was very important in their decision to ride the bus.

- Ninth, there are not a lot of cheaters in the carpool lanes. Violation rates on the HOV lanes in the county are low, averaging at or below 3 percent. CHP provides visible enforcement and the $271 minimum fine helps discourage violators.
- Tenth, carpool lanes can help air quality. Analysis indicates that the HOV lanes generate about half the emissions per person mile than the general-purpose lanes. Survey results also indicate that residents feel the HOV lanes help the region's air quality.
- Eleventh, just because the traffic is backed up in other lanes does not mean the carpool lanes are not working. Although some HOV lanes do experience congestion, they still provide mobility options to travelers. Further, survey results indicate that some 64 percent of the respondents agree or strongly agree that the HOV lanes help reduce congestion in all the freeway lanes.

What Information Does the Press and Public Want?
Lucas Wall, Houston Chronicle

Lucas Wall discussed news stories on HOV facilities in the Houston Chronicle. He highlighted the focus of recent news stories and summarized the types of questions received from readers on the Houston HOV lanes. He also provided suggestions for transportation professionals on interacting with the print media.

- Over the past two years the term HOV has appeared 60 times, or about three times per month, in by-line stories. Overall, HOV appeared 239 times in Chronicle articles over the two-year period, for an average of about 10 times per month.
- The articles on HOV facilities have covered a wide range of topics. Articles have addressed the HOT lane concept, hours of operation, and a timed test of different commuting methods. Other articles have provided profiles of casual carpoolers, vanpoolers, and carpool promotion month. Plans for HOV lane extensions, construction updates and construction impacts on traffic, the HOV component of the 2025 transit plan, and bus/automobile crashes have also been featured. Managed lanes, toll polices, and enforcement and fine collection have been discussed in articles.
- The Monday Chronicle features a column on answers to readers' questions on transportation. Many of the questions sent in by readers focus on the HOV facilities. Many readers ask why Houston has HOV lanes. Approximately 74 percent of Harris County commuters travel to work by driving alone and the vast majority of commuters get no perceived personal benefit from the HOV lanes. There is some skepticism about why the lanes exist – these solo drivers want that pavement for their use.
- Readers also ask about the design of the HOV lanes and why there are barriers separating the HOV lanes from the general-purpose lanes. Houston has a unique form of HOV lane and the public has trouble understanding that the lanes were originally designed primarily for buses and vanpools. The HOV lanes are not seen as flexible enough to many readers, with not enough entry and exit points for carpools.
- Readers also express concern about enforcement of the HOV lanes. There is a perception that SOVs are using the HOV lanes. The public complains that they rarely see METRO police enforcing the vehicle-occupancy restriction, especially the concurrent flow lane

segment on I-10 West. There is a belief that the HOV lanes are not successful if there is no enforcement. Even commuters who do not like the HOV lanes seem to want strict enforcement as they do not want someone else getting a quicker trip by cheating.

- Other questions asked by readers concern how to use the HOV lanes. Infrequent users are not sure where to enter and exit the lane. There is an insecurity about where a lane goes and how to exit. The need for better signage is a frequent request from readers. Other typical questions focus on operating hours and why the lanes are not open 24 hours a day and on weekends. Readers also ask why the HOV lanes are not bidirectional and why lanes are closed during lunchtime.
- One thing transportation personnel responsible for HOV lanes can do is provide information on the role the HOV lanes play in enhancing mobility and in moving more people in fewer vehicles. There is a need to convince solo drivers that the HOV lanes serve an important purpose and that they do benefit from getting vehicles out of the general-purpose lanes. Providing monthly or quarterly information on the number of HOV users – bus riders, vanpoolers, carpoolers, and motorcycles – is a good way to keep reinforcing the benefits of the lanes. Providing information on the average travel speeds in the HOV lanes versus general-purpose lanes is also important. Give meaning to the numbers – "If we did not have this HOV lane, X vehicles would be added to the mainlanes, which would drop the average travel speed to X mph, resulting in an average of X minutes of delay for every commuter in the corridor."
- Transportation professionals also need to explain the design and operation of the HOV facilities. Help the public understand the importance of the HOV lanes to buses and the transit system in Houston. Compare the functionality of a concurrent flow lane versus a barrier-separated lane and explain the pros and cons of different approaches. Note the ease of enforcement in barrier-separated lanes as a benefit of this approach.
- Focus on enforcement. Include the number of tickets issued and other enforcement information in the monthly or quarterly updates. Report the results of spot checks of violators versus authorized vehicles highlighting the percentage in compliance. Media ridealongs are a good way to involve reporters. Plan an intense week of HOV enforcement and bring reporters and photographers along.
- Market how to use the lanes through brochures and websites. Smarter signage is needed and the use of circuitous routes to reach an HOV lane should be eliminated. Take reporters on a facility tour, show them the system, and explain how it is designed and how it operates.
- Help reporters understand traffic counts and how the hours of operation are set. Demonstrate the costs of extra operating hours in terms of extra staff and police personnel. Explain the cost for each additional hour and provide a cost/benefit analysis. Keep the public informed of expansion plans, studies on HOT lane expansion, bi-directional studies, and other projects.
- It is important to remember that a majority of people drive alone and are skeptical or resentful of efforts to exclude them from something they are paying for. As a result, be sure to completely explain and profile HOV projects, and note how HOV lanes benefit drivers in the general-purpose lanes.

- Reporters love numbers, facts, and statistics – but they need to be comprehensible. Reporters do not like to have to do math and calculate statistics for themselves. You can help write your own story by presenting easy-to-understand facts that capture the advantages of HOV lanes. Make your public relations active, not reactive, provide information to reporters and facility tours. Do not wait for a problem to occur and a negative story. Rather be proactive in providing needed information on HOV lanes.

BREAKOUT SESSION – BUSES, BRT, HOV, AND HOT PROJECTS

Linda Cherrington, Texas Transportation Institute, Presiding

I-75 HOV/BRT Study in Atlanta

Darryl Van Meter, Georgia Department of Transportation
Roger Palmer, Parsons Brinckerhoff, Inc.

Darryl Van Meter and Roger Palmer described the proposed HOV/BRT project in the I-75/I-575 northwest corridor in Atlanta. They summarized the planning studies in the corridor, the project elements, and future activities. The recognized the assistance of Marvin Woodward with the Greater Atlanta Transportation Authority with the project and the presentation.

- The existing HOV lanes on I-75 extend from the I-75/I-85 common section in downtown Atlanta to Akers Mill Road. No HOV lanes currently exist on I-575. An extension of the HOV lanes on I-75 and on I-575 was initiated in 2002. Project limits on I-75 are from Akers Mill Road to Wade Green Road, which approximately 15 miles in length. The project limits on I-575 are from I-75 to Sixes Road, which is approximately 12 miles in length.
- The initial project goal was to extend the HOV system on I-75 and I-575. An interim solution to address the traffic congestion in the corridor was explored and discarded. The ultimate HOV system was conceptualized and the environmental analysis was begun.
- The Northwest Connectivity Study was initiated by the GRTA in 2002, concurrent with the HOV extension on I-75/I-575. The study explored transit options in the study area. BRT was selected in February 2004 as the locally preferred alternative. The Environmental Impact Statement (EIS) was the level of documentation. The two efforts were combined in May 2004 as a joint project of the GDOT and GRTA.
- The project location and study area includes HOV lanes and BRT stations on I-75 from I-285 to Wade Green Road, HOV lanes I-575 from I-75 to Sixes Road, and options for two HOV lanes in each direction from I-285 to I-575. The alternatives being considered include a no-build alternative, an HOV only alternative, an HOV/TSM alternative, and an HOV/BRT alternative.
- GDOT considered four HOV concepts on I-75 between I-285 and I-575. All of the concepts included barrier separated HOV lanes. Option U1 included all four HOV lanes in the median of I-75. Option U2 split the HOV lanes on the outside of I-75. Option U3 placed all four of the HOV lanes on the west side of I-75. Option U4 placed all four of the HOV planes on the east side of I-75.
- With Option U1, which located all HOV lanes in the median, all existing general purpose lanes would need to be shifted to the outside and reconstructed to make room for the new HOV system in the median.
- Option U2 placed two lanes in each direction on the outside. HOV access points would be at new HOV-only interchanges. Elevated segments would fly over existing general purpose interchanges. At-grade segments between existing interchanges would be maximized to reduce structure costs.

- Option U3 included two lanes in each direction all on the west side of the freeway and Option U4 included two lanes in each direction all on the east side of the freeway. In both cases HOV access points would be placed at new HOV-only interchanges. Elevated segments would fly over existing general-purpose interchanges. At-grade segments between existing interchanges would be maximized to reduce structure costs. Seven BRT stations would be located along I-75 and one station would be in downtown Atlanta.
- The notice of intent for the EIS was published in the Federal Register on March 15, 2004. Public and agency scoping meetings have been held. The conceptual design is basically complete and the environmental screening is complete. The environmental baseline is underway. The Draft EIS (DEIS) is scheduled to be completed and circulated in June 2005. If the current schedule holds, the first segment of the facility would open in 2011.
- The BRT system includes stations at strategic locations in the corridor. The stations would provide direct access to and from the HOV lanes and would be integrated into the surrounding areas. Passenger waiting areas, park-and-ride facilities, and other amenities would be provided.
- The next steps in the process include evaluating the HOV options as part of the DEIS. The DEIS chapter will be provided to agencies for review as they are completed. Based on approval of the DEIS, preliminary engineering for the locally-preferred option will be started. The Final EIS (FEIS) will be prepared, with a record of decision anticipated by July 2006. The right-of-way acquisition process will start at that point.
- More information is available at the Northwest Corridor HOV/BRT website – http://www.nwhovbrt.com.

Bus Rapid Transit in Las Vegas
Lee Gibson, Parsons Brinckerhoff, Inc.

Lee Gibson discussed BRT planning efforts in Las Vegas. He summarized the key elements of HOV systems and the main components of BRT. He recognized the contributions of Amy McAbee Cummings and Bardia Nazhati of Parsons Brinckerhoff, Inc.

- Elements of an HOV system include the HOV lane, support facilities, bus services, and intermodal integration. Funding, implementation coordination, and marketing are also important elements of an HOV strategic plan.
- HOV lanes move more people, rather than more vehicles. A variety of HOV lanes are in use in different metropolitan areas in the U.S., including barrier separated lanes, concurrent flow lanes, contraflow lanes, and busways.
- The definition of BRT used in a Transit Cooperative Research Program (TCRP) project is: "A flexible, high performance rapid transit mode that combines a variety of physical, operating and system elements into a permanently integrated system with a quality image and unique identity." Transit operators might use the following definition of BRT: "Delivering to the customer better service through integrated physical design, advanced technology, and innovative operations. BRT must be customer focused, technologically based, and improve operational economics."

- At least four elements can be identified for a successful BRT system. These elements are corridor selection, marketing, federal partnerships, and vehicle technology/procurement management. The corridor planning principles considered in Las Vegas included congestion, connectivity to regional facilities, and right-of-way and land use.
- Las Vegas is experiencing rapid population and employment growth. Most of the employment growth is concentrated in the resort corridor. There is a freeway lane shortage in the resort corridor. The population of Las Vegas was approximately 1.5 million in 2000. The population is forecast to double by 2030. The total lane miles and lane miles per capita in Las Vegas are low compared to peer cities.
- Connectivity and right-of-way opportunities are also important with BRT, as is a focus on the freeway to arterial street relationships. High densities, concentrated employment centers, and freeway lane shortages support the efforts for transit in general and BRT.
- Marketing BRT provides opportunities for creating a new image for transit through branding, charrettes, and media management. Branding creates a different visual image for buses through the use of new colors, new logos, and new names. Branding gives a fresh feel to BRT service and creates excitement. It can also improve the image of the entire transit system.
- Charrettes can be used to build consensus among local, state, and federal agency personnel. Examples of agency staff typically participating in charrettes include the transit authority, public works department, state departments of transportation, and federal agencies.
- Media management usually includes television and print media, public events, community meetings, and websites. A variety of approaches can be used to inform the public.
- Federal agency partnerships include requirements during the planning, financing, and procurement process. Planning considerations include the NEPA requirements, as well as inclusion of the BRT project in the RTP and the Transportation Improvement Program (TIP). Federal guidelines also address financing the BRT system and procuring vehicles and fixed facilities. Buy America and low-bid versus best-value issues may need to be addressed.
- Planning for BRT can be complex. Keeping the process simple by starting with a sketch-planning analysis of a number of alternatives is suggested. The number of alternatives is typically reduced as the level of detail in the planning process increases. Thus, fewer alternatives are considered in the alternatives analysis and preliminary engineering. The selected alternative is taken forward into the design phase and into construction.
- Approaches can also be used to minimize NEPA requirements. These approaches include upgrading existing bus stops and using FTA formula funding. Purchasing vehicles as part of general transit system expansion and partner with state departments of transportation for lane improvements can also help minimize NEPA requirements.
- When considering vehicle technology it is important to learn what is available in the market. It is also important to match vehicle technology to customer needs. Finally, integrating vehicle and station interfaces is critical.

- Market factors to consider include the number of vendors and the development costs and marketing plans. Other factors to consider are unique attributes, such as precision docking, optical and magnetic guidance, door design, propulsion, and cost effectiveness. It is important to consider if the unique attributes meet your customer needs. Items to consider include spaciousness, ADA accessibility, boarding and exiting, bicycle storage, and operator acceptance.
- A number of elements should be considered in procurement management. These elements include ensuring competitive negotiation, learning what works for your community, and developing performance-based specifications. It is also important to engage in real negotiations. Avoid price as the major decision factor. Require design reviews. Use cost analysis techniques to keep your contractor honest. Finally, be firm but fair.

Integrating HOT Lanes and BRT in the I-394 MnPASS Corridor
John Doan, Minnesota Department of Transportation

John Doan discussed integrating HOT lanes and BRT as part of the MnPASS I-394 project. He recognized Kenneth Buckeye from Mn/DOT as the author of the presentation. John summarized the background of the I-394 project, the development of the MnPASS program, and the link to other transit components in the region.

- I-394 was opened in 1992. The freeway includes two different HOV segments. The HOV concurrent flow lane section from Wayzata Boulevard to Highway 100 is eight miles in length. The dedicated two-lane HOV reversible section from Highway 100 to I-94 is approximately three miles in length. The average daily traffic (ADT) for the total facility is approaching 148,000. In May 2005, I-394 will become the region's first HOT lane. It will also be the first attempt in the country to toll in a non-barrier separated environment.
- A number of factors influenced the development of the I-394 MnPASS project. As with many areas, funding for new construction is limited and congestion continues to grow on freeways in the Minneapolis-St. Paul area. There is a perception that the I-394 HOV lanes are under utilized, and a 2002 study found that there was available capacity. The Minnesota Legislature approved legislation in 2003 that allowed HOV to HOT expansion.
- There is political and institutional momentum in the region for addressing transportation problems with innovative approaches. There is also a renewed commitment to transit options. These transit options include the Hiawatha LRT line, the Northstar Commuter Rail, the Central Corridor LRT line, the Cedar Avenue BRT line, the I-35W BRT line, and the Bottineau Boulevard BRT/ I-394 Transit Advantages project.
- The I-394 MnPASS goals include improving the efficiency of I-394 and maintaining freeflow speeds for transit and carpools (55-60 mph) via dynamic pricing. Other project goals include improving highways and transit in the corridor with revenues generated from the project, using electronic toll collection, and employing new technologies, such as dynamic pricing and in-vehicle enforcement tools.

- The first phase of the I-394 MnPASS project will open in May, 2005. Planning for the second phase, which will include additional transit elements, is underway. There are a number of reasons for the second phase planning effort. First, public opinion polls show congestion tops the list of quality of life issues in the region. Second, it appears there is public support for optional tolls. Third, political and institutional momentum exists for additional transit and transportation improvements. Fourth, the related Bottineau Boulevard BRT project is under development. Finally, state legislation requires that 50 percent of excess toll revenues from the I-394 MnPASS project be used to enhance transit in the I-394 corridor.
- The vision of the second phase is to achieve the most efficient use of the HOV lanes and to maximize transit advantages in the corridor. Elements being examined to enhance the efficiency of the HOV lanes include barrier system options to allow 24/7 bi-directional flow in the exclusive segment, improvements to the TH 100 interchange to allow for movements in all directions, operational enhancements for transit, and lane modifications to the Lowry Hill Tunnel on I-95. Elements being examined to maximize transit advantages in the corridor include possible expansion of park-and-ride lots, signal priority on local roads, and automated passenger counters. Other transit elements under consideration include a comprehensive evaluation of transit service in the corridor, assessing the impacts of intermediate access points, and coordinating with the Bottineau Boulevard BRT project. Possible bus queue jumps and shoulder lanes are also being explored, along with limited stops and signalization. Attractive, heated, and well lit passenger shelters, along with additional traveler information systems, and off-board fare collection are also under consideration.
- There are 11 access points for the I-395 MnPASS project, five eastbound and six westbound. The access points are approximately one-fourth to three-fourths miles in length. The access points will include visual enforcement of occupancy levels and electronic toll tag readers.

BREAKOUT SESSION – DESIGNING FOR MULTIPLE USER GROUPS

William Finger, City of Charlotte, Presiding

Managed Lanes in San Diego – Trade-Offs in Designing a Multi-Modal Facility
Heather Werdick, San Diego Association of Governments

Heather Werdick described the I-15 corridor BRT and managed lanes project in San Diego. She summarized the major components of the project and discussed the design of the BRT stations. She noted that Dave Schumacher, San Diego Association of Governments, who was scheduled to give the presentation, was unable to attend the conference.

- The I-15 corridor BRT and managed lanes project is approximately 35 miles in length. It stretches from Escondido in the north to downtown San Diego in the south. BRT stations are spaced every four-to-five miles. The facility is part of the regional network of high-speed LRT and BRT routes. BRT service will be operated every 10-to-15 minutes.
- Construction of Stage 1 began late in the summer of 2003 and is schedule for completion in December 2007. This stage includes BRT stations and direct access ramps in the northern section of the corridor.
- A number of issues had to be addressed in the design of the managed lane facility. First, there was a need to ensure freeflow conditions for BRT. Second the desire to extend the FasTrak™ program had to be accommodated. Third, the ability to respond to traffic emergencies was critical. Finally, the design needed to accommodate long-term needs.
- To accommodate these and other issues, a four-lane managed lane facility using a moveable barrier is being pursued. The FasTrak™ program is being extended. Direct access ramps and BRT stations are being incorporated as an integral part of project.
- The movable barrier will be used to adjust the number of lanes in each direction of travel based on traffic conditions. Multiple access points will be provided from the freeway main lanes to the managed lanes. The managed lanes will act as a freeway within a freeway, providing priority for transit, carpools, and FasTrak™ users.
- The Rancho Bernardo Transit Center will include a BRT station, park-and-ride lots, and direct-access ramps to the managed lanes. It will also include direct access to the arterial street system. The direct-access ramps will be open to buses, carpools, and FasTrack™ users.
- A number of issues had to be addressed in the design of the Rancho Bernardo Transit Center. These issues included concerns about out-of-direction movements for the BRT vehicles, the need for interface with local buses, and concerns about the freeway noise and impacts from traffic on-ramps. To address these issues the decision was made to locate the station off the freeway to create a more pleasant and safe passenger waiting environment.
- A number of issues also had to be addressed in the design of the Sabre Springs Station. These issues included the right-of-way cost for the preferred parcel adjacent to the

freeway and out-of-direction movements for the BRT vehicles. To address these concerns, the decision was made to locate the station on an undeveloped parcel of land.

- The BRT strategy in the I-15 corridor includes two types of routes. First, a trunk line providing all-day service will be operated on I-15. Second, point-to-point commute service will operate from remote stations and park-and-ride lots to the transit stations on I-15.
- At City Heights, locating the transit station in the freeway median was the only choice due to the inability to construct access ramps to the bridge deck. The arterial transit plaza required widening the bridge decks. Access to the freeway level BRT platform will be by elevator and stairs.
- A number of issues are being addressed with the design of the City Heights Station. Concerns about noise from the freeway are being addressed by locating the waiting platforms on the median platform not directly under bridge deck, and using plexi-glass barriers and enclosed waiting shelters. Concerns about security and safety perceptions are being addressed by locating platforms away from the bridge deck for increased visibility, using designs that avoid hidden areas, and proving for well-lit platforms at night. The concerns related to access between the plaza decks and the median station platforms are being addressed by providing elevators and stairs on both sides of the bridge deck and providing a walkway link under the bridge deck.
- The I-15 project provides insight into the design tradeoffs associated with BRT stations along a freeway corridor. Locating stations along freeways and managed lanes is less than desirable due to noise and safety concerns, conflicts with other traffic, and out-of-direction travel for BRT vehicles. The design of the freeway stations on the I-15 project has involved a series of tradeoffs. A peer review process will be used to evaluate designs for possible future station changes. Additional managed lanes and BRT corridors are included in the 2030 RTP. There is a regional commitment to managed lanes and BRT in the San Diego area.

Traffic Control Devices for Managed Lanes
Sue Chrysler, Texas Transportation Institute

Sue Chrysler discussed traffic control devices for managed lanes. She described the findings from research projects sponsored by TxDOT and FHWA. She noted the assistance of Jerry Ullman, Steve Schrock, and Beverly Kuhn from TTI with these projects.

- The amount and the complexity of information needs increases with the flexibility provide by managed lanes. Possible vehicle user groups for managed lanes include SOVs, HOVs, bus and BRT vehicles, trucks, ILEVs, motorcycles, taxis, and emergency vehicles. The selection of user groups will depend partially on the corridor characteristics, project goals and objectives, and policy issues. The selection of user groups will impact the design, operations, enforcement, and technology associated with managed lanes.
- A driver-decision model for managed lanes was developed to help focus on key elements. The model identifies decision points, influences on decisions, and information needs.

These elements may be a function of driver type, which include unfamiliar drivers, semi-familiar drivers, and familiar drivers.

- The driver-decision model first focuses on if the lane is opened or closed. Desired information at this point includes entrance location, hours of service, if the lane is open or closed, the type of managed lane, and incident management. The second decision a driver has to make is to determine if they are eligible to use the lane. Information needed at this point includes vehicle restrictions, occupancy requirements, and toll rates. If a driver is eligible to us the lane, the next decision is to determine the benefits of using the managed lanes versus using the general-purpose lanes. Desired information includes the desire to avoid a late arrival, perceived value of time, travel times, travel time savings, and perceived safety. Finally, a potential user will want to determine the cost of using the managed lanes versus the general-purpose lanes. Desired information includes toll rates, potential perceived discomfort from barrier-separated facility, and exit information.
- The current MUTCD provides some guidance for signing managed lanes. The terminology "preferential lane use," is used, but guidance is spread across several sections. There are many topics that are not addressed in the MUTCD. There are also inconsistencies across sections and some inaccuracies.
- Current MUTC guidance focuses primarily on regulatory signs. There are some conflicts and confusing language for barrier versus buffer separated facilities. There is good guidance on sign placement, however.
- The MUTCD provides guidance on pavement markings for some types of preferential lanes. It also provides guidance on signing for some types of managed lanes, such as barrier-separated HOV facilities. The MUTCD provides good sign-sequencing guidance, including signing for intermediate access points.
- The MUTCD provides an example of signing for the entrance to and exit from an HOV lane, including guidance for both signs and pavement markings. MUTCD guidance is also provided on general-purpose lane transitions to preferential lanes.
- Another example focuses on signing for a direct-access ramp to an HOV lane from a park-and-ride facility. This section includes guidance for trailblazer signs from residential and arterial streets feeding the park-and-ride facility. An example of signing for a direct-access ramp to an HOV lane from a local street is also provided including guidance on trailblazer signs. The possible need for coordination and approvals from local jurisdictions is noted.
- The current MUTCD provides an example of signing for a direct-access ramp between HOV lanes on separate freeways. Diagrammatic advance guide signs are suggested because of the left exit. Houston METRO uses diagrammatic signs along the HOV lanes to provide advance guidance for park-and-ride lot entrances. The MUTCD also provides guidance on lane-use control signals, including reversible lane operations.
- The two projects have helped identify research needs related to signing managed lanes. Topics for further research include the use of unique background color and the use of banners and plaques across the top of guide signs, and on regulatory and warning signs. Another possible issue is the use of uniform toll tag symbols. Distance and destination

signing for exit points, signing for travel time information, and posting of toll rate information all may need further research. The use of horizontal signing and application of additional pavement markings would also benefit from further research. For example conflicts between signing for general-purpose and managed lane exit information needs to be examined. Alternatives to address these types of issues include using unique colors for managed-lane signs, using separate structures, using unique banners, and using auxiliary plaques.

- The MUTCD does not address signing for pricing. Different approaches are currently being used on the value pricing projects underway. Possible research needs related to signs providing pricing information include the use of a different color, the use of horizontal signs, and the use of a uniform ETC symbol.
- Reports from the projects are available at http://managed-lanes.tamu.edu.

Design and Operations Associated with Single Lane Directional Managed Lanes
Casey Toycen, Texas Transportation Institute

Casey Toycen described recent research conducted by TTI for TxDOT examining single lane directional managed lanes. She summarized recent factors in Texas influencing interest in the topic, highlighted case study examples, and discussed potential design and operational issues.

- Recent legislation in Texas provides additional opportunities for managed lanes, toll facilities, and innovative financing. In addition to the congestion and mobility issues facing most metropolitan areas throughout the country, truck traffic is a major issue in Texas. Truck volumes on I-35 and other freeways in the state are expected to increase based on the North American Free Trade Agreement (NAFTA).
- The research project first examined current guidelines relating to the design and operation of HOV and HOT facilities. The American Association of State Highway and Transportation Officials (AASHTO), TxDOT, and Caltrans HOV guidelines were reviewed, along with the FHWA guidance on HOT facilities.
- Case studies of existing HOV and HOT lanes were developed. The case studies included the I-10 West and US 290 HOV lanes in Texas, and I-394 HOV lanes in Minneapolis, the I-680 HOV lanes in the San Francisco Bay Area, and the SR 167 HOV lanes in Seattle. The two Houston HOV lanes include a HOT component. MnPASS will be implemented on the I-394 HOV lanes in May 2005. HOT components are planned for both I-680 and SR 167.
- The HOV lanes on I-10 West and US 290 are both barrier-separated reversible lanes. A 3+ vehicle-occupancy requirement is in effect from 6:45 a.m. to 8:00 a.m. on both facilities and also from 5:00 p.m. to 6:00 p.m. on I-10 West. The I-10 West HOV lane is 13 miles in length and the US 290 HOV lane is 15 miles in length. A HOT program, QuickRide, was implemented on the I-10 West HOV lanes in 1998 and on US 290 in 2000. The QuickRide program allows registered two-person carpools to use the HOV lanes for a $2.00 per trip fee during the 3+ restricted periods.
- The I-394 HOV lanes are 11 miles in length. These are two HOV sections – a three-mile, two-lane, barrier-separated section and eight miles of concurrent flow HOV lanes.

MnPASS, a HOT program, will be implemented in May 2005 allowing SOVs to use the lane for a variable charge. The concurrent-flow section will operated 24/7 and the reversible section will operate inbound from 5:00 a.m. to 1:00 p.m. and outbound from 2:00 p.m. to 4:00 a.m.

- The I-680 concurrent flow HOV lanes are 14 miles in length. A HOT Program is scheduled to be implemented southbound in 2009. The operational characteristics have not yet been determined, but 24/7 is being considered.
- The SR 167 concurrent flow HOV lanes are nine miles in length. A HOT pilot program is planned for implementation in the next few years. A 24/7 operating plan is anticipated.
- The cross-section for the five HOV lanes were examined. The two Houston projects included a 12-foot travel lane and 4-foot buffers on each side before the barriers. The I-394 concurrent flow HOV lanes include a 10-foot shoulder, the 12-foot HOV lane, and a 2-foot stripe buffer. The I-680 HOV lanes include a 10-foot shoulder in most sections, a 12-foot HOV lane, and a 4-foot painted buffer. The two HOV lanes in Houston are barrier-separated. Both barrier and buffer separation are being considered on SR 167. None of the projects allow passing.
- The case studies use a variety of access controls. The Houston HOV lanes use slip ramps at the ends and direct access ramps to park-and-ride lots and transit centers. I-394 concurrent flow HOV lanes will change from unlimited access to six access points with the implementation of the MnPASS program. The I-680 lanes use slip ramps at the ends, two mid-point ingress locations, and two mid-point egress locations. The SR 167 HOV lanes are anticipated to change from unlimited access to four northbound and three southbound access points of at least 1,000 feet.
- The QuickRide program in Houston uses a fixed price of $2.00 per trip with a registered account. The MnPASS program on I-394 will use dynamic pricing with rates of $0.25 during the off-peak periods and up to $8.00 during the peak period. The I-680 project will use dynamic pricing of $0.22 to $0.38 per mile based on LOS. The SR 167 project will use dynamic pricing, with tolls ranging from $0.60 to $1.25 per trip.
- A number of other design and operation issues are being examined in the study. These issues include modeling for managed lanes, new construction versus conversion, and accommodating and monitoring vehicles with free access. ITS infrastructure needs, enforcement technologies and strategies, and incident management are also being examined.

Managed Lane Ramp Design Issues
Marcus Brewer, Texas Transportation Institute

Marcus Brewer discussed ramp design issues associated with managed lanes. He noted that the presentation is based on information from research projects sponsored by TxDOT and FHWA. He also recognized the involvement of Kay Fitzpatrick and Steven Venglar in both the projects and developing the conference presentation.

- There is increasing interest in managed lanes to help address traffic congestion in urban corridors in Texas. The emphasis of the research effort was on access-ramp design

treatments. All types of managed lanes were considered, not just HOV lanes. However, the research indicated that the experience with HOV lanes is applicable to other types of managed lanes. The research study included a literature review, an assessment of current practices in different states, case studies, and computer simulations.

- A literature review was conducted to assess potential issues and experiences with managed-lane ramp designs. The findings from a literature review identified the importance of considering speed-change lanes, taper designs for exit ramps, and large truck characteristics in the design of managed-lane ramps.
- The review of current practices in other states helped identify the definition of ramp design elements. It also provided information on the benefits and use of exclusive HOV ramps. Information on ramp design speed, ramp/interchange spacing, and weaving section length was also obtained. The results from the literature review also highlighted the preference for right-side ramps in most states.
- One of the case studies examined ramp designs on the New Jersey Turnpike. The dual-dual roadway on the turnpike separates heavy vehicles from light vehicles and provides flexibility during periods of heavy traffic congestion. There are separate ramps for each barrel or roadway. There is no weaving across the outer roadway, which enhances safety. All merging occurs prior to the toll plazas, which enhances efficiency.
- An initial crash analysis conducted shortly after conversion to the dual-dual roadway indicated an 18 percent reduction in crashes. A recent study found that the dual-dual segment had between 26 to 61 percent less crashes than non-separated segments. It is possible that similar benefits may be realized from managed lanes due to direct access and the separation of vehicles.
- The goals of the computer simulation were to quantify the effects of ramp spacing and to help identify when to consider direct-access ramps. The variables in the simulation were speed, ramp spacing, volume, and weaving percentages. The geometric layout was a single-direction freeway with four mainlanes and two managed lanes, which restricted weaving from managed ramps.
- The simulation examined the influence of different measures for ramp spacing, initial freeway volumes, and weaving percentages. Ramp spacing of 1,000, 2,500, 4,000, and 5,500 feet were examined. Initial freeway volumes of 1,250, 1,500, 1,750, and 2,000 vehicles per hour per lane were included in the simulation. The weaving percentages of zero, 10, 20, and 30 percent were examined. A total of 64 scenarios were run with four values for each of the three variables. Each scenario was modeled three times for a total of 192 unique simulations.
- Traffic conditions were defined in the simulation. First, heavy vehicles accounted for 10 percent of the total traffic. Second, vehicle volumes in the managed lanes was less than or equal to 75 percent of the freeway volume. Third, freeway entrance ramp volumes were set at 70 percent of freeway volumes per lane. Fourth, freeway exit ramp volumes were set at 60 percent of freeway volumes per lane. Finally, managed-lane entrance ramp volumes were based solely on weaving percentage.

- Previous studies indicated that a direct-connect ramp should be considered when ramp volumes are 400 vehicles per hour. This recommendation was supported by the findings from this simulation. For a more conservative approach, the research results indicate a direct-connect ramp should be considered at 275 vehicles per hour.
- At least three key findings resulted from the study. First, there is a need for guidance concerning the placement of managed-lane ramps. Second, weaving directly affects freeway speeds. Finally, direct-connector ramps should be considered at 400 vehicles an hour to maintain speeds, or a more conservative 275 vehicles an hour.

GENERAL SESSION – FUTURE TRENDS IN MANAGING MOBILITY

Heidi Stamm, HS Public Affairs, Presiding

Public Perceptions in Remarkable Times: Tracking Change Through 24 Years of Houston Surveys

Stephen Klineberg
Rice University

It is a pleasure to participate in the closing session this morning and to discuss the results of the public opinion surveys that we have been conducting in Houston for the past 24 years. Houston is a fascinating city, facing virtually all of the issues you have been talking about at this conference, including mobility, traffic congestion, and burgeoning ethnic diversity. Houston was riding the oil boom to continual prosperity through most of the 20th century; then suddenly the city had to come to grips with a radically different set of realities in the 21st century.

For almost a quarter-century, we have conducted annual random-digit-dialed telephone interviews, in English and Spanish, with representative samples of Harris County residents. In 13 of the past 15 years, the surveys were expanded to reach at least 450 Anglos, 450 blacks, and 450 Hispanics. In 1995 and 2002, the research included large representative samples from Houston's entire Asian population, the only such surveys in the country. No other city in the nation has been the focus of a long-term study of this scope, and none more clearly exemplifies the remarkable ongoing transformations of urban America.

When the first survey was conducted in 1982, Houston was still in the midst of its extraordinary boom. Between 1970 and 1982, almost 1 million people — mostly non-Hispanic whites — were streaming into the Houston metropolitan region. The population was growing by more than 1,300 per week. Every day on average, 250 additional cars and trucks were trying to navigate the streets and freeways of Harris County. The boom was the result of a 10-fold increase in the value of oil between 1970 and 1982. In 1980, 82 percent of all the area's primary-sector jobs were tied into the business of refining hydrocarbons into gasoline and petrochemicals and servicing the world's oil and gas industries. Houston was the undisputed resource and energy capital of the world, the Golden Buckle of the Sun Belt, the bastion of classical laissez-faire capitalism, the epitome of free enterprise America.

In May 1982, two months after the first survey in this series, the oil boom collapsed. The price of a barrel of Texas crude dropped from about $32 in early 1982 to less than $28 by the end of 1983, and then plummeted to $10 in 1986. Houston recovered from the deep recession of the 1980s to find itself in the midst of a restructured economy and a demographic revolution, at the center of the sweeping changes that have redefined the nature of American society itself in the 21st century.

Utilizing a variety of identical questions over the years, with new items added periodically, the surveys record a rich array of socioeconomic and demographic characteristics, as well as measuring attitudes and beliefs in many different areas. They have tracked the public's perspectives on economic conditions, poverty programs, crime rates, mobility issues, downtown development, and transportation. The surveys have assessed area residents' attitudes toward the

region's air and water quality, government programs, and public education. Attitudes toward immigration and ethnic diversity, discrimination and affirmative action, abortion, homosexuality, and other dimensions of family values have been measured.

Houston recovered from the 1980s recession to find itself in a more problematic economy. The vigorous "resource economy" of the Industrial Age has now receded into history. The "blue collar path" to financial security has largely disappeared. Almost all the good-paying jobs today require high levels of technical skills and educational credentials. In 2004, 75 percent of those surveyed disagreed that "a high school education is enough to get a good job" and in 2005, 64 percent agreed "there are very few good jobs in today's economy for people without a college education." From now on, as the saying goes, "What you earn depends on what you've learned."

During the quarter century after World War II, the rising tide lifted all boats. The richest 20 percent of American families doubled their incomes, but the poorest 20 percent increased their incomes even faster. The average American worker, wherever he was on the up-escalator, found his earnings steadily growing from one paycheck to the next. Those were the years of the stay-at-home housewife. The average American woman gave birth to 3.6 children, and the baby boom was launched upon the land.

In the new global, knowledge-based, two-tiered, "hourglass economy" of today, poverty increases even as the city grows richer. Opportunities narrow for many while they expand for others. Income inequalities grow ever wider and deeper. This is a very different kind of economy than the one we knew during the blue-collar Industrial Age.

The source of wealth today has less to do with natural resources and more to do with human resources. The nation's skilled and creative "knowledge workers" can live anywhere in the country. Talented individuals and leading companies are making business location decisions based on quality-of-life issues. Business leaders in Houston and other cities understand they must make major improvements in transportation, urban amenities, air pollution, crime, and other aspects of urban life to attract and retain the new knowledge-based workforce.

In recent years, the business community in Houston has taken a pro-active approach to address these issues. The "Quality of Life Coalition," formed in 2001, represents one example of the new approach. The goal of the coalition is to mobilize Houston's public and private sectors to accelerate tree planting and landscaping along the city's major thoroughfares and bayous, to expand parks and recreational areas, to remove billboards wherever possible, and to clean up litter and graffiti. The business community has also taken a more active role in addressing air quality concerns.

Houston is in many ways a microcosm of America, but it is unusual in one important respect. This city was founded on the Buffalo Bayou, some 50 miles from any natural barrier in any direction. It became the rail hub for the area, with agricultural products brought in from the hinterland, transferred onto barges, and delivered to the Port of Galveston. On September 7th, 1900, in the worst natural disaster in American history, the Great Storm destroyed Galveston. Four months later, the Spindletop blew near Beaumont. Houston was at the center of the Oil

Age, and the dredging of the Houston Ship Channel enabled it to grow into the second largest port in America.

This city was built by, for, and on behalf of the automobile, made possible by air conditioning, and it grew in all directions. Houston is the most spread-out major city in the country, with one-third the density of Los Angeles. The city limits cover more than 620 square miles, an area into which could be placed simultaneously the cities of Baltimore, Philadelphia, Chicago, and Detroit. The eight-county metropolitan area encompasses a total of 8,778 square miles, an expanse larger than the state of Massachusetts. No wonder Houston has been called "the blob that ate southeast Texas."

While Houston's downtown area is the most important, there are 18 major activity centers scattered throughout the metropolitan area. Some 85 percent of all the work commute trips go from one suburban area to another. It is difficult to serve this low-density development with public transportation.

A number of transportation-related topics have been tracked in the surveys over the 24-year-period. Even with the spread-out nature of the city, there has been growing support for making improvements in the downtown areas over the years. This support holds true for residents living inside the I-610 Loop and those living further out in the suburbs. There has also been increasing support over the years for mass transit, explicitly including a rail component.

One of the survey questions has asked residents of the city if they would be interested in someday moving to the suburbs and suburban residents about their interest in moving to the city. In 2004, for the first time in the surveys, more suburban residents indicated an interest in living in the city and than city residents saying they were interested in moving to the suburbs. The 2004 survey was conducted in February, just one month after the city hosted the Super Bowl and the opening of the LRT line. These two events may have influenced the responses in 2004, so the question was repeated in 2005. The surveys revealed a tripling (from 4 to 12 percent) between 2003 and 2005 in the number of suburban Anglos saying they were "very interested" in someday moving to the city. This does indeed appear to be a real and lasting change, one with important implications for the future of downtown development.

My sense is that we will continue to see a growing interest in living in the central city on the part of suburban residents. I think this interest reflects three phenomena. First, many of the most creative young people will want to live where the action is, not in track suburban housing. Second, many empty nesters will be interested in moving back to the central city for its expanding cultural and other amenities. Third, while the downtown area is just one of 18 major activity centers in the city, it remains the location of many of the best jobs, the headquarters of most of the city's major corporations.

There has also been a change in perceptions with regard to environmental issues over the years. For example, support for requiring vehicle emissions testing increased from 38 percent in 1995 to 74 percent in 2005. The ratings of Houston's efforts to control air and water pollution in the 2005 survey were the most negative ever given on any question in all the years of this research. Fully 45 percent of the respondents rated the city's efforts to improve the quality of its air and water as no better than "poor."

Respondents are asked each year to identify the biggest problem facing people in the Houston area. Traffic has ranked as the major problem both at the beginning and at the end of the 24-year period. The economy was named as the biggest problem during the mid 1980s, and crime was the predominant preoccupation in the mid 1990s. Traffic has continued to rank as the greatest concern of area residents in all of the past six years.

During this same 24-year period, Houston has been transformed from a biracial Southern city dominated by white non-Hispanic males into one of the most ethnically and culturally diverse cities in the country. Approximately 1.2 million people lived in Harris County in 1960. Anglos accounted for some 74 percent of the population; 20 percent were black, 6 percent were Hispanic, and less than 0.5 percent were Asian. Whites were streaming into the area during the oil boom years. Houston grew by 38 percent in the 1960s and by 29 percent in the 1970s. By 1980, this was now the fourth largest city in America with a population that was still 63 percent Anglo. Only 15 percent of Harris County residents in 1980 were Hispanic, and 2 percent Asian.

With the collapse of the oil boom in 1982, the Anglo population stopped growing. The numbers grew by 1 percent in the 1980s, and then declined by 6.3 percent in the 1990s. Meanwhile, between 1990 and 2000, Harris County's black population grew by 22 percent, the Hispanic population by 74 percent, and the Asian population by 76 percent. In the year 2000, there were 3.4 million people living in Harris County, of whom just 42 percent were non-Hispanic whites. The area's population was now 33 percent Hispanic, 18 percent African-American, and 7 percent Asian or other.

The metropolitan regions of Los Angeles and New York together contain more than one-third of all foreign-born residents in America. Then come four smaller but important gateway cities — Miami, San Francisco, Chicago, and Houston. Of these cities, Houston is one of the most ethnically diverse, with a more balanced distribution among America's four great ethnic communities. By 2004, the state of Texas had joined California, along with New Mexico, Hawaii, and the District of Columbia, in majority-minority status.

Americans are living longer and healthier lives than ever before in human history. The current population of senior citizens is disproportionately Anglo, and they will soon be joined by the predominantly Anglo baby-boom generation. The 73 million Americans who were born during the halcyon days after World War II (1946-1964) are now aged 41 to 59. In the course of the next 30 years, the number of Americans over the age of 65 will double. The younger populations who will replace the baby boomers are disproportionately non-Anglo and considerably less privileged. These trends are particularly striking in Houston. The surveys indicate that 75 percent of everyone now living in Harris County who is 60 years old or older is Anglo, and close to 70 percent of all those under the age of 30 are either blacks or Hispanics. Clearly, if this community's "minority" youth are unprepared to succeed in the knowledge economy of the 21st century, a prosperous future for the city as a whole seems unlikely.

These economic and demographic changes will continue to impact the transportation system, the school system, and many other aspects of the urban scene. As that ancient Chinese curse would have it, we are indeed living in "interesting times." How well this city addresses these trends will be significant not only for the future of Houston but for the future of America as well.

Round Table Discussion and Open Forum

Chuck Fuhs
Parsons Brinckerhoff

My comments focus on the traditional component of the 12 TRB international HOV conferences – that is HOVs. As we look at managed lanes and variable-pricing strategies, it is important that we not lose sight of the important role buses, vanpools, and carpools – HOVs – play in providing mobility and helping manage congestion.

This morning, buses in the XBL lane in New York City carried some 30,000 riders. Another 15,600 people an hour are using the El Monte Busway on the San Bernardino Freeway in Los Angeles. By the end of the day approximately 116,000 people will use the six HOV lanes here in Houston. These facilities have been performing at these levels for many years and should continue to do so in the future.

Many of the individuals responsible for planning, designing, developing, operating, and approving these HOV projects have retired or have moved on to other responsibilities. It is important to remember that we have new policy makers and stakeholders who may not know the background of current HOV projects or the benefits they provide. This conference has provided a wealth of information. It is up to each of us to communicate this information to others – both technical staff and policy makers – and to assist them in making informed technical and policy decisions.

Metropolitan areas throughout the country are considering different alternatives and moving in different directions, based on local needs and concerns. Depending on the final language in the Reauthorization of TEA-21, California and a few other states will be focusing on the use of HOV lanes by hybrid vehicles and what to do if demand exceeds capacity. Here in Texas, the implications of adding a toll element to the planned HOV system will be considered in Austin. A focus in San Diego is access to a managed-lane system. Different operating strategies are being considered for planned pricing projects in Seattle and Denver. The first freeway HOV lane is being planned in the United Kingdom. Funding issues are a concern in Charlotte. These issues illustrate the diverse needs of each area.

The information from this conference will be of use as we examine the choices being considered in these and other metropolitan areas. Choices relating to modes, technologies, markets, and funding are all being examined. While we will continue to see different approaches being taken in various areas, I think the HOV component – buses, vanpools, and carpools – will continue to be a key part of most projects.

Dan Beal
American Automobile Association

It is a pleasure to participate in this closing session. The American Automobile Association (AAA) has almost 48 million members in the U.S. and Canada. With over six million members, the Automobile Club of Southern California is the largest of the some 70 AAA affiliates in the U.S. We are very interested in HOV facilities, HOT lanes, managed lanes, and

other topics addressed at this conference. The AAA's policy has always stressed the best possible use of prior, current, and future transportation investments.

In considering these topics, I think it is important to remember that the personally-owned vehicle will continue to be the main source of mobility in the future. By comparison, every other mode is a niche operation. While we need to support and help expand use of these other modes, the personal vehicle will continue to be the main source of transportation for most people, although we may see changes in the propulsion or the fuel systems.

The automobile provides numerous benefits to all segments of society. It has reduced the isolation of rural areas, it has provided mobility and access to jobs and it has made social and recreational opportunities available to all groups.

Let me offer a few comments from the customer or user perspective, as we hear a great deal from our members on a wide range of topics. First, there is a credibility problem among elected officials, especially at the state level. Many states are diverting gasoline tax revenues and other resources that should be going to transportation improvements to fund other projects, including schools and prisons. In California, some $5.5 billion has been transferred from the transportation account to the state general fund over the past four years, either directly or indirectly. I understand that here in Texas close to $10 billion from the transportation fund has been used for other non-transportation purposes over the past 10 years. I also understand that toll facilities are being pursued very aggressively here to help finance new projects. If a portion of the gas tax revenues continue to be used for non-transportation purposes, the end result may not be as big a gain as anticipated.

Second, in the discussion of pricing and tolling, do not discount the public's aversion to converting existing roadways and freeways to toll facilities. You have to look no further than Austin to see the public's negative reaction to tolling roads that were previously presented as non-toll roads. The website, http://www.texastollparty.com/index.php?direct=1, which is a play on the Boston Tea Party, provides an indication of the strength of the opposition to toll roads in the area. Further, the mayor of Austin and some members of the City Council are facing recall petitions. If you are going to introduce tolling, do so on new capacity, not existing roadways.

Third, do not immediately rush to pricing if you have capacity in an HOV lane. In southern California most HOV lanes are at capacity and in some cases over capacity, but other areas of the country may have HOV lanes with available capacity. In these cases, do not assume that pricing is the highest and best use of the HOV lane. Other options to explore include subsidizing super-HOVs, increasing bus use, truck-only lanes, or converting it to a general-purpose lane if there really are not enough HOVs in the corridor.

Fourth, as noted in one of the presentations yesterday, there is a need to evaluate the unique elements of individual projects. Many people talk about I-15 in San Diego and SR 91 in Orange County as if they were the same type of project, when the are actually very different. Every project and every situation is different. A set approach should not be applied to all projects.

Fifth, do not overload the discussion of pricing and other alternatives with policy objectives. Too often we turn a relatively simple idea to a Christmas tree, with everyone hanging an ornament. An example is allowing hybrids to use HOV lanes, which makes no sense. Why do we reward the purchase of a vehicle that is already in demand? Further, other gasoline-powered vehicles on the market in California have lower emissions and get better gas mileage. A second example is the policy suggestion to rebate tolls for low-income individuals. There are many things low-income individuals cannot afford. Pricing is supposed to influence people making travel decisions. What is accomplished if these influences are removed for a whole group of people?

Sixth, do not change the objective or message in mid-stream. We have been telling people for 30 years to double up and share a ride to gain the benefits of using an HOV lane. Now we are kicking them out so we can sell the space. What kind of policy message is being sent by this change? In Southern California and in other areas we will have to face a policy change to 3+ HOVs because the HOV lanes are becomming too congested at the 2+ level. While this change will be painful, it will be necessary.

Seventh, do not assume that the theory that glows within its own inner light makes good public policy. This conference has provided a practical focus. It is important that you communicate clearly with the public on what is being done and why it is being done. The recent discussion on a possible VMT tax in California provides a good example of how not to approach a topic. The discussion got out of control and you will probably not see a VMT tax in California anytime soon. The approach in Oregon was much different with the legislature developing a well reasoned approach, which will be pilot tested.

In closing, I would again like to commend you for an excellent conference and well reasoned discussion of some very important issues. AAA is please to participate in the conference. Remember the American public is your customer. Engage them in your discussions and form partnerships with them as you move forward with projects.

Alan Clelland
Sieman, ITS

It is a pleasure to participate in this session. I have been asked to comment on ITS and HOV/HOT lanes and value pricing. ITS provides enabling technologies to implement HOT lanes. We could not be talking about managed lanes, congestion pricing, and other alternatives without ITS. My comments will focus on ITS as an integration tool.

The need for integration was a common theme in many presentations during the conference. ITS plays a key, although overlooked, role in integration. There are different levels of integration. The first level of integration is institutional. As John Breeding pointed out yesterday, the customer expects the transportation system to function together. The public does not care if it is the state, county, city, or transit agency's responsibility – they want the system to work. All of these institutions must come together to make the system work. While the different components can operate individually, we will not optimize the system if they are not coordinated. For example, a city can operate its traffic signal system independently of other

jurisdictions. This approach does not maximize the benefits of a synchronized and coordinated traffic signal system, however.

ITS has promoted institutional integration. ITS has brought agencies together to plan, fund, implement, and operate advanced transportation management centers, traveler information systems, and many other projects and services.

A second level of integration is technical integration. ITS plays a critical role in technical integration. Coordinating the timing of traffic signals, providing real-time traffic information, and many other services would not be possible without ITS.

A third level of integration is operational integration. Operational integration is key to the success of HOV, HOT, and managed lanes. A recent study conducted by the University of Maryland suggests that although there have been significant investments in traffic signal systems in the U.S., these systems are not operated correctly in most areas. One of the problems identified in the study is the lack of funding to keep the traffic signal timing up to date.

In 1987 it was realized that there was a need to increase funding to improve traffic signal systems. Significant investments have been made in traffic signal technology over an almost 20-year period. What we have realized, however, is that an equal investment has not been made in funding the operation of these new systems.

I think there is an opportunity to change this trend with managed lanes, value pricing, and HOV/HOT facilities because revenues are generated with their use. It is critical that the revenues from these projects are used to support their operation, including the ITS components, or we will not realize the full benefits of managed lanes, value pricing, and HOV/HOT facilities.

We have not been successful at communicating the benefits of what we do as transportation engineers and planners to the public and to policy makers. We need to do a better job of presenting information on the benefits of HOV/HOT and managed lanes. The presentation yesterday on the Los Angeles HOV evaluation program provides a good example of communicating the benefits of HOV facilities. A brochure focusing on the top 11 things people should know about the HOV lanes was used as the executive summary. It proved to be a good communication tool with elected officials and the public.

We have to improve our communications with key stakeholders. With ITS technologies we have the ability to collect and analyze a tremendous amount of data. Ensuring that we provide useful and understandable information to policy makers and the public based on this data is important.

I serve on the Transportation Commission for the City of Pasadena, California. A priority of the city is maximizing the benefits and developments associated with a new LRT line. There is an expectation on the part of some people that the LRT line and associated transit-oriented development will reduce the need for automobiles. The focus should be on reducing the number of trips made by automobiles, rather than expecting that people will totally give up their personal vehicles.

Katharine Nees
Carter & Burgess

I have been asked to provide a perspective from toll road operators. Toll authorities are in the business of selling a product that adds value. Toll operators are also in the customer service business. They provide their customers with a product – a toll facility – that provides benefits worth paying for. Customer service is critical because toll operators sell what public transportation agencies provide for free.

Toll authorities typically offer a product line. Toll operators are interested in HOV, HOT, and value pricing as an extension of their current markets or product lines. Toll operators can provide the tolling technology, the "back office" collection services, marketing, and toll enforcement.

In Texas, transit agencies, along with TxDOT, play a key role in developing and operating the HOV lanes in Houston and Dallas. Obviously, transit agencies want to ensure that the HOV lanes operate at a LOS that provides freeflow conditions for their buses. Transit agencies may be less concerned about generating revenues from HOT lanes. Toll agencies, on the other hand, are very interested in generating revenues to pay off the bonds used to finance projects and to finance system expansion. It is important to understand and acknowledge these differences. Defining the roles and responsibilities of public agencies and toll operators is critical with managed lanes and HOT lanes.

HOT lanes and managed lanes provide the opportunity to maximize assets by selling unused capacity to lower-occupancy vehicles. There is so much demand and so little available infrastructure that we need to maximize the use of available assets. The major issue, of course, is how to allocate the available capacity.

Expanding HOV lanes to include a pricing option is being considered in many areas. ITS and toll collection technologies are key to HOT lanes and value pricing. The tolling industry has an interest in HOT lanes because they can provide the toll technologies and "back office" services necessary for HOT lanes.

Most HOV lanes are located in radial freeway corridors focused on the downtown area. With the dispersed development patterns in most metropolitan areas, there are increasing demands for enhanced system connectivity. HOV, HOT, and toll roads can play an important role in providing regional connectivity. Here in Houston, HCTRA, TxDOT, and METRO are working together on these issues.

Most toll operators are moving away from cash-based payments systems to all-electronic tolling. Electronic tolling is much less labor intensive and it has environmental benefits from reducing noise and lights at toll plazas. Interoperability is also important. Toll agencies are examining interoperability on a national, not just regional, basis. The toll industry is watching the national vehicle infrastructure integration (VII) initiative. This initiative is examining vehicle-to-vehicle and vehicle-to-infrastructure communication. The VII will influence HOV, HOT, and toll facilities, as well as freeways and roadways. In the not too distance future, toll payment technologies will be imbedded in vehicles as a standard feature.

The use of open-road tolling (ORT) will become more widespread. ORT is basically non-stop tolling using either electronic or video tolling. I think the use of video tolling, which involves recording images of vehicle license plates and sending the owner a bill, will become more common. One of the limitations with this approach is that it relies on vehicle records from state agencies, which are not often up to date.

I think we can learn from the European model of transportation hubs. These hubs bring together different modes, including automobile, long-distance passenger rail, LRT, buses, and other modes. We have not really developed multi-modal transportation systems in most of our metropolitan areas.

Finally, I think we will see more use of public/private partnerships due to funding and financing needs. Public/private partnerships are based on a European model of concessionaries providing financing, operations, and maintenance. This approach is new to the tolling industry. Public/private partnerships are being used with some mega projects, which are having difficulty with funding. Private investors are buying major transportation assets, such as the Illinois Skyway, and operating them.

Adeel Lari
University of Minnesota and Minnesota Department of Transportation

My comments focus on financing managed lanes. I think it is important to keep the revenue generating potential associated with HOV, HOT, and managed lanes in perspective with other elements of the transportation system. For example, Minnesota's system-wide HOT network is estimated to generate about $40 million a year in 2010 and $70 million in 2030. While $40 million is a significant amount, it is important to keep it in perspective of Mn/DOT's overall budget. In 2003, Mn/DOT's annual budget was $1.6 billion. The department's budget is estimated to be $2.5 billion in 2010. The estimated $40 million represents 1.6 percent of the total budget. The situation in Georgia appears to be similar to Minnesota in terms of the estimated revenue from the HOT lane network as part of the total transportation budget. These figures indicate that promoting managed lanes primarily as a financing mechanism may not be as strong a case as promoting the benefits of these types of facilities.

The luncheon speaker yesterday talked about how transportation agencies can work with private businesses to advance transportation projects. He noted that transportation creates value and adds value to landowners and businesses. There seems to be a disconnection between how we fund transportation and who receives the benefits. In Minnesota in 2003, approximately 40 percent of Mn/DOT's $1.6 billion budget came from the federal government, primarily from the fuel tax revenues. Approximately 25 percent came from the state fuel tax, 19 percent from the state vehicle tax, and 8 percent from the state vehicle sales tax. Bonds, interest income, and other related sources accounted for the remaining 8 percent.

None of these revenue sources include the landowners and businesses that benefit from the transportation system. Thus, the biggest beneficiaries of the transportation infrastructure are not contributing to its development and operation. Private businesses and landowners do not help fund the transportation system, but realize an unequally large share of the economic benefits from a good transportation system.

The luncheon speaker noted that businesses recognize the importance of mobility and a good transportation system and are sometimes willing to tax themselves to help pay for improvements. If the government continues to tax only the users of the transportation system they are choosing to give an unearned bonus to landowners. If the government is unable to build needed transportation improvements because of inadequate financing, and if they do not want to increase existing taxes, they are denying new travel options for users and economic benefits to landowners.

Recent experience indicates that new toll roads require subsidies, either cross–subsidies from another toll road or direct contributions from the public agencies. In the past 15 years, five major projects in the U.S. have been built with active private sector sponsorship and investment. These projects include the Dulles Greenway in 1995, at a cost of $378 million; SR 91 in 1995, at a cost of $326 million; the Southern Connecter in 2004, at a cost of $208 million; and Pocahontas Parkway in 2002, at a cost of $377 million. SR 125 will be opening soon at a cost of $722 million. All of these projects required public subsidies. I would suggest that not all the beneficiaries of the toll roads are contributing to their financing. We need to consider approaches to involve landowners and businesses in the financing of toll projects.

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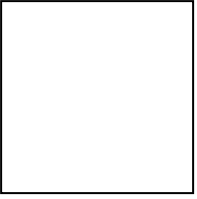

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