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Driving Into the Twenty-First Century: Technology Solutions to Transportation Problems Symposium, IISTPS Report S-99-I

Mineta Transportation Institute

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Created by Congress in 1991

IISTPS Report S-99-I

Driving Into the Twenty-First Century: Technology Solutions to Transportation Problems Symposium November 16, 1998

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To order this publication, please contact the following:

IISTPS
College of Business
San José State University
San Jose, CA 95192-0219
Tel (408) 924-7560
Fax (408) 924-7565
e-mail: iistps@iistps.cob.sjsu.edu
http://transweb.sjsu.edu

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FOREWARD

Transportation in the impending 21st century will be very much impacted by the new technologies—global positioning systems, SmartCards, and Mayday systems, for example. How can the transportation industry promote the use of these new technologies not as novelties, but as full-fledged solutions to the transportation problems being faced by most metropolitan areas?

Driving Into the Twenty-First Century:Technology Solutions to Transportation Problems is the transcript of a symposium held on November 16, 1998. The symposium was sponsored by the Norman Y. Mineta International Institute for Surface Transportation Policy Studies, the Silicon Valley Manufacturing Group, Hewlett-Packard and Lockheed Martin. Numerous industry leaders and innovators were invited to participate in the open forum, and several vendors of electric and alternative power vehicles were on hand for participants to view and test drive.

Participants in various discussions, myself included, were:

- Mark Amstock, National Alternative Fuel Planning Manager of Toyota Motor Sales
- Hamed Benouar, Program Manager for Caltrans Traffic Operations Program
- Jim Beall, Chair, Metropolitan Transportation Commission
- James DeStefano, Business Development Manager, Hewlett-Packard
- Karsten Fels, Traffic and Transportation Research Group at Daimler-Benz
- Dick Fitzmaurice, Director of External Affairs, Pacific Bell
- Carl Guardino, President and CEO of the Silicon Valley Manufacturing Group
- Russ Hancock, Vice President, Bay Area Council
- Kent Harris, Director of Advanced Vehicle Programs, Pacific Gas and Electric
- Steve Heiminger; Legislative Director, Metropolitan Transportation Commission
- Victoria Nerenberg, Technology Manager at Bay Area Rapid Transit (BART)
- Charlotte Powers, Chair, Santa Clara Valley Transportation Authority and San José City Council Member

- Robert Ratliff, Executive Director, CATS
- Dan Sperling, Institute of Transportation Studies, UC Davis
- Bill Van Armstrong, Vice President of Marketing and Communications, Calstart
- Dr. Stephen Van Beek, Deputy Administrator for Research and Special Programs, United States Department of Transportation
- Conrad Wagner, Mobility Car Sharing, Switzerland

The technologies discussed were as varied as the speakers. Hybrid vehicles which are powered by a combination of electric and combustible fuel are available today. Fuel-cell vehicles, which are powered by hydrogen and oxygen which produces electricity are on the horizon. Intelligent Transport Systems are under development as are intelligent vehicles. Mobility Car Sharing, currently in operation in Switzerland, offers consumers the opportunity to use a car for several hours at a time without the expense of owning or maintaining that car.

For the Silicon Valley to keep pace with the global economy and cut down on wasted productive time we all experience on our roadways, businesses and consumers must work together to seek innovative solutions to gridlock and try to make every minute of the workday count. Tomorrow's transportation goals are to make life more pleasant and productive; the technologies being developed today will help to ensure our area remains a leader, both economically and in quality of life.

Rod Diridon

Executive Director, The Mineta Institute

EXECUTIVE SUMMARY

The Norman Y. Mineta International Institute for Surface Transportation Policy Studies (IISTPS) has been fortunate to receive funding, through the Federal Research and Special Programs Administration (RSPA) and the California Department of Transportation (Caltrans), to conduct policy-related activities in the areas of research, education, and information-sharing to benefit the United States surface transportation industry.

This document,*Driving Into the Twenty-First Century: Technology Solutions to Transportation Problems*, is the transcript of a day-long workshop which was held on November 16, 1998. Co-sponsored by the Norman Y. Mineta International Institute, the Silicon Valley Manufacturing Group, Hewlett-Packard and Lockheed Martin, the forum offered participants and spectators the chance to not only hear about the latest technologies available, but actually view, and in some cases, test-drive those technologies, which included hybrid and electric cars.

Not only were improvement in automobiles discussed, new technologies which will make commute times more pleasant for the 21st century worker were introduced. High-tech user-friendly highways, with electronic toll-collections, quicker response times for emergency vehicles, and tomorrow's Intelligent Vehicles will help ease time spent in traffic, thus making commute time less stressful, and perhaps even productive.

Highlights of the day of each presentation included:

- Carl Guardino beginning the day by defining the challenges facing the transportation industry, and opening the door for possible solutions.
- Kent Harris discussing options in the electric transportation industry, including fuel types and charging technologies.
- Conrad Wagner introducing the audience to his successful Swiss-based car-sharing program, Mobility Car Sharing.
- James DeStefano talking about intelligent vehicle systems, which not only include todays air bags and automatic braking systems, but the possibility of collision warning systems and global positioning systems on every vehicle.
- Karsten Fels discussing current transportation industry activities and what innovations are currently in research and development.
- Mark Amstock speaking about the types of vehicles which may be seen on the roadways of the future, with an emphasis on the small personal transportation class of vehicle.

- Hamed Benouar updating the audience in on what Caltrans is doing to produce an integrated multimodal transportation system.
- Dr. Stephen Van Beek discussing the changing nature of the public/private partnerships in the federal government, and the impact those policies will have on the transportation industry, as well as strategic goals the Department of Transportation has identified to ensure the transportation system and modalities will support continued economic growth.
- Dan Sperling speaking about business opportunities and possible partnerships which could benefit in developing the new technologies.
- Rod Diridon talking about implementing the new technologies and the importance of implementing those technologies for long-term survival.
- Jim Beall speaking about the Silicon Valley Smart Corridor, the components and advantages this system gives to Highway 17/880 commute, which is one of the most impacted in the Silicon Valley.
- Robert Ratliff discussing Intelligent Transport Systems and the statewide ITS plan CATS is developing in preparation of implementing a statewide ITS program.
- Bill Van Amberg highlighting trends in the Silicon Valley and discussion on why these trends and new innovations currently in the works must be implemented in this area, both as short and long-term solutions.

Moderators included Dick Fitzmaurice, Russ Hancock, Victoria Nerenberg, Steve Heiminger, and Charlotte Powers.

There are many innovations currently in testing or on the drawing boards; the next step will be to implement these new transportation advantages and convince the public to embrace and use the new technologies to their advantage.

INTRODUCTIONS

DICK FITZMAURICE

Welcome, I'm Dick Fitzmaurice. I'm with Pacific Bell, and I'll be your MC for today's workshop.

Have you had a chance to check out the exhibits yet? If you haven't had a chance to do that yet, you'll want to do that during the breaks and at lunchtime. Take a look at them around the room and out in front; there's some really good information available here today.

I also have a reminder for you. This afternoon at 2:30, we'll get a chance to test drive some EVs—electric vehicles.They're pretty slick; I got to drive one a few months ago in Sacramento, and it was quite fun.

Today's workshop is going to be a very good one. Let me first welcome you, and second, thank the sponsors—The Silicon Valley Manufacturing Group is of course spearheading the event; you can see their sign over there.

But also, thanks go to Hewlett-Packard for providing the meeting hall today. And I want to thank Camelia Nelson for her work on the event.

Thanks also go to Lockheed Martin and the Norman Mineta International Institute for Surface Transportation Policy Studies at San José State University; the Mineta Institute will be publishing today's proceedings for us.

We're here in the heart of Silicon Valley, where technological changes are commonplace—so much so that I sometimes wonder if anybody even notices anymore. It's kind of a "bummer day, man," when somebody doesn't invent some new chip or some new application to make our computers and our printers work better. It's no surprise then, that high tech is being applied to our vehicles and to the roads we drive on—or "upon which we drive those vehicles," to be grammatically correct, as my professors at Cal State Hayward used to say.

In fact, that is our format for today's seminar. We are going to talk about advances in car technology, and discuss some of the high-tech advances that promise to make our highways more user friendly. Then as a wrap-up, we'll try to get some perspective on both, and figure out how those applications are going to work together.

You know, survey after survey indicate that transportation, or the ability to get to where we need to go, is an issue of major concern in the Bay Area. On one front, we need to make a commitment to drive less, to take public transportation, to rideshare, and to telecommute. But the fact is that there are

times when our jobs and our family activities demand that we drive, and mitigating the impact of those times is what today is all about.

By the way, you're at the right workshop if you're concerned about traffic congestion—if you want to help address air quality issues, because you know that about 60 percent of air pollution comes from mobile sources—those cars that you and I drive. You're in the right place if you want to help address air quality issues—if you want to help employers struggling to recruit qualified workers who have farther and farther to go these days to get to their workplace. You're in the right place if you need money to implement a transportation-technology project, or if you have money to fund a transportation-technology project.

We only ask two things of you: One is to think out of the box today; and two is to give us some honest feedback and participation. And you can participate at the end of each of the panel discussions by asking questions; you do that by filling out the card that is at everybody's place. Fill out your card, pass it to the end, someone will pick it up, and we will get to your questions at the end of each of the workshops today.

Well, as we mentioned, the prime mover of the workshop is the Silicon Valley Manufacturing Group. The Manufacturing Group has really been a leader on both sides of the transportation equation, and the person most responsible for that leadership position is the President and CEO of the Manufacturing Group, Carl Guardino. At one time, Carl was Vice President in charge of transportation issues for the Manufacturing Group. He also worked for a time right here at HP in government relations, and at one point was Chief Assistant for a local Assembly Member. All that from a guy who went to San José State—a veritable testimonial to the quality education that you get at the California State University System. Please say hello to Mr. Carl Guardino.

Carl never misses a chance for a grand entrance—let me take your helmet for you, sir.

CARL GUARDINO

Thank you—I have 9-1-1 on speed dial. You know, these Zappy Power Scooters have zero air pollution, they take about an hour to charge, and are one of the many current and futuristic items that we're going to have a chance to talk about today.

Welcome this morning to "Driving into the Twenty-first Century: Technology Solutions to Transportation Problems." I, like Dick, want to thank Hewlett-

Packard for allowing us to be on-site this morning, and for all of their work to make this morning possible.

The Manufacturing Group has had a long-term commitment to congestion relief and cleaner air in the Silicon Valley—and in the Bay Area.

In 1984, because of the work of private citizens and our private sector companies, we were the first in the state to pass a one-half cent tax designed to fund transportation solutions through what is known as Measure A.

In 1996, we were the first in the state to pass a renewal tax and one-half cent sales tax through Measures A and B.

And those in transit technology—all of us together, private and public, in Silicon Valley—are first in state-of-the-art solutions for both transportation and air quality.

The purpose of our conference today is simple: We have close to the worst traffic in the world. We also have the smartest people and the best technology in the world, and it's time that we merge our highways with high-tech for solutions.

The challenge is clear: We have a $6 billion deficit in the state of California's transportation improvement plan. According to the Metropolitan Transportation Commission, we lose $3 billion annually just in the nine county Bay Area, in time lost moving goods, services, and ourselves. And in Santa Clara County alone, we lose 35,000 hours a day stuck in speeds stalled below the speed limit. And this last summer we were redesignated for air quality as non-attainment for ozone. Fortunately, we will not focus today on the challenges; we know what those are.

Today we will focus on solutions—both those that we can realize today and those that are possible in the future. And, we will evaluate how we can apply technology.

We can apply technology remarkably, in a number of ways—many demonstrated both internally in the room today, as well as externally. These include electronic toll collection, better travel information for transit, quicker emergency response times, improved traffic flow, fewer traffic jams, improved trucking and fleet management, better air quality, and savings to all of us as taxpayers.

I want to give you just one example—if Katie Heatley with Outreach can just stand or wave her hand for a moment. Outreach, of which Katie is President and CEO, helps the frail, elderly, and disabled in our community to have a full range of mobility in their life by having full access to mobility options.

Outreach has 85 vans with GPS—Global Positioning Systems—if you have a chance, peek into the Outreach vans that are here on display today. With GPS, Outreach's 85 vans are updated every 20 seconds as to exactly where they are within three to five meters—anywhere in Silicon Valley. This has allowed Outreach to save $480,000 last year in real-time rerouting of those vans. And the results—what we all shoot for—have been fewer trips that carry more people at great savings to taxpayers. That's the type of thing that we can apply as we merge technology with traffic, and public with private sector partnerships.

Representing some of those partnerships and opportunities, we have a few elected officials here with us today who have made a real commitment to traffic relief, and I just want to mention them quickly: Ron Gonzales, Mayor-Elect of the city of San Jose; Jim Beall, the incoming Chair of the Metropolitan Transportation Commission; Charlotte Powers on the Valley Transportation Authority Board as well as the Metropolitan Transportation Commission; and our newest Commissioner on MTC, just elected last Thursday night—the dew is still wet on his ears for that appointment—John MacLemore with the City of Santa Clara. It's these folks who can help us to make sure that as the private sector invents, the public sector moves it forward.

I want to mention just a couple of the displays this morning. I rode up on Zappy, and managed not to kill myself. Zap also has a display in the back including power bikes as well as their power scooters.

Trapeze is here with software applications.

As for transit, we have a number of electric vehicles today: GM's EV1, which broke the land-speed record of 183 miles an hour—but they only let you take it up to 180 mph out on these streets, so be a little careful.

Toyota is here with several vehicles, including the Prius, which is a hybrid that can run on both gas and electric power, but is 90 percent less polluting than today's new cars.

There is also a Jaguar convertible out there that is as high-tech as it is beautiful.

We also have Smart-Card technology, which links transit systems in the Bay Area on display.

And of course, the Outreach vans and a number of other vendors that I hope you'll take a moment to see.

Finally, again, I want to thank Hewlett-Packard, specifically Camellia Nelson, Marissa Kachigian, Linda Haddock, Mary Ann Gorsky, Jim DeStefano, and Rachel Bertoni for all their work leading up to this conference.

From Outreach, again, thanks to Katie Heatley. And from Lockheed-Martin Missiles and Space, thanks to Susan Schara.

It's time now to sit back, strap in, and get ready for a ride into the future in Silicon Valley today. Thank you again for coming.

DICK FITZMAURICE

Your helmet, sir. Speaking of cars, did the person with the Mercury Sable get their lights turned off?

Thank you, Carl. You're not going to ride out on it? You're not going to push it, huh?

CARL GUARDINO

I almost had a heart attack.

DICK FITZMAURICE

And he's smart too.

Let's move to our first panel discussion. The scheduled moderator was Sunne McPeak, the President and CEO of the Bay Area Council, the other business coalition in the region. You've got to know that when both business coalitions around here are involved in an issue, it's important to the business community, and to our economic well-being. That is certainly the case with transportation and mobility. Well, at the last minute Sunne couldn't make it, but she did send a person to fill in for her; the Council's resident transportation expert and Vice President of the Bay Area Council, Russ Hancock.

Dr. Hancock has directed the Council's efforts to implement congestion pricing in the Bay Area, coordinate transit across counties, extend the Bart system, and most recently, has spearheaded an initiative to dramatically increase ferry transportation in the Bay Area, particularly in the South Bay. Please welcome if you would, Dr. Russ Hancock.

RUSS HANCOCK

Thank you . . . you can hear me, I trust?

I'm delighted to be here and to introduce three distinguished panelists who I'm going to invite now to join me up here at the table.

The first is Mr. Kent Harris, who is the Director of Advanced Vehicle Programs at Pacific Gas and Electric; thank you Mr. Harris.

And then joining Mr. Harris is Victoria Nerenberg who directs new programs at BART; thank you, Victoria.

And finally, I'm going to bring in Mr. Jim DeStefano of the Electronics Instrument Group here at HP. And so, as soon as we are appropriately wired, I'm going to turn the time immediately over to Mr. Harris.

As you know, the purpose of this first panel is to talk about the vehicles and technologies themselves—the sorts of things that are there just over the horizon for us to look forward to as we move into this next century. Also, from a very practical point of view,what the real perils and pitfalls are, the technical challenges of implementing this technology—what will our prospects become, and how soon can we see their real applications here in the Bay Area?

So with that, we'll take up first electric and hybrid cars, and we'll hear from panelists.

VEHICLE OPTIONS: ELECTRIC CARS, CAR-SHARING AND INTELLIGENT VEHICLES

KENT HARRIS

Thank you, Russ; good morning.

I want to thank you very much for having me here today. I feel like I'm a little bit of a pretender, in that I look out at the audience here today and see many people from CALSTART, Lawrence Livermore, and others, who perhaps know much more about where electric transportation is going in the next 10 years than I do. But perhaps I can bring you my perspective regarding where I see it going, as well as where we find ourselves today, because in a very, very real sense, electric transportation's future is here today and it's on the road.

When we talk about electric transportation, particularly light-duty vehicles—I'm referring to cars, trucks, the light-duty category, which I use every day in my working fleet—currently, the primary choices we have available are the battery-only operated, and a few hybrids that are coning to the market. I'm going to talk a little bit about both of these, and then we'll have the opportunity to hear from others who will know much more about them, particularly those folks from Toyota.

Those products that we've seen come to market in the last two to three years have been characterized by two types of batteries. One is a fairly modest but capable lead acid battery—the advanced lead acid battery for transportation use—and the second is the more advanced nickel metal hydride and lithium ion technology that have twice the capability of lead acid batteries, and are actually delivering usable range in work-a-day fleets, such as mine. Batteries continue to be a critical area that people are focusing on in terms of looking for advancements, both in performance—the ability to store and deliver energy, as well as costs—which gets to be a critical consideration for a fleets as well as individuals.

As for hybrid electric transportation—those that include a combination of power systems on board a vehicle—what we've heard being discussed most often are the internal combustion engine- and electric-drive type of hybrid. However, there are some others: batteries and fuel-cells, fly wheels (some refer to these as mechanical batteries), super-capacitors, and multiple combinations thereof. All of these would qualify as hybrid-drive systems.

There are many design challenges that face us today. There are also considerations regarding your objectives. If you value low emissions system-

wide, the minimum emissions requirements for hybrids would tend to drive you towards a choice where you have enough battery capacity on-board to have some battery-only range—and your strategy for using say, an internal combustion engine—would not be to provide substantial amounts of power, but rather, to provide just enough power to meet your daily mission. This is what the folks at the University of California, Davis, Supercar Program refer to as "charge-depleting-strategy."

And there are other strategies. The Prius uses a "charge-sustaining" scheme, with their internal combustion engine-and-battery combination.

Fuel choices:

Petroleum, as one of the more widely dispersed fuel sources we have in this country today—is often the first choice for those vehicles that have the ICE, or internal combustion engine, hybrid situation. But there are other choices as well.

Fuel-cell technology directions may use the fuel-cell as a power source. Here hydrogen is far and away the cleanest solution—both from an emissions, as well as, operating standpoint—for fuel-cell types of cars.

If electricity is chosen, it may be stored in lead-acid, or mechanical batteries such as the flywheel.

The alcohol fuels:

I noticed some flexible-fuel vehicles in the parking lot today, they use alcohol fuels as can fuel-cells in some other types of equipment.

Also methane, or natural gas, which I drove in today.

You're going to see several examples of these vehicles today out in the parking lot, and have the opportunity to drive many of them. These vehicles represent tremendous advances in vehicle technology just over the past three to five years.

These advances include the control systems and the power electronics that are involved, all designed to manage and provide power in a way that you and I will find acceptable and fun to drive. This is a tremendous challenge that should not be underestimated.

Let's quickly move into charging technologies. Currently the market is struggling with two choices:

The first choice is the conductive direct metal-to-metal contact type of transfer of power—your standard wall plug is an example of that—although according to building codes in the state of California, electric vehicles do require a unique

plug set-up to preclude them from being used in any other application as a safety consideration.

The second choice is inductive charging using high frequency power to create magnetic fields that transfer the power—induce it, thus the name—on board the vehicle.

Choices here may also include whether the equipment—that is, the physical power conditioning equipment—is on the vehicle or off the vehicle. Here design alone may improve range, in that an off-the-vehicle choice has the advantage of lighter weigh, thus improving range.

Power transfer rates:

This too is currently a hotly discussed area. The typical vehicle coming to market, for example the Toyota, the Honda, the GM, the Ford, and the Chrysler, tend to have charging rates at power levels of five to six kilowatts. That's a considerable amount of energy, and those types of charge systems provide recharge of the vehicle battery pack in a three to six hour time-frame. Some folks would find that to be too long, but for a typical driver such as myself commuting to and from work, that provides as quick a charge as I really require. Because of the available range, I can easily charge overnight—and speaking as a utility representative, I would prefer that you charge overnight when I have lots of reserve capacity.

The power levels that people are debating include whether we go to 50 kilowatt, or 100 kilowatt system—and there's one test underway for a heavy duty application down in Santa Barbara at 330 kilowatts of power. These types of power levels would provide recharges in the range of 15 to 20 minutes, versus the five to six hour time frame of the lower powered systems—a tremendous benefit if you're trying to use the vehicle to do cross-country, or at least extended-range kinds of uses.

The challenges of recharging system development are many, and cost is one of the key factors—there are only two manufacturers with product on the market.

Still another challenge is the systems on board the vehicle which manage the generation of heat and the power levels that these battery-packs would be seeing under these regimens.

Still, opportunities exist in this area. In the Bay Area, we can foresee the likelihood of fast-charge systems once the manufacturers start allowing them to be used on their vehicles, up in say, the Highway 80 corridor between Sacramento and San Francisco, or in the East Bay and Peninsula corridors—perhaps even on the South Bay corridor.

Charge off-the-generator or off-the-grid?

This refers specifically to hybrids. I need to mention a charge-depleting and a minimum emission strategy for hybrid electrics. This is the type of vehicle that you would have say, a 150–250 mile range with combined power sources on-board, but you would also plug it in overnight to bring the battery pack back up to full charge for your next day's use.

Other strategies have called for more independence from the charging network by using a smaller battery pack, usually just one to provide a peak demand power to meet accelerations in hill climbing. In that situation, the internal combustion engine for example, would provide all the recharge that that pack would require. It uses a little more fuel, provides for a little more emissions, but also then provides you with the convenience of refueling using the liquid fuel or gaseous fuel, whichever your choice had been.

And then finally, a little bit about fast-charging. As I said, there are two manufacturers that produce systems for sale today: They're in the 60 kilowatt to 140 kilowatt range, and one has a system under test of 300 kilowatt. We will see those as the manufacturers provide more options around which allow their vehicles to be charged using these types of power levels.

What is ahead for EVs? As with any product, I think the market will grow if—and that's a big if—you're trying to provide to a market. You need to fill a need, but you have to have the right performance at the right price. That is the challenge that all the manufacturers are facing with their battery-powered electrics right now. Prices are very high because of limited production—the availability of manufacturing capacity for batteries, and the like. That will have to be overcome—volume itself will help a lot, but development in the technology areas would be a great benefit as well.

Increasing diversity:

I see a variety of systems now. There are some areas in which we would like to see actually decreasing diversity, such as in the charging interface devices—whether it's inductive or conductive—we'd like to see a single system in place. I'm sure it would make it a lot less expensive for those of us in the Bay Area who are striving to create our public-charging infrastructure. It would be nice not to have to have two or three different connector types out in the market.

Drive systems:

Right now we see AC induction motors, and we see permanent magnet DC drive systems. Both are fairly efficient, although many folks say that there is some room for improvements in efficiency.

There is also room for improvement in the conponents of the batteries we talked about. Nickel metal hydride is the current leading technology, the most popular battery choice for the manufacturers in the vehicles offered today. Lithium ion is being tested by Nissan, and I think we'll see more from that particular battery. Lithium polymer is what many of the organizations under research grants have been working diligently to provide, and that promises a doubling of the range of current technology.

The hybrids:

I gave you a list of a variety of choices that designers have in combining power systems to create hybrid electrics. These can result in better range—they *will* provide better range in a battery-dominated mode—and they will also provide lower emissions for all of us.

Fuel types:

We're going to continue to see diversity in fuels. For instance, right now methanol has been in the market for some time, but has not seen a lot of acceptance by the market. Some of the major transit operators have tried it out in their bus systems and found some challenges with the mechanical systems related to it. But this situation may change with the introduction of fuel-cells. Methanol is considered one of the leading contenders for fuel supply in fuel-cell type systems.

Targeted vehicle designs:

Currently our light-duty transportation vehicles tend to be designed for some very general types of uses. Sedans and coupes really are very broad-based in the missions they're trying to meet; the same thing is true for pick-up trucks and the like. It is projected that future vehicles will be more targeted to specific roles, and you will see some examples of that here today at the electric vehicle ride-and-drive. I think what we're going to continue to see is a growing diversity: vehicle opportunities and choices to better meet specific missions, and drivers who do not have to pay for capabilities that they really don't need for a particular application.

Consumer choices:

Right now, the manufacturers are offering essentially different vehicles covering a wide variety of categories. There's the mini-van, a pick-up truck or two, the sport coupe, sedans, and the station wagon, but the consumer really doesn't have the scope of choice that we would like to see, which helps drive innovation, as well as costs and prices down.

So, what are some of the things that need to happen to move the market forward?

Market incentives are an important element to keep this market moving forward. We're looking at tax and fee offsets that currently exist, and are provided both at the federal and state, as well as at the local levels by the air districts; those need to continue.

HOV lane access, carpool lane access:

Currently federal law allows for vehicles such as electrics, which are inherently lower emission vehicles, to access carpool lanes. It takes an act by the state to put that into place, but I think in the Bay Area, where we see our HOV lanes underutilized for the most part, there are a number of parties that are interested. I know that if you are a commuter in today's South Bay area at all, you would love to be able to access a carpool lane with a single person in the car because you're driving a clean electric vehicle.

Maintaining consistent regulatory stance:

The state just went through a review of its low emission vehicle program, which is part of its program to meet federal requirements for improving air pollution in the state. There were some tweaks and changes made to that program which allow for some partial credits. This would mean that zero emission vehicle credits be allowed for vehicles that were not, strictly speaking, zero emission, but that have very low emissions and have certain other characteristics that make them close to what electrics can achieve. That stance, once having been made, needs to stay in place. It's tough to attract investment to a development area when you don't have a certain future—when you, the drivers, some of the drivers that are at play—are changing. Well, I think we're going to see this through the next 8 years, at least at this point.

Consumers need to know that EVs meet their driving needs. Today, I operate a fleet of about 15 or so electric vehicles, nine of which are in everyday use. They get flat tires—I've even had one totaled alread;, it held up very well as far as injury protection. They're very strong cars, and they do meet my operating needs every day. People need to understand that these cars will meet their operating needs, as well as their commuting needs.

How many people here—let me just do a quick survey—how many people here drove less than 25 miles each way to work today? Look at this room—in this room each of you is a candidate for an electronic vehicle today.

And so finally, volume growth, competition, and technology development. Those are the keys to keeping this exciting area developing for the future.

Thank you.

DICK FITZMAURICE

Thank you, Kent.

And if you have questions for Kent, again, I encourage you to write them down on your cards, and then send them to the outer bounds of the room. People will be bringing them forward.

I'm going to turn next to Ms. Victoria Nerenberg; her biography appears in your packet, as do all of the presenters. Victoria is a technology manager at the Bay Area Rapid Transit (BART) District, and among her responsibilities there, she is project manager for the San Francisco Bay Area Station Car Demonstration Project. Here to tell us more about that, we now turn our time over to Victoria.

VICTORIA NERENBERG

The first thing I want to do is introduce Susan Chihein. Susan? You may have thought I was going to come and talk to you about our station car program—and some of you know about that—but what I really want to tell you is how the station car concept has evolved into a broader concept which is called "car-sharing." Susan Chihein is the U.S.'s leading researcher on car-sharing; she's mentioned in the current issue of *ITS World*. And Susan, I think you have a paper somewhere that people can pick up.

And I'm also really going to turn the program over to Conrad Wagner.

I was working with Susan Chihein, Ph.D. candidate at UC Davis, and we then started working with Conrad Wagner of Switzerland, because believe it or not, this gentleman that you see before you, Conrad Wagner is the father of car-sharing in Europe. So what I would like to leave with you is a maximum opportunity to hear from Conrad, and then I will make a few closing comments.

CONRAD WAGNER

Thank you, Victoria. It's a pleasure for me to be here in this meeting in Palo Alto.

I would like to give you a short introduction into car-sharing and new mobility services in Switzerland and throughout Europe. You probably understand that the situation you're currently handling has to do with car-oriented lifestyles. This is just a fact of life; there is a rational approach to this kind of topic, but

there's also an emotional approach to this topic, and you have to keep that in mind when we do any kind of development in the area of cars.

There's another issue that cities are concerned about—access—access to work site, access to leisure, access to home site. I think this is the other side of the medal. We want to create a lifestyle which gives us a lot more options than just being in some kind of a traffic jam, which actually happened this morning for probably all or most of you.

We are talking about many things, including the configuration of cars. It looks like we are heading in the direction of having "one-size-fits-all" cars. But, actually it's a lot more intelligent to have a smaller car for one occasion, and a really big, huge, nice car—perhaps a convertible—for another occasion. So, we might create a system where there would be quick access to different kinds of cars—to a whole fleet of different cars. In this situation you would gain a lot more—it's an added value.

You might say you have one car or say you have two cars, while I can say that I have thousands of cars. So, I would have total access to all of these types of cars. Actually this would be pretty close to the idea of the Internet, where we have access to an entire world of information, but you don't own the whole world—you just have access—and you take advantage of the opportunity and receive the benefits.

In other areas, this has actually been pretty much the case. In the trucking business, Mercedes-Benz is just such an example. They often charter, but do not buy trucks. And a lot of trucking companies don't really buy their trucks, they just take advantage of having these charter trucks to cover their peak needs more efficiently. In this way, they have the truck that they really need.

Well, what we did is represented by Mobility Car Sharing in Switzerland. It's been operating for about ten years. It started very small and has grown quite a bit; currently, it is growing by about 100 percent each year.

The idea is that there are 700 parts, like point of docking, or lots, or locations where cars are located. Right now 1,200 cars serve 25 thousand customers, and as I've said, the growth is tremendous.

You have two options: You can be a member in the system; or you can just be a user of the system.

The member pays a deposit of 1,000 Swiss francs, which is about a 600 dollars, and then would just have access to these cars. Rates are based on hours and miles driven. You have 24-hour access to service for your reservation call, seven days a week, so this is very much like a privately-owned car. Instant and

spontaneous access to these cars is provided, since it takes you only about 1 or 2 minutes to obtain the kinds of cars which we were just talking about in relation to technical development. So, it's a type of self-service system where there's just a few staff involved—this saves on labor expenditures—and you have fairly quick access to these cars and to a reliable network of these car-sharing lots.

In this way, car-sharing is really competing with the privately-owned car. It is very similar to a privately-owned car, but of course the private car is just standing in front of your door, so this is the competition we have to overcome in car-sharing systems. Right now they are just covering the demands of existing customers.

Now I would like to discuss the reservation system which is currently in existence. Actually, there is some insistence that the company provide instant access so that there would be no requirement for reservations. Currently however, reservations are required unless the lot has achieved a certain critical mass, where you're getting up to a 100 cars in one lot. If this is the case, you do not need to have a reservation anymore, you will have a kind of an open-ended booking. You do not have to give a precise end time, that is, when you have to bring this car back. There are also one-way rental opportunities in the system.

The booking process can be done at four levels:

In the first one, you have an agent—40 percent of the customers are using this at a 24-hour service call center—you have a person-to-person situation any time you need to call.

Another is that you have an interactive voice response system—we call this the automatic reservation system—where we talk to the computers and you get feedback regarding what kind of cars in what category are available right now. This is all built on a database system.

Finally, you have the Internet and the Intranet solutions via modem—so an employer who has contracted with the system, and has an out-sourced fleet run by this service, can have real-time access to these cars.

This then will be transmitted by a GSM model, which is the European cellular standard, into the on-board computer of the car through radio frequency transmitted to your car. Everyone will have a Smart-Card, a touchless chip card that allows direct access to these cars through a mobility checkpoint in the windshield. Car keys will be a thing of the past—you just open up your car with your Smart-Card.

If it has been contracted as such, you can use this card in your public transit system, for your shopping, whatever. It's based on credit-, debit-, or cash-cards, or it can be used just as an identification card for billing.

The technical features include an on-board computer; this is separate from the dashboard. We do not want to harm the dashboard because this car will be sold after two or three years at the latest.

Computerized management of information on your reservation and on your gas card is included here. However, we expect that we won't need the gas card in about 3 to 4 years because gas stations will be intelligent too—these are the kind of features to expect from the card.

So, let's go back to lifestyle. Your lifestyle is kind of like painting your own Picasso. True individualism is actually having access to different kinds of modes, so you might walk sometimes, and you might go by bike sometimes—there's the taxi, there's car rental, there's public transit, and there is car-sharing.

Car-sharing somehow fits in between all these different kinds of modes. It's like mobility insurance—whenever you need the car, you just take one out of the fleet—wherever you are. You can make a decision in Berkeley, or if you're down in San Jose, you just decide that you need the car, and you take it out of the existing fleet. And this might change for you, because you're changing your behavior in traffic—using car-sharing might be a seasonal thing. It might be that you've temporarily changed your work site for two months and then you go back. You wouldn't have to buy a car. And, when you travel somewhere, you would just have access to these cars.

The structure of the car-sharing company includes three kinds of departments. There's customer service, which deals with serving your clients, then there are the reservation center tasks, finally, there is consulting—because you will do consulting—you could be doing consulting on electric vehicles, as we're also bringing some electric vehicles into our fleet.

Car-sharing is very similar to the car rental business. They're so close to each other as a product that it's like chocolates in a chocolate shelf—they're all chocolate but there are different brands and different kinds of chocolate. This actually creates an environment where different kinds of chocolate can be sold from the single generic chocolate.

This is a market-driven kind of distribution, so car-sharing is actually dependent on the fact that there's also car rental available. If you need a car for longer than two or three days, you would get a much better deal out of a car rental system.

So, from within these reservations systems, you get different kinds of modes: You can get the car rental; there's the car link, which we will talk about later on; there's car-sharing; there's the taxi, which is a chauffeured car-sharing system; and there is car-sharing which is like a non-chauffeured taxi.

Finally, the fleet of cars must be managed. Invoicing must be done—or if it's done by credit or debit card, it just goes directly by the Smart-Card system.

As I mentioned, car-sharing was never intended to be—and still is not—a solution in and of itself. It will not solve all of our problems. But, it fits into a mobility package, and this is where we see a breakthrough in thinking. The mobility package gives us the opportunity to mix different transportation modes—it's intermodal behavior—it's multi-modal behavior in tripping. We sometimes call this "travel blending"—it's like a coffee blend, or a tea blend, or a tobacco blend. The blend itself gives an added value to these materials. When the blend is applied to travel, you will have different kinds of modes, and value will be added to your lifestyle and to your behavior in traffic.

This is actually also a shift of paradigm. Collective traffic modes and individual traffic modes will work together at one point because people want to be provided with mobility and they do not want to be provided with just cars, or trains, or buses. So, it's truly the market or the consumer— riented vision involved here.

For example, in Zurich they have about 140 lots right now and about 360,000 inhabitants. Zurich is pretty small, so you'll find that there is a lot of this type on every third or fourth street. So, it's possible to simply walk over to another lot and get a car out of there.

The shift of paradigm is that the public transit agency —which has been in charge of collective transit for 50 to 100 years—is in addition, now providing individual cars. And the other way around—car manufacturers or car dealers could also be involved in collective transit and could choose to join into these kinds of platforms, or into these kinds of mobility packages.

So, it is interesting that you've got a lot more options with this system. You can have whatever you like—on Monday a convertible, and then on Tuesday a station wagon, on Wednesday you may take the bike, and on Thursday you might take the bus. So, you have variety—it's like a menu in a restaurant—there's more than potatoes on this menu, not just the same kind of food every day—you can have a variety of foods, a variety of modes that you can go for and drive with.

Here is an example out of Bremen, Germany—I'll show you some examples quickly. You can drive a car with your Bremer Karte, which is the public transit card in Bremen. In collaboration with car dealers, you would have the option to choose an extra small, small, medium, large or XL car. So it's not "one-size-fits-all," you get choices. Pretty much, all of these choices there are all based on Smart-Cards, those touchless chip cards I mentioned earlier—which I might add, are very trendy right now.

These choices also include collaborations with the national railroad system in Switzerland, which is a very dense system. You can request the option to drive from Lucerne to Basel and get the car out of there, or vice versa. It's a collaboration between collective traffic and individual traffic, done quite nicely.

There's another system in Berlin, it's called a "Cash-Car," and it's another approach to car-sharing. There is some gambling involved here. A person who uses cars quite a lot—who has a leased car—might eventually take off for a vacation for two weeks. This person does not need this car, and so would just turn in the car to the car-sharing company and get cashed out. So you can gamble with your car and get cash out of your car—that's why they call it the Cash-Car.You can cash it in, and it will motivate you to take other modes of transportation—to go for say, a bicycle ride instead of for a car ride when you go on your vacation, and just cash in your car and get a little money out of it.

The prices for this are actually updated every hour; you get the price on the Internet, or you just call in and ask what's the price right now if I take the car for a day or for two days. The prices go up on Friday afternoon because there's more demand for cars for the weekend, and the prices go down on Monday and Tuesday.

This is the kind of capacity management system where the market is giving more options to existing transportation materials. It's a kind of dematerialization, or a trend toward dematerialization, and I would say it is associated with a kind of new prestige. If you look at very modern homes, they're isn't so much furniture in them anymore, but there is an Internet system. You have access to the whole room rather than all of this big furniture packed in your living room. And this trend is similar to what is going on with cars—there may be a new prestige associated with having access to many options and not having to deal with selling these cars, or managing these cars, or get dirty changing the oil.

Just about four weeks ago, DaimlerChrysler introduced a new little car called "Smart" in an area in Paris. It's a two-seater car, and fits just perfectly into

these kinds of fleets. When you have three people, or when you have more luggage, you can just use another kind of car.

In Switzerland, you can build a mobility package in collaboration with the DaimlerChrysler Smart. When you buy a Smart, which costs $10,000, you get automatic access to all the car-sharing cars—to all the 700 lots in Switzerland—so you're free to use them on hourly and kilometer-based rates, which change along with the standard price.

The emphasis is on intermodality. Avis is a part of this collaboration. You can use your little Smart—which is actually bigger inside than a conventional car, but about a third as long as your cars here and fits any parking place—and then you can just change to another mode, perhaps a bigger car. Later you can change back to a Smart car out of the car-sharing fleet. Additionally, to add still another mode, you can put this car on a trailer, drawn by a train, and you pay just half the price because it's less than half as long. It's similar to the motorcycle rates, and it looks quite smart and clever when you can do that.

I just want to show you some other start-ups, like in Portland, that deal with car-sharing. We're in an early stage of learning about how these projects—or these programs—or these companies—can transfer over to the American market.

And there is another system, which I think they'll be talking about later on, called "Carlink"—a Smart car-sharing system that is being promoted as a commuter solution. These cars can be used by three different parties in just one day, instead of just one.

It's capacity management, it's efficiency in using cars, and it's actually adding value to have a whole range of different kinds of cars. This might also fit quite easily into programs similar to those in Los Angeles—their livable communities.

So, this might turn into a kind of partnership management where you have operational partners like in car-sharing, in van pooling, and in public transit. The distribution of partnerships may evolve so that employers act like developers to find your customers. And, it begins to sound like amazon.com actually, which is somehow dealing in the same kind of system—there are existing resources of book wholesalers, and on the other side there are customers, and you do this kind of interface between book wholesalers and customers. So car-sharing could be a kind of amazon.com idea existing between the car manufacturers and their customers.

So, now I come to my last slides. We have spoken so much about technology—and it's very important to focus there—but there are three other important things which are transmitted by this picture:

First, you have to get your customers excited about the idea, and you have to get them to go for this kind of an idea, as you see them going for it.

Second—you don't see exactly what they are looking at, and what they are excited about, so you have to anticipate the future, and somehow figure out what they will be excited about—and you have to attempt to influence them and give them the right picture. So, there's a kind of the interaction between the development of the idea and people's excitement.

Third—there's a whole lot of technology involved to get all of these markets running.

Car-sharing involves a lot of complexity because you must put together different kinds of modes into one mobility package. You increase complexity, and people don't like complexity, so you have to simplify. This simplification can be done with technical tools—and we're talking about a kind of interactive process of technical development on one side—and the market oriented development of mobility features. This kind of interaction interests us a lot.

Here we are, right now sitting in Silicon Valley, and this could be the next high-tech development, cutting edge venture for the next five to six years—relating technical development to the market development for car-sharing.

Thank you.

VICTORIA NERENBERG

Now you can see why I wanted to maximize the opportunity for you to get to hear from Conrad. Thank you, that was great, Conrad.

I've just returned from studying car-sharing in Europe for one month; Susan Chahein has been to Europe and to Japan once this year, and she's on her way to Europe for a second time. Conrad is willing to come to the U.S. and be a resource to all of us in this country who want to get car-sharing started here. So, if you have an interest in car-sharing, please give either Susan, or myself, or Conrad your card. We would like to see what your interest is.

I just want to emphasize that what Conrad is talking about is real—I mean, it's already been instituted—it's not just that it's a good idea. And in Switzerland where it is really taking off, I was so impressed with the local, regional, and national rail systems, the rental car companies, the car manufacturers, and the car-sharing organization mobility. They've all figured out that if they feed each

other instead of compete with each other, they have a huge mobility market. Forty percent of the people who live in Zurich don't even own a car—and in some Swiss cities, it's 50 percent.

And speaking of Zurich, the highlight of my trip was this Zurich map—and as Conrad mentioned, Zurich is a small city of 360,000 people—and as it shows right here on this map, there are 140 locations where you can go to pick up a car. You don't need to own a car—every few streets, there's one available—you just call up, reserve it, and take it. That seems like an opportunity that many cities in the U.S. could take advantage of.

We're focused on the West Coast because we seem to have the leading edge on the "Left Coast," with Portland, and Seattle, and San Francisco, and LA, and San Diego, so if any of that interests you, just give us your card.

DICK FITZMAURICE

Thank you.

We turn now to our final presenter on this panel.

Mr. James DeStefano is a Business Development Manager, right here at Hewlett-Packard. He is responsible for developing corporate-wide business strategies with respect to surface transportation. In the course of his duties, he has developed tremendous expertise on automotive information systems and wireless communication technologies in their many applications, including the mobile office, distributed monitoring, automated car rentals, and automated package delivery applications. To speak about all of it this morning, we're very pleased to have Mr. James DeStefano.

JAMES DESTEFANO:

I would really like to thank Conrad and Victoria for providing an excellent segue into talking about intelligent vehicles.

The developments they shared with you about car-sharing reflect just a very small segment of what's happening in the industry overall. In fact, if we look at cars today, a little less than about 20 percent of their costs are for electronics. However, as we see developments happening, it's not inconceivable that anywhere from 30 to 50 percent of the cost of cars will be electronics in the future. This should be of interest to most of the conpanies in Silicon Valley—it certainly is to Hewlett-Packard.

HP currently does a few billion dollars a year in business with the automotive industry—in the area of designing vehicles, helping to manufacture vehicles, providing the intranets that tie together the OEMs and their suppliers—even in diagnosing the electronics in your cars and dealerships. So as we look towards the future, we see tremendous developments taking place that provide a great opportunity not only for HP, but for a number of other companies in The Valley, including Sun, Cisco, Intel and others.

So today, I would really like to focus upon the intelligence that is going into vehicles. In particular, I want to talk about the current status of electronics in cars—how we see it evolving, how some of that intelligence can provide local solutions for Silicon Valley, and finally, how we can get the solutions commercialized in Silicon Valley.

But first, a good starting point should be to talk about what really is the definition of an intelligent vehicle—and various segments of the industries have different perspectives.

If you take it from the viewpoint of the U.S. DOT with their Intelligent Vehicle Initiative, they're really concerned about safety issues—air bags, ABS, Mayday systems—and in the future we will have collision warning systems that will actually notify you of the possibility of getting into a collision. They're also talking about having roadside transponders to warn you of emergency situations as you're driving down the highway. All of this will occur on a real-time basis.

Another aspect to intelligent vehicles is the whole aspect of total-picture traveler information. As Conrad pointed out, in the future we might have a multi-level mobility solution. So the question is how do you get all that information to the driver—to the conmuter—regarding congestion, navigation, alternative routes?

Another aspect of intelligent vehicles is really what's happening in the trucking and bus industry. As it was pointed out, in the Outreach program, every single one of their vehicles is equipped with GPS, which is certainly not uncommon in the industry; virtually all of the major trucking fleets have GPS on them. A lot of cities are now putting GPS on their buses, so they know exactly where that bus is and when it's going to get to the next stop. We're having paperless collection of documents for trucks going across borders, so they no longer have to stop for hours at the border of Mexico into the U.S. to have all their papers checked in terms of regulatory compliance. This is all happening now, and it's really accelerating because of the economic benefits it provides both to the trucking industry, as well as to busses and other applications.

Let's look at it from the viewpoint of drivers: We now have vehicles that you can personalize according to your needs. As you step into the vehicle, the radio adjusts; the cell phone may adjust to your needs; the seat adjusts to your needs. And this is going to continue to accelerate in the future—where there will be information delivered to you for your specific needs.

To give you an example, on German rail today, when the commuters get on the train, there's an HP printer that prints out a newspaper according to their personal specifications, so each commuter has their own personalized newspaper as they get onto the train. That sort of technology can be in cars in the future.

When we talk about communications, we see a multitude of communication applications going into your vehicle—everything from cellular communications, to satellite communications, to short-range RF communications. There's going to be a plethora of—at least three, perhaps four—different communication roads going to and from the driver.

Within the vehicle itself, there are some automakers today who are developing a dual-microphone system in the car, so that the microphone system can basically filter out all the extraneous noise and recognize the driver's voice. Well, that same technology can be used to localize the driver as the person in control of the car, so drivers can change the radio stations, but the passenger sitting next to them can't.

So these are some of the unique features that can be in cars in the future.

One of the areas of interest to us is really the car as a mobile office—and by a mobile office, I don't mean you're doing your office work as you're driving—but perhaps, let's say we have a salesperson going to a customer's site, and they forgot their data-sheet—they can call back to their secretary and have that data-sheet downloaded to their car and printed out in their trunk as they're driving to the customer site. Or, while at a customer site, you are discussing changes in the contract with the customer—you can walk out to your car and pick up the completed contract to bring in to have signed by the customer before you leave, therefore eliminating needless trips back and forth to the office.

If we look at where the automotive industry is today, we can see that it has gone through a number of evolutions.

Ten years ago the automotive industry was really in an exploratory stage regarding electronics—"What is this technology? How do we use it?"—those were the days of "the door is ajar-types" of electronic applications. But the industry has evolved quite a bit.

Today electronics is a primary differentiator in cars. It's the thing that really distinguishes cars from one another, and the automakers are really racing to be on the leading edge of the wave.

Electronics has also set the forefront in safety applications—everything from air bags, to ABS brakes, to traffic control. It's just amazing what air bag developments have taken place: We've gone from having front air bags, to head air bags; some car have knee bags; and there are even cars that have air bags in the rear seat. So, you can envision in the future that your car may have 10 air bags in it.

As we look down the road, the industry is really moving more and more toward information services going directly to the driver. So, this is a case of the OEMs or the automakers being in direct communication with their driver of their car, providing a much higher level of the service.

They're also moving towards driver-assistance services. One such example is the 1999 Cadillac—it's going to have a heads-up infrared display so that for night vision, this infrared can look out far—just like Desert Storm—and show you on your windshield through a projection where objects are that you can't see. So that's one such technology that's coming down the road.

Let's look at the entertainment industry. Ten years ago, we were really into modular electronics, VCRs for time shifting. Today the industry has moved more towards digital applications—HDTV, digital video desk—and also they've made them more portable. There's even a digital video disk player that looks like a Walkman. It's a little bit larger, but you actually can carry it with you like a laptop computer and play movies on the screen.

As we look toward the future, the trend really is more toward on-demand services. We all know about movie services that can be provided to you on-demand in your home. Well this one company is working on the technology for your radio, and if you like to listen to a certain program—let's say that program plays at 10 o'clock in the morning, but your driving time is from seven until eight—this technology will time shift—it will actually record the station and then play it back to you while you are commuting. So we see that there is a trend towards more on-demand services, and we also see more interactive services.

Game technology is changing so fast—you want to be able to download games almost in real time, so that you have the latest technology available to you.

These sorts of applications are driving the entertainment industry more and more to look at the applications in automobiles.

In the wireless area, the cell phone originally was a tool for a businessperson. Now it's become almost indispensable to housewives, teenagers, anyone else who perceives it as being a safety device; it's sort of a security blanket knowing that you can be in communication with people.

As we look down the road, what has happened is that the new digital technology has vastly expanded the bandwidth available now on the cellular network, so now the cellular system providers are looking for new applications. Well, those applications may be downloading data sheets into cars; those applications may be linking up with the NOW satellite low-earth-orbit telephone service, to provide the sort of curbage that you really need for an automotive application. So the wireless industry is getting more and more interested in the automotive applications that are out there.

In the competition area, we've gone from business solutions to home mobile solutions, such as this laptop. We're now moving into a stage that we call "pervasive solutions," or "plugging into the information utility." And the best way to describe this would be to look at some of the cell phones that have been very popular in Europe, but are just now coming to the U.S. Those phones have a little Smart-Card that you slip into it, and moreover, you can slip your Smart-Card into anyone's cell phone and use it. Well, just imagine in the future that computing technology is everywhere, so that as you get on a plane, you slip in your Smart-Card and use the computer on the plane; or, you slip in your Smart-Card and use the computer on the train or bus.

In the area of measurements—before the Cold War was over—the emphasis was really on high-technology applications—military applications. At the end of the Cold War, we really shifted over towards lower-tech types of application service technicians fixing computers or information networks.

There also was an expansion to volume applications, such as in the production of semiconductors. Today there are about six billion microprocessors produced per year and each one of those has to be tested—that's part of our business.

As you look down the road, the shift is really going more towards distributed measurement monitoring, and by distributed, I mean a person here can monitor the entire communication network for a service provider by having remote systems out there sitting on the line. And that information is not only technical information, but also collection information that allows them to do fraud detection—so it's shifting from pure measurement towards monitoring.

Again, these are technologies that are very applicable to an automotive application. In the foreseeable future, your car is going to be remotely

diagnosed, and when there's a problem, it will appear in your dashboard—the automaker will know before you know.

However, even though all of these industries are really focusing on the automotive opportunity, the big challenge has really been finding applications that are really successful.

The car phone never quite made it because people wanted the portability to themselves, not to their vehicle. But look at traveler information systems: There's a GPS phone now that's being tested in Denver, where your cell phone can locate your position to about 12 feet, and only costs about another $7 on the bill. Now, I can envision the very near future that that cell phone will have travel information on it, and that that will probably happen in about the next two years—that's my guess.

Likewise, the auto PC—there's so much technology on your portable device and the technology is changing so fast—why would you want to build that into your car? And we have product lines today that have four-month lifetimes. Why would you buy a car that has electronics built into it when you have that car for about four or five years?

The navigation systems and the Mayday systems have gotten a little bit closer, but even in those applications, it hasn't been quite on target yet. In fact, if you look at the applications in the automotive industry, the ones that have been closest are the ones most closely linked to the vehicle, like ABS and air bags. But even with those technologies, there have been reports in the newspapers about the problems with air bags and small children. And in the case of ABS, there are certain situations in which you don't want your ABS to come on, particularly if you're driving on gravel roads, or on roads with light snow.

But over time those are becoming more refined, and they're becoming more targeted for the specific application—I think one of the best applications in car electronics today is probably the keyless entry for your car. So what the industry really needs to find is what are those killer applications that can really help with the safety of the vehicle as well as with the congestion problem.

Now, I'd like to throw out a few ideas: I think one of the big sellers is really going to be this concept of night vision. As baby boomers, we're getting older, our vision is depleting, so any sort of technology out there—be it infrared-based, be it radar-based, or be it laser-based—that can assist the driver, will probably be a very popular technology, help with safety, and as a consequence of reducing accidents, will probably help with congestion.

Now the other area is going to be collision warning and braking devices. We're spending more and more times in our cars; the driving task is becoming more

complex because of congestion; we're trying to do more and more things in cars—everything from talking on your cell phone to putting on make-up—so anything that helps the driver in terms of warning them of potentially dangerous situations, again, will probably be a very big seller.

The third area is really driver monitoring...and now what do I mean by that? Well, there is technology today that can actually monitor how a person drives a vehicle, down to the point of whether or not they're weaving in and out of traffic lights. Now why would you want this? Well, you're a safe driver, and you're willing to let your insurance company monitor the way you drive in order to get a 30 percent discount on your insurance—this is a benefit that you get for making no changes in your driving habits.

Today in Europe if you have Low Jack on your car, which is a theft detection system, you typically will get about a 30 to 40 percent discount on your insurance because so many cars are being stolen into Russia.

Again, if we had technology here that allowed your insurance company to monitor how you drive, it could result in a very substantial discount in your insurance rates. It could also dramatically the improve the resale value of your car.

So, this monitoring technology not only pertains to private individuals, but also to groups—imagine a fleet manager who can get a much higher price selling their fleet cars because they monitor the way those cars are being driven. Let's say you're a Hertz, or an Avis, or an Enterprise today when you bring your car back, they inspect it for physical damage—what if they also inspect it for abusive driving? Now, Hertz and Avis and Enterprise can get more money for their vehicles.

The last killer application could possibly be the satellite office. In some surveys we have done with our own salespeople, as well as surveys that American Express has done, the average salesperson can probably save an hour or two per day by having this technology in their car—eliminating needless trips translates into a payback of anywhere from $30,000 to a $100,000 dollars per year. This is a very saleable concept.

However, putting electronics in car has its challenges. Perhaps one of the big challenges is cost. The price of cars has gone up faster than the rate of inflation for about the last 10 years. This year, we've actually seen car prices drop slightly, but in general, the car is much more expensive to buy and own today than it was 10 years ago. In fact, I've seen estimates that indicate only about 20percent of the American public today can afford a new car. So how can we

address the car cost problem? Well, perhaps one solution is shifting more costs away from mechanical systems and putting them into electronic systems.

Today in Europe, GM that has a vehicle that has electric steering on it. You eliminate the pump, you eliminate all the hydraulic lines, it's cheaper, faster, lighter, more fail-safe—it's better in every single way. There's also electric braking on the GM-EV1 that's out in the parking lot. Again, you're eliminating all that mechanical componentry and actually having a solution that costs less than the mechanical hydraulic solution.

The other way of addressing the cost issue is, don't building everything you are putting in there. Provide ports where you can plug devices into—and this plug-in may be an inductive charger or an infrared link. So it doesn't have to be something that's hard-wired into the car, it can be adaptable for many applications. Well, that requires having an integration platform underneath that, and I believe that the integration platform is going to evolve in the industry. In fact, the automakers have gotten together in a consortium called the AMIC, which is the Automotive Multimedia Interface Consortium, and they're right now trying to work out a standard electronic architecture for cars.

The other challenge is really the electronic industry itself. Unfortunately in Silicon Valley, we've been very preoccupied with the financial and communication industries. These are big industries—they are so fast-growing—that consequently not much time and effort has been really placed upon automotive applications.

The other issue we face is that the automotive industry is a very different business model from the one that the electronics industry is used to. And so for convergence between those two industries to take place, there's going to have to be a melding of their two business models which works for both parties. And part of that melding is the movement towards an open electronic architecture. But even if and when we get there, then there's the question of how "open" is "open?"

Toyota has a vehicle in Japan called the "Progress," and this vehicle has feedback from the navigational system to the power train so the vehicle will actually slow down in anticipation of going around curves. Well, most people would say a navigation system is an open systems architecture issue. But they would question an application directed towards the power train—so really, where is this dividing line?

If we look at safety systems, about 70 percent of people who buy a new car have a cell phone. Why couldn't their cell phone be somehow linked into the

air bag system so that when the air bag goes off, their cell phone automatically calls for help?

Perhaps the biggest challenge is going to be in the driver interface. What the car can provide is a nice big display screen, good speakers, and multi-microphones, that you can't have in a portable device. So really, should that interface be controlled by the automakers, or what control will be provided to the makers of the all the portable equipment? These are very pressing questions, and they're bound to become very valid ones in the near future.

If you look at the vehicles out in the parking lot—the Toyota Prius vehicle, and the e con vehicle—both of them don't have the classical dashboards. Both of them have flat screen displays. So, Toyota is already anticipating that this change is going to take place. All of this technology is great, but I think as we've discovered in transportation, unless you can sell it to the consumer, it's not saleable, and it will never become a reality. However, as we look at the technologies that are available, a lot of them are very well aligned with the consumer's interest. As I said, as we get older, we're going to be desiring driver aids that can extend our ability to have the mobility that we seek. I've already mentioned the night vision systems and the collision warning systems—there are some automakers that are looking at putting health monitoring systems into cars, so that when the car detects that you have had a heart attack or some sort of medical problem, it will automatically slow down and disable itself—this is another possibility.

Another issue is really vehicle ownership costs. How can I as a consumer get value for the amount of money I put into transportation? Well, one approach might be these multi-car leases that are also tied into car rentals and car-sharing.

Ford is experimenting with a lease program where they will also allow you your choice of any rental vehicle from Hertz for 30 days each year. So, if you need a sport utility vehicle for two days or a minivan for the soccer kids for another two days, you can go into Hertz and get the vehicle a day at a time for a period of up to 30 days to meet your specific needs. This type of added value incentive also can be applied to car-sharing—perhaps in the future your automobile dealer will sell you a mobility program, not just a car. So as we tie this concept into the idea of short-term rentals and operating monitoring to lower your insurance costs and pay for your resale value, these technologies become very appealing to the consumer.

Finally, the consumer is really looking for congestion productivity devices. Unfortunately the traffic is going to get worse—no matter what we do, it will get worse—and so people are going to want to be able to do more in their

vehicles. Now it's talking in your cell phone. In the very near future, it will probably be printing out a data sheet in the trunk of your car, maybe beyond that it will be real-time shopping as you're looking for specials that may be on your route home from work. So as you become more and more productive in other applications in your car, you're also going to want devices that can help you drive the car so you can avoid getting into an accident. These are the kinds of technologies that really seem to appeal to Silicon Valley.

Now how do we package this altogether, into a solution that works for the Valley? Well, my guess is that the thing that will really work in the Valley is a combination of having point-to-point express buses with a personal last mile vehicle. And the reason I chose buses is because you really need to deliver a higher degree of service to the executive traveler. So if you have a bus that has wireless access to their laptop, has 20 channels of music plus news programs beamed into it, plus it allows them access to the Internet, plus has a little cappuccino machine in the back of the bus—I can envision a scenario where you get on the bus in Stockton, or Modesto, or Los Baños or Hollister, you go directly to your work site, they drop you off there, they're probably doing a maximum of maybe two other stops, so you stop off at a large company like 3Com or Silicon Graphics, or Sun, or HP. And, perhaps also at that drop off point there's a whole fleet of shared vehicles. So, for all those people who work for the smaller companies, they get off the express bus, they get into their shared vehicle by swiping that Smart-Card through, and they drive off. So now you have a transportation experience that really can be conpetitive with driving your personal car. And that's the key issue, is this going to be a better choice when it comes to time, comfort, convenience, flexibility, and productivity than driving my personal car? Because a Silicon Valley employee who maybe in the $50,000 to $100,000 per year price bracket values their time anywhere from probably $25 to $50 a hour. Are you really willing to take a mass transit solution that's going to cost you another two hours a day, does it really make sense economically?

The other solution I think would really work in Silicon Valley is the satellite office. I mean, we have a lot of salespeople here, we've got a lot of service people, we've got several thousand companies, and there's a lot of traffic going to and from those conpanies during the day. So, to what extent could a satellite office cut down the amount of trips back and forth to the office to get back-up support, to get information etc.

The third area I threw out was this concept of semi-automated driving. Today there are a number of auto makers, particularly in the trucking industry, that are developing electronic tow bar for trucks. And the way in which this would work, is that you would have three or four trucks that would electronically

couple up, and for going across vast areas like Siberia, or Alaska, or across Australia. These would be truck trains, electronically coupled. Now this technology is viable. Last year it was demonstrated down in San Diego. I know that Toyota is working on a driverless bus. Now just imagine a scenario where this express bus also has a line of personal cars being towed behind it. Now these are people who need their cars during the day—either they've got to bring home something from work, or they're taking out customers—but they're willing to pay a premium to be electronically towed in, so that they work on the way in, as well as avoid the rush hour. So, again, this is a third concept that can work for the Bay Area.

Now what's the extent of these applications? How much will they impact the industry? Well, for that, we really need to have much better research on what the commuter's patterns are. Specifically, at this point in time, we really don't know how many people telecommute, how many people have flex-time, how many people take night classes, how many people have to drop off the kids at day care, or how many working couples there are. We also don't know what their priorities are in terms of transit time, comfort, convenience, etc, etc.

To really make this work, it's going to require a level of market research that I've not seen available in the industry. In terms of putting this into motion, perhaps a number of major companies should get together and contract out for these express busses, and then go to both private as well as public agencies and determine who would provide the best solution.

In addition, I think there needs to be a partnering that takes place with the car-sharing organizations like Mobility, perhaps bring in a major car rental company that can actually run the operation.

Today at a number of HP sites, we actually have Hertz parking lots on our site. And I'm sure this is the case with other companies in the area, so it's not much of a reach to extend this concept to also accommodating short-term car rentals for commuter applications. In terms of the satellite office application, HP has over 1,200 cars in the Bay Area. If a number of the major employers got together in the Bay Area, and went to an automaker and said we want 10 or 20,000 of these satellite office cars, it might be sufficient volume to motivate someone to actually develop this for that application.

Now Silicon Valley could also start at looking at targeting the road warrior. We've been doing that with palmtop computers—Palm Pilots—with cellular phones, but why not take that one step further and really focus upon those applications in the vehicle, not only your own personal vehicle, but perhaps having also that technology in this car-sharing vehicle? You could perhaps have that same technology in rental cars, so that as you travel to another city,

QUESTION AND ANSWER SESSION: VEHICLE OPTIONS

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KENT HARRIS

Yes, we commissioned McKenzie and Company to help us look at some of the strategic opportunities in electric transportation in about 1990. One of the areas that they focused on would be the cost exposures that utilities would experience in the various growth levels of electric transportation.

The basic answer is if 80 or so percent of the vehicles choose to recharge overnight, at that time the current level of capacity—which has really gone up since—was able to accommodate a million electric vehicles in the state without adding generating capacity and minor amounts of transmission distribution capacity.

So, the short answer is yes, we can accommodate it.

DICK FITZMAURICE

Thank you.

We have a question now that we will direct to Conrad.Conrad, actually these are a handful of questions, but I will put them all together.

One is, whether you have any estimates on the amount of capital that would be required to set up the kind of car-sharing system that you've discussed today?

That's the first part; the second is to ask you in the same breath what you think would actually be the biggest challenge to implementing this kind of system in the United States—not just in the United States but specifically here in the Bay Area?

CONRAD WAGNER

In terms of capital you have to divert into such a system, the investments for the cars would probably have to be done by banks, and this is possible with the use of leasing systems.

In terms of start-up, the company could run for 18 months at $500,000 dollars for one location. If it began at three different locations, it would be $1,500,000 to start up with a standardized, somewhat comparable system in three locations—let's say in Seattle, in Portland, and in the San Francisco Bay Area; I think it's important to have comparable data, not just to start at one place.

One idea might be to have a rather public access to a public target group kind of thing in San Francisco as a metropolitan city, and toward surrounding areaas targeting developers and employers in Silicon Valley, Santa Clara and Palo Alto. It would be very interesting actually, to have a comparison between the public target oriented start-up, and the developer-employer oriented start-up here in the Silicon Valley, somehow combined with the technical developments which Jim just discussed.

DICK FITZMAURICE

Thank you very much.

Kent, we have another set of questions for you, a short one: What is the average cost of a vehicle charge?

KENT HARRIS

On PG&E's E-9 residential electric rate, for a typical vehicle you would be hard-pressed to spend more than about $1.25 to recharge overnight, and that would provide you about 80 to 100 miles range.

The commercial rates for businesses and the like are already on a time-of-use basis, and those vehicles would run just a few pennies more—but again, it assumes overnight charging. You chose to charge at peak rate times, and that cost is about four to eight times that of overnight cost.

DICK FITZMAURICE

Thank you.

Another question: What are the common mechanical failures in EVs and fuel-cell vehicles?

KENT HARRIS

Over the past 10 years that PG&E's been testing electrics, we've really had only a handful of failures, so the data is not statistically valid if you will.

Something that I see more often would be improperly tightened connections to the battery—that's within the battery pack itself—that typically has happened on one of my electric buses—we've had that a couple of times.

Really, punctured tires and the like are the most common failure that I've run across. I've broken a couple windshields over the years. We've had very few failures, period.

DICK FITZMAURICE

Okay, thank you.

Back to you, Conrad, how do the car-sharing prices compare to car rental prices?

CONRAD WAGNER

They're cheaper for trips shorter than two days. These products are actually complimentary to each other. Car-sharing cars are used for between one hour and up to say, five, six, eight hours at the most. Over 90 percent of all drivers use the car-sharing cars for this approximate time period. We try to motivate people to take car rental cars so we also have this product in the reservation call center. If a person asks for three or four days, we just give them the car rental option in the current department. For periods of longer duration, like one week or two weeks, the car rental cars are a lot cheaper. And then up to four weeks you've got short lease.

VICTORIA NERENBERG

Just to fill in a detail there, Conrad: Doesn't it generally run like a $1.50 an hour and then $.30 a mile, or something like that?

CONRAD WAGNER

Right.

VICTORIA NERENBERG

You have a high percentage of use, but it's just for two hours or four hours or so. Whereas with a car rental, it's a minimum of 20 hours, so you pay the full $40 dollars a day or whatever. But with car-sharing, you have the option just to use a car for a very short period of time.

DICK FITZMAURICE

Back to electric cars—Kent, what safety precautions are in place to deal with battery acid pollution? And also what safety precautions are in place to protect an occupant from that acid?

KENT HARRIS

That's a good question and a timely question. Just this past week, I saw a recent study that took place over the past few months. It indicated that for lead

acid batteries in this country—and there are over 200 million of them on the road every day—they're under the hoods of our cars and in our boats, and in other locations as well—the percentage of recycled material is well over 97 percent—it's almost 98 percent. And that includes the casing, including everything associated with the battery; the loss that occurs is usually due to an unrecyclable battery case material that was chosen, or batteries that are lost because of improper return.

Now, concerning protection for the individual and those batteries being used today as a traction battery for electric vehicles, I don't know of any acceptance in buses that have free-flowing material in them. They are either starved electrolyte type, which has a glass mat and the material is embedded in the mat, or a pasted lead acid material with electrolytes pasted. So, that coupled with the fact that all these batteries come in a pack that provides insulation and isolation from the rest of the vehicle, provide all the protection that we can think of, to meet safety needs.

DICK FITZMAURICE

Okay, we have a final question—it's about electric power generation.

Kent, how about harnessing the power of ocean currents and tidal changes to generate electricity by anchoring large paddle wheels of the coast or in the delta waters?

KENT HARRIS

Tidal power is being used in a few areas of the country, although it's not of that type as far as I understand. But, not being an expert in alternative generation technologies, I'd have to get your card and refer you to one of our R&D people.

RUSS HANCOCK

All right, well, we have now actually gone beyond our appointed time. Again, my thanks and your thanks to all four of our panelists, thank you very much.

DICK FITZMAURICE

It is time for a 15-minute break. Be sure to visit the exhibits, and if you didn't get a registration packet, there are some at the seats up front, so if you didn't get one, move up a little bit closer. We'll be back at 10:00 to discuss technological developments concerning the infrastructure.

INFRASTRUCTURE—TODAY AND TOMORROW

DICK FITZMAURICE

Everybody, we need for you to take your seats. Please—we're going to start the next session here in just a moment, and we want to stay on time for you. Would the panelists for the next session please come up front and be seated please, panelists for the next session, come up and be seated.

Thank you, we're back.

The moderator for our first session this morning was the Bay Area Council. The moderator of the second session is an alumnus of the Bay Area Council.

Steve Heiminger was the Vice President for Transportation before Russ Hancock for a number of years there. He cut his teeth on transportation issues some years before that when he served on the staff of the California State Legislature and the U.S. Congress. Today he is the Legislative Director at the Metropolitan Transportation Commission in Oakland and if he would move his right hand over just a little bit, he would be a heck of a golfer.

Ladies and Gentlemen, welcome Steve Heiminger please.

STEVE HEIMINGER

Good morning, everybody.

You have already heard about the vehicles this morning. This panel is about the infrastructure—although I have a feeling that we'll talk a little bit about the first session's panelists' subject, just as they talked a little bit about ours

The Metropolitan Transportation Commission where I work has a keen interest in technology solutions to transportation problems—the title of our conference—we have several projects underway in fact, ranging from our TravInfo, traveler information system—and I never miss a chance to put in the plug, you can dial 817-1717 from any area code, and receive the fruits of that project over the telephone—and also be connected to any of our public transit systems in the Bay Area.

We are also going to be testing, probably within the next 12 months, a translink we call a Smart-Card, which would be a single universal transit ticket for the Bay Area. Its an idea that's about 20 years late, I suppose, but something that we ought to have, and have been working on, for some time and hope to debut as I mentioned within the year.

We are also the funding agency for the Bay Area and in that capacity with the next six-year batch of federal transportation funds—now known by the acronym of TEA-21—we have set aside approximately 25 percent of those monies, $120 million over the next six years, for projects to improve the operations and management of the existing transportation system. We expect that technology projects will feature prominently in that share. My boss, Larry Dahms—I'm taking his place today—also has served a term as Chairman of the National Intelligent Transportation Society of America group and also serves on its Board of Directors. So we have a strong interest in these issues and I am very pleased to be here this morning with this panel.

I think it still remains the case, however, that ITS technology is more promise than reality at this point and I know in the afternoon session you will hear about some of the challenges that the technology faces. I would like to throw out three of my own—just to take the privilege of the moderator for a second.

I think the first is that during the interstate era, the paradigm was to build our way out of congestion. The problem as you know persisted anyway, and I think we risk, however, repeating that same mistake with the technology if—to borrow a phrase from Star Trek —we try to believe that we can "beam ourselves up" from the problem of traffic congestion as well—I think that paradigm is likely to fail just as the prior one did.

I think what we need to do is take up the challenge of managing our transportation system with a multitude of tools. Technology is one, so is information, so is pricing, and so—still—is expansion. We need, in other words, not to confuse the fact that technology is the means and not the end.

A second infrastructure challenge, clearly, is adapting the institutions that own and operate our transportation system. We are not like Europe and Japan. We have, if anything, too many of those institutions.

Just in the Bay Area, we have Caltrans, we have two dozen transit agencies, we have a 100 cities, 9 counties—all of them own parts of our transportation system, and adapting those institutions to deal with technology is really, in the United States, one of the major challenges in implementing transportation technology solutions.

Just one quick example of how far we need to go: Caltrans has a traffic operation system that they are implementing in the Bay Area, a system of sensors and cameras and other things that feed some of the information into our TravInfo system. They at one point in the implementation, and probably in the future as well, encountered a hitch in the implementation with the contractor. Because the state, however, has this phobia about sole-source

contracting, Caltrans wasn't in the position to go back to the same contractor that they've been working with, but were facing the prospect of putting it back out to bid again—and this is not like buying guardrails—technology is a different kettle of fish. As a result, MTC had to take over the contract because we were able to get around that sole-source issue.

So again, that's just one tip of the iceberg, an example of the kind of new thinking that we need to have on the government's side of implementing these technologies.

A third one I would lay out, I think, is that we need a more productive engagement on these issues from the environmental community. First of all, as you've already heard, a lot of these technologies will have great application for public transit, vehicle location and other kinds of things, our universal transit ticket is another one. But I think too often there is the reaction that we hear from some environmental organizations, that anything that makes driving easier is to be demonized. And I think again, if they—as well as government, as well as business, as well as the technology purveyors—can all come to some sort of common agreement about managing the system as our objective, and use technology and other tools to do so—I think we will make more headway.

But enough of the moderator's musing, it's time now to get on with the panelists.

Our first panelist is a surprise guest...he is not Paul Mehring with Daimler-Benz—Paul must be in Detroit helping the guys at Chrysler clean out their desks—so we have today again, Karsten Fels in his place.

Karsten, like Paul, works right down the road here in Palo Alto, and received his electrical engineering degree from the University of Stuttgart in Germany. He is currently evaluating the ITS infrastructure and market for Daimler-Benz which I guess changes its name, he tells me, tomorrow.

So please welcome Karsten Fels.

KARSTEN FELS

Good morning, ladies and gentlemen. As Steve said, we are in the process of merging, as you are all aware, and tomorrow is day one of DaimlerChrysler; the stocks will be listed under PCX, in Frankfurt and in New York.

I want to give you a presentation about how information systems can help in finding solutions to transportation problems—obviously, from a car manufacturer's perspective.

First, I want to talk a little bit about the characteristics of transportation today and tomorrow within a time-frame of three to five years. I want to discuss how information systems are one enabler of tomorrow's solutions—and we will find out that there are several things that have to come together—that have to be developed together in order to find the right solution.

I want to talk a little about the current industry activities—what's going on right now. Some of those issues have been mentioned already, and I think that it's good that there's a correlation between the different presentations here.

I want to talk about the Silicon Valley and what has been going on here. Steve mentioned TravInfo as one project that has been successful.

I want to point out three different examples: One example will be a product that has been introduced to the market; one will be a field trial; and one will be an idea that we have in mind.

Then I also want to take a look at the business model side. We are all talking about technology solutions right now, but we also have to consider what it takes to realize those ideas—what it takes to introduce market products and how products will serve us in the market—it's not simply technological solutions.

And then a brief outlook will be the conclusion.

Transportation today—what are the characteristics of current transportation?

We see a car-oriented individual personal transportation—I mean, how many people here own a car? Some don't even have enough arms to indicate how many cars they own, right? It's characterized by unsupported trip-planning.

By unsupported trip planning, I mean that before the driver takes a trip from a source to a destination, the driver cannot receive detailed information about the route. It would be nice to know if there's going to be an icy road; if there's going to be a bridge that's icy in the wintertime. Those issues, events, what's going to occur throughout the trip, exact incident information about the route, perhaps an alternative route at the beginning—these could provide the basis for a go-no-go decision. And the information we now have available to the driver is basically information via the broadcast media—TV and radio. There is basically an information dump to the driver, and the driver has to figure it out by himself, and he has to make the decision based on his own experience, and his guesses. There is no decision making tool at the moment.

Then, everybody has sat in traffic congestion, I assume—everybody has experienced that unpleasant and inefficient feeling of sitting around in traffic—which is obviously bad for the environment, but is also very bad for the

individual. And Jim pointed out some solutions that could address those issues, like mobile offices.

What we see right now is are first steps for eventual solutions. We see that static navigation systems are in several cars, but it's not at the magnitude that the suppliers, and we as car manufacturers would like to see them.

And we see web-based traffic information—like, for instance, with TravInfo, you can look at what the area around you will be like.

We see cellular phones in vehicles, but obviously these are not a real targeted solution to our transportation problem.

Tomorrow's transportation as we see it will still be a car-oriented individual personal transportation—I don't think that will change too fast. What we will see, however, is a change in the information flow. The driver will be able to receive targeted, customized personal information—already pre-processed—and we'll have a real decision-making tool that may provide some suggestions.

We will also see new information data sources. A lot of people are talking about floating car data right now, to replace or to enhance the car and sensor infrastructure.

We will see the Internet in cars, which offers a lot of opportunities for future solutions.

We will see remote diagnostics.

We will see emission monitoring—and that is more of a political issue than a technical issue.

As I mentioned before, there will be driver support for trip planning, and vehicles will be connected to each other and to the infrastructure. This will enable that information and those services I have spoken about.

And we will see new forms of mobility, like Conrad pointed out: car-sharing, fleet use, intermodal transportation links, etc.

And for those who will still be sitting in traffic, there will be unique entertainment and information available.

Okay, so how can information systems help us? We see four areas that have to be developed in order to really solve the transportation problems.

First, services have to be cheap enough so that they're attractive to the customers and they have to have good quality. Good quality relies on content—what kind of traffic information, what kind of traffic data, what kind of event data do you have? Does it relies on the infrastructure, the sensors, or

probed vehicles for the floating car data? The communication infrastructure obviously must rely on the technology in the car.

This is a combination of information technology, communication technology, and location technology.

And it's already started to merge together; it's illustrated here. We're sitting here today, and the way it could look was demonstrated last year for the Internet Multimedia on Wheels Concept car, actually built here at our research facility in Palo Alto. Several of the Internet cars have been demonstrated by manufacturers, so I think that's the way to go. Certainly, that's why I was put in here, but for now it's only a demonstration, it's a concept, so we really have to think about how we can get into market.

What are the car industry activities? Jim pointed out the AMIC. I would like to go a little step back, the Convergence 98 really made a clear statement: Vehicle infratronics enabling the integrated mobility experience—yes, that's what we would like to see. There have been two announcements: The AMIC is focusing on standardization of the interface for automotive information entertainment and communication systems; and the TSC, the Telematic Supplier Consortium, is another group that has been founded in order to address that link between the fixed service providers and the interface defined by the AMIC.

The ITS database is one example that could become the standard defined by the AMIC. What's going on in the Silicon Valley? Well, there has been ITS infrastructure deployed; there are sensors out there; there is the TravInfo project that Steve mentioned—and again it's 817-1717 if you want to get information about road conditions and transit.

A very successful data communication network has been deployed by METROCOM which offers high-speed connectivity—which is very important if you want to make a connection to a vehicle and if you want to link that vehicle to be the Internet.

And I think one thing that's really important about the Valley also is that it's characterized by innovators, which means if there's going to be new technology, new systems out there, it's going to be likely that the people in the Silicon Valley will take that chance and really try and play it. So I think the customer base here is substantial and is suitable for a large demonstration project.

I want to give you some examples of singular solutions: One solution is dynamic autopilot. A lot of people talk about these, and Mercedes-Benz has introduced two systems: one in Japan last year; and this year, a dynamic autopilot system in Germany. The way it works is you have the car, and your

route request is sent to the service provider by an operating center, and then the traffic information that's relevant to a specific route is transmitted back to the car, and the individual navigational system calculates a route based on the traffic.

The sensors in this system were deployed as part of a private effort—there was a private company that installed sensors on all the bridges of the Autobahn—the German highway system—and now basically the whole Autobahn network is covered by sensors. As I said it has been introduced this year, so it's actually reality.

Another example that I wanted to show you is a PDA-based traveler information system that utilizes information from TravInfo. This is a project in conjunction with Fastlink, a local company in San Francisco. It basically has three functionalities: it has a transit assistant that gives you schedules of the public transportation system; it gives you real-time information about the routes that you want to take; and it gives you individual routes—you can find points of interest and the nearest hotel and so on. One other thing, it also gives you airport information—which is not just an automotive application—it's obviously very helpful for business travelers who would like to know whether there is going to be a delay or not. This is all through a hand-held PC device, and it shows the capability of independently accessing that information—it's not just linked to the car.

Another interesting idea is what we call the "Telematic for Flexible Vehicle Use." What we see here are these areas of information services, where the customer and the vehicles are connected to each other:

The customer has a connection to the information servers via various different devices—it could be his home computer, it could be Web TV, it could be the telephone—it could be whatever.

Internet access is available for traffic information, for news, for weather, and other services on the Internet. You could also use this architecture for a car-sharing organization or for fleet use. That means the customer will reserve a vehicle out of that fleet—it could be a small city vehicle, it could be a sedan, it could be a roadster, it could be an SUV if you want to go up skiing to Lake Tahoe—whatever meets your purposes, you can reserve the car and then receive traffic information from within that car.

You have access to information services and your billing is done automatically, so you are charged only for the vehicle use. That's the type of system that Conrad discussed and it's very successful as he demonstrated.

We talked about technical solutions a lot, but technical solutions alone don't solve the problems; you also have to introduce it to the market.

I want to give you a quick perspective from the car manufacturer's point of view. If you take a look at Telematic services, you need to have four different areas covered:

You have to have the Telematic service itself, obviously

You need the communication service for the communication link between the vehicle and the service operator.

You need the information communication devices.

And you need the vehicle integration system—which is our job.

But what I want to point out here is we have four different players, and the world looks totally different for each individual.

Let's say you just take the supplier for instance—suppliers can be OEM manufacturers; they are cellular phone manufacturers; they are PDA manufacturers for products such as the PalmPilot for instance; and so on. And this concept of individual focus is not only aimed towards car applications, as we all know, so the business models for each individual player is totally different. And we have to establish a model that suits all of the players in there. Furthermore, this is only illustrates the complexity of the private side.

There are also public side complexities such as the multiple providers of the sensor infrastructure and how they handle data ownership for instance. Those are business models that have to be really developed carefully, and as we have experienced in different areas of the world, it always has to be an individually targeted business model. There is no off-the-shelf solution, and we also believe that there is no killer application—there is no killer service—you have to have the whole suite of services. It's important not to leave one out, but I don't think that one service by itself is going to be successful.

I want to conclude with the quick outlook. We believe that intelligent vehicles and information systems are key areas for driving into the 21st century, and the first steps in that direction, I think are completed—but we still have a long way to go.

Point solutions as shown have been successfully demonstrated in pilot projects; for instance, the TravInfo project, and in products already introduced in Japan and Germany, so we're not talking about ideas alone. What is missing is a concerted effort toward an integrated intermodal system, like Conrad discussed regarding Switzerland. I think that Silicon Valley is an excellent candidate for a large-scale deployment of such a demonstration because of the

previously mentioned reasons: You have the right clientele here, you have the right people who are willing to use those systems, you have the need, you have the transportation problems here—I think everybody who lives in this area knows that—and you have the infrastructure that has to be improved...but there's a good part of that already done. And so I want to encourage this type of demonstration here in Silicon Valley.

Thanks a lot.

STEVE HEIMINGER

Thank you, Karsten.

Our next presenter is Mark Amstock from Toyota—and I checked with him—as far as he knows, as of this morning, no one has taken them over, and they're not taking anyone else over.

He is the National Alternative Fuel Planning Manager for Toyota Motor Sales. Mark earned his Bachelor's of Arts degree in Economics from Notre Dame, and he serves on the Board of Directors for the Electric Vehicle Association and the Electric Transportation Coalition. Now we'll hear from Mark about vehicle infrastructure, so please join me in welcoming Mark Amstock.

MARK AMSTOCK

Well, thank you. Good morning, and it's good to be here this morning to speak to you.

Discussions about the future, with all its promise and opportunities are almost always exciting and thought-provoking. Today we're hearing from experts in technology and transportation, sharing their views on what can be, and what is already happening. Electric vehicles with charging stations in key locations, car-sharing, automated rentals—pilot test phase programs right here in The Bay Area—intelligent transportation encompassing everything from GPS navigation and automated toll debits, to autopilot and the mobile work station website. It's clear to see that significant opportunities will exist in the mobile transportation sector.

The organizers asked me to speak about the family or types of vehicles that we may see in the near future, concentrating on the small personal transportation class. Well the future is still somewhat unclear, with ever-changing technological advancements and government regulations, so this speaking assignment is rather tough. But at Toyota we're pursuing a range of propulsion and in-vehicle technologies so that we can make the best business decisions for our company's future.

As a project manager for the advanced transportation vehicles at Toyota USA, my job is to bring the products bearing new propulsion systems to market—electric vehicles; hard run electric vehicles; compressed natural gas; and ultimately the fuel-cell electric vehicles—and in some cases, attempt to establish a market for these products to compete.

Today I will share with you one automaker's view of these future technologies from our marketing perspective. I will discuss Toyota's view of propulsion technologies, intelligent vehicle technologies, and a little bit about the small personal vehicle class, to get an understanding of how these technologies will reach the marketplace.

Let's first take a look at the dynamics of the auto industry. The world auto industry is undergoing massive change at an accelerating pace driven by several factors: too many companies with too much production capacity and too many products chasing too few buyers, escalating customer expectations, soaring costs driven by intense competition, government regulation, product proliferation, and the shift to new green technologies.

The prime rule in today's auto industry is that there's no place to hide—product niches and new technologies are quickly invaded, either directly or through acquisition. Like a TV sitcom, every new product concept is soon copied. Eleven months after we launched our car-based venture, the entry-level sport utility vehicle RAV4, the Honda CRV followed it to market; now Ford and BMW are preparing to launch similar products.

On the corporate level, small specialty companies like Jaguar, Rolls, and Rover are acquired by larger companies with deeper pockets and enough production to provide economies of scale.

Orders are also being breached by global communication. We live in a CNN world, where nationalism is slowly being eroded by globalism. With the Internet exploding and capital being able to be catapulted five time zones away with the flick of a computer key, barriers will continue to topple. And as they do, our economies, our problems, and our opportunities will become one another's.

In the auto industry, product proliferation pushes back against scale and globalism. The major automakers want to have something for every potential customer in every potential market. This drives up development, distribution, and marketing costs, but also drives creativity. The "one size fits all" global car may never arrive—safety and emissions regulations differ in various major markets; fuel is cheap here and expensive there; Brits like Hatchbacks and Americans prefer a trunk; the French like a cushy ride and the Germans want

to feel the road. There are problems real or perceived—like global climate change—which are beginning to exert pressure for change on a worldwide basis.

Companies with deep pockets and global vehicle platforms are providing visible economies of scale, while allowing flexibility to address local tastes. And local or global regulation will win by gaining customers and shedding costs as a combination of local design and international scale continues to increase.

Other trends are also becoming apparent, for example, vertical integration is dying. Responsibility for the design and engineering of major vehicle components is being pushed downstream to suppliers. Today's leading automakers are organized more like a wheel, with primary engineering and assembly at the hub, and supplier partners around the rim. Connecting the hub and rim are spokes of technical dialogue and shared responsibility that reduce time and costs by enabling parallel rather than serial development of vehicle systems. This translates into opportunities for companies not currently supplying the auto industry, like many of you here today. The same need for the cost savings provided by share development production scale is beginning to drive the growing green-car revolution. That's one of the reasons why you're seeing alliances like the Ford-Ballard-Benz partnership and the Daimler-Chrysler merger—and you'll see more.

I think there's a fair amount of consensus within automakers that the industry is on the cusp of a major power-train revolution. It won't be sudden—we will explore multiple options and probably go down some blind alleys over the next 10 or 15 years, as new power-trains are researched and developed. Current gasoline-fed internal combustion engines will dominate for a long time yet, but the stranglehold of the internal combustion engine is weakening as options creep over the horizon. Even without the regulatory push, this is inevitable. There's already a huge global automotive fleet—worldwide demand will grow because developing nations want the personal ability developed nations already have. Even though emission control technology has made huge advances over pre-controlled vehicles, the size of the global fleet and the vehicle miles traveled results in huge pressure for additional per-vehicle reductions.

There's also a new concern about global warming, and although the underlying science is unproven, it is nonetheless prudent for the auto industry to reduce CO_2 output.

What kind of technology solutions will we see emerge over the next decade? What are the current known strengths and weaknesses of each,

and how can the auto industry, the regulators, and the energy and technology providers, cooperate to make the transition as successful and cost effective as possible?

The transition to cleaner technologies will proceed along multiple paths. Based on what we currently know or foresee, the broad categories include cleaner, more efficient internal combustion engines—some using alternative fuels—and a variety of advanced vehicles, including battery-only electrics, hybrid electrics with gasoline or diesel internal combustion engines, and fuel-cell vehicles—both with and without batteries.

If we take the analogy of a prizefighter, the current reining champion is the internal combustion engine. It has a very clean power plant, and it is getting cleaner—from low-emission vehicle, LEV, to ULEV, down to Super-ULEV in the near future—that's all California emissions jargon, by the way.

The current champ also has its advantages over the newcomers: a dedicated infrastructure, a gas station on every corner, developed and dependable technology, the ability to run on several different and relative inexpensive fuels—each with its own strengths and weaknesses—a very good performance range, and cost characteristics. Of course, we'll need clean low sulfur fuels nationwide to take the internal combustion engine where it's capable of going, but this heavyweight will be very difficult to complete dethrone.

But the first challenger to step into the ring is the battery electric vehicle. Its primary strength is that it is currently the only zero-emission option available. However, even its strongest proponents recognize that it has many weaknesses. The reason of course, is the battery.

The Economist magazine recently described GM's EV1 with its 1,200 pound lead acid battery pack as the equivalent of a gasoline-powered car with a two gallon gas tank that takes eight hours to refill. Gasoline is a tough competitor—expressed in watt-hours per kilogram, it contains more than 380 times the energy of a lead acid battery. Nickel metal hybrid batteries store about two-and a-half times the energy of lead acid batteries, but they cost more than four times as much, and the new lithium ion batteries gain another 18 percent storage capacity, but they're even more expensive, and they have exhibited a disturbing tendency to catch fire.

Today's electric vehicle is the darling of regulators, but unless you trade range for speed, it's slow, and even massively subsidized, it's wildly expensive, its charging infrastructure is limited, and even the best have a real-world range of about 100 miles-per-charge. These limitations severely hamper a volume market appeal.

Let me spend a couple of moments talking about what we see in these small personal vehicles—a new class of vehicles for North America, a new way of thinking about personal transportation for North Americans.

First of all, when I mean small, I mean two of them back-to-back in a parking stall, 1,800 pounds, seating for two, 63 miles-per-hour top speed, with a range of 63 miles, meeting all the federal vehicle safety specifications, and a three hour recharge time. One can describe these using numerous product concepts—commuter vehicle, station car, community vehicle—and at Toyota, we're still searching for those market niches, where an EV doesn't compete against the expectations of an internal combustion engine-equipped car or truck. Considering that battery technology drives the cost of electric vehicles, the RAV EV is a big car with big batteries, hence big costs. E-COM is on the other end—a small car, using smaller batteries, meaning less cost. Admittedly it may be a stretch today to think such a market exists in North America for small cars—with the price of gas less than a gallon of water fueling our love affair for those big cars and sport utilities—but we think that the small EV concept is worthy of further study and development. We believe that for a station car or shared vehicle, it may be a very good application.

Did you know that those three-wheeled gasoline engine parking enforcement vehicles that you see running around San Francisco or New York City cost in excess of $18,000 dollars? We think E-COM can be very well suited for many fixed range or fixed route applications such as meter reading, parking enforcement, campus security, station car, commuter, community vehicle . . . who knows? Maybe it can be the next cool car for youth—can't go too far, can't go too fast, can't get too many of them in it, and it has all the safety features; please take a look outside this afternoon and judge for yourselves.

Let me emphasize though, that Toyota will continue to pour development money and engineering time into battery electrics—because they're very clean performance is attractive, because the research will help with other power plants that have an electric element in their make-up, and because the regulators want us to do so—but without currently unforeseen breakthroughs in the cost and performance of batteries, we believe that is unlikely that battery electric vehicles will achieve the high volume necessary to have a significant effect on air quality— not to mention the market acceptance of the general public. Their role is likely to be limited to short commute markets where severe air quality problems require them, and where convenient centralized charging is available.

Which brings us to the next technology contender—hybrid electric vehicles. Non-grid connected, gasoline-battery hybrid electrics appear to deliver low

emissions, startling fuel efficiency, extended range, acceptable performance, and infrastructure compatibility, all at a potential price that would make them more marketable than battery-electric vehicles. For these reasons, Toyota's betting that hybrids are the next likely high-volume step in the evolution towards fuel-cell electric vehicles—even though some question their marketability in cheap fuel markets like the U.S.

Toyota backed its hunch by launching the Prius hybrid in Japan last December—and one is on display outside. During the first 10 months on the market, the Prius has sold more than 15,000 units. Some believe that internal combustion engines can be made as clean and fuel efficient as hybrids at less cost—and Toyota will continue to explore that pathway as well—but we currently believe that these hybrids are the more promising mid-term, green technology, and we plan to launch a hybrid vehicle in this market—optimized for U.S. driving conditions—in mid-calendar year 2000.

And that brings me to fuel-cell electric vehicles. Although there was some CO_2 emissions associated even with direct hydrogen fuel-cells, fuel-cell electrics promise to be the cleanest of the pack. But right now, they're very much a laboratory technology, with a lot of problems to overcome—including packaging; power density; costs; infrastructure compatibility; all weather compatibility—all of these problems need to be overcome before we can enter the market, even at low-volume fleet vehicles. We don't foresee many of these types of vehicles moving from the laboratory to the marketplace before 2002 to 2004.

During at least the first couple of decades in the new century these technologies—internal combustion engines, battery electrics, hybrids, and fuel-cells—will co-exist. And it will not be the automakers, the utilities, or the regulators who determine the winners—the market will determine the winners and the losers.

Now that I've covered the propulsion technologies, what about these intelligent technologies? A February 1998, *Automotive Industry* article, cited that there are 17 percent more cars in American than there were 10 years ago, and the number of miles driven has increased 35 percent since 1987. Owing to the increased amount of time people are spending in their vehicles, demand is up for a more productive and entertaining environment in the car. The same article goes on to cite a survey by Consumer Electronics Manufacturers Association, noting that people are looking forward towards a future of mobile offices and mobile electronics—18 percent have a need to listen to their voicemail on the road, and 13 percent want to check their e-mail and send and receive faxes.

With this increasing number of usages for vehicles come challenges, such as chronic congestion. We cannot continue to add additional traffic lanes to our highways, causing greater vehicle emissions, driver stress, fatigue, and accidents. And as you've already heard, research and testing is now underway on intelligent transport systems—a new generation of transport systems that should effectively address these problems for us.

ITS has three goals: reducing congestion, improving safety, and protecting the environment.

As Toyota moves towards a development of a highly mobile society in the next century, the company is engaged in R&D and several ITS fields including navigation systems, automated highway systems, voice warning systems, and high-speed cruising—we are working on the same thing that every other car company is working on. Toyota will promote its ITS to help create a smooth functioning, highly mobile society, that will take traffic comfort and safety far beyond current levels while protecting the environment and contributing to the creation of new industries worldwide.

Let's imagine the city of the future. Traffic congestion is virtually never seen. All cars are equipped with navigation systems which provide drivers with both directions to their destinations, and information on congestion and accidents, which enables them to select alternate routes. Drivers are provided with a number of in-vehicle tools, including communications, entertainment, security and information—from up-to-the-minute traffic and weather reports, to entertainment events, to the availability of parking lots, to phone and e-mail directory information. Drivers use communications and navigation functions without taking their hands off the wheel or their eyes off the road, thanks to voice activated technology in their vehicles. Vehicles are equipped with Mayday systems, systems that automatically reports accidents, call for assistance, and remotely identifies the car and driver to authorities, who can then pinpoint the precise location of the emergency using GPS satellites. Citizens of the 21st century will make great use of communication and GPS satellites in everyday life.

And we can already see the first signs of that—for example, future freeways could and will have many video cameras and beacons to quickly detect problems such as accidents—and this information will flow quickly to drivers coming up on these scenes, preventing multi-car accidents.

In addition, on-board sensors would detect any decline in the driver's level of alertness and warn him before an accident occurs. What was just a dream—automatic driving—will be reality—magnetic sensors on the car will detect magnetic markers embedded in the roadway to keep the driver safely within

the lane, and the system will provide accurate information on other traffic so the car can automatically change lanes. These will also detect vehicles, debris, and other obstacles in the road ahead, and will automatically take evasive action to avert an accident, or to continue smoothly down the road.

In the city of the future, these advance vehicle control systems will make travel more comfortable, and smooth out the flow of traffic. They will also help save energy by reducing the number of miles traveled, which in turn reduces CO_2, and protects the environment.

But how will we get there?

Well, Toyota researchers are working on a wide range of medium- and long-range products The first is called the Vehicle Roadway Warning System. These utilize sensors on the car itself, or in the roadway infrastructure, to monitor the vehicle's surroundings and issue warnings when appropriate.

In other areas, the Adaptive Control System maintains a safe interval with the vehicle ahead by controlling the vehicle's accelerator and brakes.

The third area is the Automated Highway System, which steers the car automatically based on sensors to detect the vehicle's lane position in the curves in the road.

These systems, which are still in the development stage, separate vehicle automation into two classes: driver-assist; and automated driving functions.

The driver-assist systems aid the normal operation of the vehicle by providing a lane departure warning—an automated system that returns the vehicle to the intended lane of travel—and a cruise control system that maintains a constant following distance, regardless of the speed of prevailing traffic.

Automated functions include automatic obstacle avoidance and lane change, automatic vehicle stop in the event of a lane change not being possible, and close-proximity vehicle following prevention.

Automobile safety devices which include air bags and anti-lock braking systems, represent great strides forward, but the most important aspect of safety is detecting the obstacles far enough in advance to prevent collisions in the first place. The key concept behind automated highway systems is to give an automobile the function of human eyesight. At this point, we move from simply warning a driver, to the development of controls for preventing accidents.

In August 1997, at the National Automated Highway Systems Consortium in San Diego, Toyota demonstrated its advanced vehicle control systems in a public display. Toyota's vehicle automation required no infrastructure or

modifications to the roadway, other than a clean road with well-defined edges or painted lanes. The demonstration used Toyota's most advanced optical imaging systems and several laser range sensors. A front-vision camera scans the roadway ahead and uses pattern-recognition software to identify lane markings and brake light patterns of preceding vehicles. Side-mounted rear-vision cameras are pointed out at the vehicle's blind spots to detect cars approaching in adjacent lanes. One laser range-sensor in the front of the vehicle scans the roadway ahead for obstacles or slower moving traffic, and side-looking sensors measure the distance from the vehicle to the sides of the road or to other cars.

Toyota integrated these sensor systems with a high-speed computer, and electronically controlled steering, braking, and throttling actuators, to make the completely automated vehicle. Specific demonstration scenarios included lane departure warning, controlled adaptive cruise control and headway maintenance, automated control in stop-and-go traffic, automated lane keeping, automated obstacle avoidance, cooperative vehicle following, and emergency braking for obstacle avoidance.

The city of the future's road traffic management will help maintain a safe, efficient, highly mobile society. Roadside beacons can alert to drivers to temporary stoppages or speed limits. Parking management systems will not simply collect parking fees, but will supply information on the number of vacant parking places and their locations—as well as schedules for public transit in the area. Park and ride systems—where you take your car to a parking lot at your stationary bus stop, park there, and switch to public transit to your final destination—will not only reduce the number of vehicles in city centers—relieving congestion—but also shorten commuter travel time.

In the utopia of the year 2015, high-tech systems will precisely coordinate the schedules of trains, subways and other public transport with the needs of motorists. For example, before you set out on a trip, you can use the system to reserve a parking space near the train station and confirm your reservations on the express train. If you're early for the train, you can rent an electric vehicle and do some shopping in the local area without tiring yourself out walking.

Use of intelligent transport methods will make life easier for the elderly, the handicapped, and other transport-shy people, giving them access to the entire community.

Motorists and users of public transport have often felt that the two transportation systems—individual and mass—were developed with little regard for those who must use them both. Linking them together and considering them an integrated matter is called intermodality. Intermodality

takes the view that society is based on transport, and therefore uses high technology to introduce such ideas as reserving parking spaces via mobile communications, the use of communication systems to obtain information on public transport schedules or to make ticket reservations, and thus bring the entire traffic flow into a single network.

Other examples of intermodality include short-distance transit systems in city centers and rentals of electric vehicles and busses. Further development will lead to the reservation of downtown parking with a single phone call, allowing for a smooth transfer of automobile to public transit and an integration of the entire transportation system to more effectively meet the needs of society.

Of course, all of this technology is great, but how do you get it in the hands of the customer? Who is going to buy these new technologies, and perhaps more importantly, how many customers are out there?

The organizers also wanted me to speak about the family, or class, of vehicles which use propulsion and communication technologies and may be prevalent in the future. The fact is, we don't see too much change in the near future, from where we are today. Our research is showing that technology and environmentally-conscious customers want many of the same things from their future personal transportation that they have today—so you will see it in sedans, vans, pick-ups and sport utility vehicles.

Personal transportation will become more of a challenge with congestion and rising costs, but the majority of the public still aspire to the freedom, convenience, and luxury of personal vehicle ownership.

Consumers demand quality, dependability, and a level of performance and safety, and of course, value. But we're not there yet on all these new technologies.

The first introduction of these new technologies target the affluent, because the initial prices are relatively high—the navigation and other technology options are featured mainly in luxury-level cars and sport utility vehicles—and of course, the electric vehicles are much higher priced than the gasoline engine counterparts.

Introduction of the GM EV1 and the Honda EV Plus electric vehicles have allowed us to look at the demographic make-up of customer's leasing high price transportation technologies. We call this segment the "innovators" and the "early adopters"—the first real EV consumers. They're mainly male, professional, affluent, and techno-friendly.

By comparison, we've discovered that most mainstream consumers simply aren't willing to pay much more for products that are environmentally sensitive. But what surprised us most in our research was that just in the past two-and-one-half years, consumers' willingness to pay more for an environmentally sensitive vehicle has actually declined by seven percent in California, and six points across the U.S. This drop in consumers' willingness to pay a supposed eco-premium occurred in conjunction with the dramatically rising awareness from the ZEV publicity and GM's EV1 launch.

In other words, the more people learn about the product, the less likely they'd be willing to live with compromises in convenience, range, and affordability. This group is influential—they're small, but they're out there—and we see that they are key. But really, for the new technologies to take hold in the marketplace, we expect that this product must be practical, affordable and convenient.

At Toyota, all of our product engineering and market development is geared towards achieving that goal of convenient, practical and affordable products.

Thank you.

STEVE HEIMINGER

Thank you, Mark.

Our final presenter in this panel is Hamed Benouar from Caltrans. Caltrans, as I think you all know, is facing a takeover in January by a guy named Gray Davis, as are a number of other agencies of state government.

Hamed is the program manager for the Caltrans Traffic Operations Program, which manages eight transportation management centers statewide, that are central to the department's new operation strategy. Prior to that position, he served as Chief of the Advanced Highway Systems Office in the Caltrans New Technology and Research program.

So, a fine pedigree for our final speaker—please join me in welcoming Hamed Benouar.

HAMED BENOUAR

Good morning. What I'm going to do is give you a Department of Transportation perspective on our transportation system. From a DOT perspective, what we have here, is a vision of California transportation agencies and system operators working together to provide a balanced, integrated, multimodal, transportation network. What that means is we have a

number of cities, counties, transit operators—whether it's rail or busses—working together to provide you a multimodal transportation system. So that's the vision.

Also, we hear about transportation problems, but at Caltrans, we view the transportation system in California as an asset to Californians. Also the transportation system enhances California's competitiveness nationally and internationally. So, I manage the traffic operations program and the theme of the program is Managing for Mobility.

Again, the state highway system is not an island unto its own self; it is part of the bigger transportation system. No one entity can manage a transportation system, so we have to work together to manage that system.

We heard the vehicle manufacturers speak in the same language that the Department of Transportation uses—reduce congestion; enhance safety; provide services, and so on. So, when we talk about a transportation management system, you see here the view from a transportation management center (TMC)—whether it's a state or local agency, or transit operator—needs to communicate with the other TMCs around the region, and then use the communication network and a number of field infrastructures to be able to manage this system. As you see, the connection to public transit, emergency services, the media, and so on, is what we call a transportation system.

Congestion over the last 10 years has gone up since 1987; as you can see, we use that year as a base. In 10 years, you see the lane miles—the additional infrastructure that we built out there—is not very high, just a few percent, while the population has grown 20 percent or so—and the vehicle miles traveled have increased even more than population growth. We've been managing the system since the late 1980's, and we were able to help reduce congestion. If we hadn't managed the system and were just trying to build ourselves out of congestion, this is where the congestion would have gone. So we're doing the best we can to manage congestion, but yet we can do a lot better in reducing congestion.

Now, how do we do that? We believe that we are under-utilizing the system that we have out there—we can raise the bar by better managing the system. By planning our investment, we can actually get the full carrying capacity of the system. We believe that we have end-use capacity that we can still use; here, the latest research in the planning process looks at system operations, basically as the basis for making investment decisions. So transportation depends on economic development, quality of life, the environmental quality, and so on.

Each region then decides upon their goals and objectives—how to manage their transportation system. But the decisions that have to be made—in investing, or in creating new infrastructure, or managing the system—are based on how the system is operating. We don't want to be fixing spots, or piecemealing our approach by just basically moving checkpoints, or moving congestion a few miles up, and so we need to look at it from a systems perspective—and that's what the researchers are telling us.

So, we're looking at a puzzle. We have an existing system—what do we do with it?

We need to manage it better—we conduct operational improvements, for example, an auxiliary lane. When you go onto an on ramp into a freeway, you want to get into the system with ease, so you want to minimize the weaving and clogging in the system—that's what we call an auxiliary lane. You may need a wider ramp to get into the freeway—that's an operational improvement—and so on, so you use a new technology to try to get the system managed better—and of course, build new facilities in areas where it's needed to ease up the operations of the system. And, Steve was talking earlier about how just in the Bay Area alone, there are 100 cities, nine counties, and a number of transit operators, bus operators, and so on, so we need to work together in partnership to be able to solve that transportation puzzle, and to be able to provide better services in the area.

Earlier we were also talking about the needs of the customer. The customer is the same whether it is on a city road, the highway, its origin or its destination. So, what we're looking at is managing the system better. We need to collect the data; we need to know what's going on out there to be able to monitor system performance.

We heard a lot about travel information this morning. In the Bay Area, we have thousands of lane closures a week for construction, for maintenance, for people that need to do work on the freeway system. The maintenance supervisor or the construction resident engineer both want to get their job done on time and on budget. The traffic manager wants to minimize the impact on the public, so if the lane is closed and the traffic is backing up, we can actually ask the contractor or the maintenance supervisor to get out and reopen the lane. We look at the impact of those lane closures on traffic and we make decisions on-site if there is a problem. Also, we use some sophisticated methodology to try to determine the best times for those lane closures. Those times that have the minimum impact on traffic so we can get in and do the maintenance and the construction and so on.

Accident prevention is also important. We heard the car manufacturers talking about vision-enhancement, talking about collision avoidance, talking about a lot of things that we can put in the vehicle to prevent accidents. About 50 percent of congestion out there is due to unplanned incidents. So, if you just reduce those accidents, or those unplanned incidents, you can actually help traffic...primarily it's important to save lives, but it also can have a great impact on reducing congestion.

And then there is managing the incident. When they happen out there, we need to know about them right away—we need to be able to verify that they are there, and be able to take them out as soon as we can. So managing the incident is very important.

Strategic partnerships—obviously working with the different entities to be able to find solutions where we can balance the system. It's very important to provide solutions in partnership with others.

Deployment of ITS user services—ITS architecture—the car manufacturers I hope are looking at the architecture on the vehicle side, because if you have a vehicle side that doesn't talk to the roadway side, then we have problems. So if you look at the architecture and so on, and make sure that those are coordinated, we can get the highest benefit.

Geometrics improvement—when we talk about safety, we do curb collections to find out where there are problems that occur, and then we go in and fix those. We talk about auxiliary lanes, improved ramps, managed lanes—lanes that could be created by movable barriers when the congestion is only one way. You can create three lanes in the morning going northbound, and three lanes in the afternoon going southbound. And then, of course, all these things we are hearing about here from the vehicle manufacturers and all the work that they're doing with the TravInfo and Silicon Valley Smart Corridor.

We are always seeking new tools to help us fight congestion and also challenge paradigms. We don't want business as usual, we want to find new ways to solve those problems.

So let me just talk to you a little bit about the regional infrastructure, because that's really what they asked me to talk about today. This region contains about 150 detector stations—several loops go into one detector station—ramp meters, closed circuit television, most of you know what these things do.We also have changeable message signs and traffic management teams. When there is an incident or when there's a problem out there, we dispatch those teams to the location of the incident or problem to close the lanes and control traffic supported by portable message signs.

We also have HOV lanes here as part of managing the system. These promote ride-sharing and increase the throughput of the freeway. Also, taking it from a systems approach, we're attempting to close the gaps, provide drop-ramps from traffic generator areas, coordinate with transit properties with park and ride lots, and so on.

When the system is complete and it's coordinated with these things, it will provide you with a much higher people throughput. If you have three people in a vehicle, and you've got 1,500 vehicles per lane per hour, you've got 4,500 people going through an area—while in the regular lane, you may only have 1,500 people—so the people throughput is important.

Also, the freeway service patrol—you see a lot of the tow trucks out there—this is a partnership between the California Highway Patrol, Caltrans, MTC, local agencies, and so on which provides service to the public quickly and clears those stalled vehicles so that they have minimum impact on the traffic.

So, just to give you an idea of what we have out there, this is a map that shows us what we're doing in the area. The green is the existing program—meaning it's funded, it's in construction right now. The blue area is additional infrastructure that we are planning to see out in the Bay Area.

So, in the detection area, you can see that there is a lot of detection that is coming your way. There is some out there now, but there is a lot more that is already funded and hasn't been implemented yet. These programs are funded from a variety of sources: federal, state, and local funds.

And the vehicle manufacturers were talking earlier about these types of detectors that allow them to use the information that's collected on the infrastructure, in the future—if you count the number of the CCTVs we have out there, changeable message signs, ramp meters, detection station and so on—this is what's funded and needed in order to cover the entire system in the Bay Area.

This is what we estimate that we will need, but again, these are only estimates—these may not be needed if we have higher penetration of vehicle infrastructure that would be able to provide us with the same type of information. So we're not just going out and putting these things in the ground—we make sure that we're working with whatever is going to be available out there in vehicle infrastructure to minimize what we have in the roadway and on the roadside.

So, a lot of you have heard of electronic toll collection which is coming to all the Bay Area bridges—this could be used as infrastructure. The proposed project reads vehicles that have transponders, and if you can put readers

strategically around the Bay Area, you could track cars and know how traffic is moving. This would compliment the infrastructure—or you could use the sensors that you have in the ground, and can be provided to the traveling public to do the same thing—that same information can be provided to the vehicles through their dashboard, with the equipment that they have on board.

TravInfo—most of you know about the TravInfo project. Steve gave you the number, so please call it. The latest information that we have indicates a trend where there are more and more people calling in. Look at this number—33 percent of the motorists calling for freeway information take an alternate route if congested—so the importance of the project is clear.

I'm sure that you are also familiar with the Silicon Valley Smart Corridor. This is an example of where you have a number of communities getting together and deciding how they will get a system that is balanced.

The state highway system has about 48,000 lane miles—that's less than 10 percent of the road-miles in California. However, it carries more than 50 percent of the VMT—the vehicle miles traveled—you've got less than 10 percent of the total road-miles that's carrying more than 50 percent of the total state traffic.

We have an opportunity here to be able to have the minimum impact on the surrounding areas, to balance the system by giving information to the traveling public, so this could be a great example of how that works.

There are other technologies that are in use here, and that you are familiar with, including the Smart Pass concept—we've heard a lot about all of these great things that the vehicle manufacturers are working on, and they must be coordinated well with the infrastructure.

So in summary, what I wanted to basically relate to you is that the original infrastructure—or the roadside—and the roadway infrastructure must be coordinated with the vehicle infrastructure for maximum benefits. Again, the ITS architecture will help us get there, but it must be coordinated not only in the inter-operability and so on, but also in terms of knowing what will be deployed over time.

Regional partnership coordination for successful system management—traveler information—again, whether it's a transit operator or a bus operator, whether it's a city, or a county, or a taxi company or whatever—if you can get together and put the information together, you can provide better information to the public. The informed traveler is the ultimate system manager, because the traveler that knows where it's congested, can avoid congestion, therefore you can again balance the system. The information could be given not just in

vehicles, but it can be kiosked, stored in handheld devices, at the roadway transit stops, and elsewhere.

Thank you.

QUESTIONS AND ANSWER SESSION - INFRASTRUCTURE

STEVE HEIMINGER

Well, not to cast aspersions on the vehicle panel, but the infrastructure panel has concluded on time. So we have not stolen any of your question and answer time. If the cards can make their way forward, you can ask questions of the panelists. While they're doing that, I jotted down a few myself.

Karsten, let me ask you first, I suppose—you indicated the challenge of trying to develop a business plan, especially in the United States, for all the local circumstances, all of the applications...what's the business plan for the Bay Area—without giving away any trade secrets—what do you think it has to look like?

KARSTEN FELS

For what system?

STEVE HEIMINGER

You name one.

KARSTEN FELS

I can't disclose any details at this moment, but I think it is crucial that each individual region is very specifically characterized by various different approaches tailored to that individual different region. Each has probably defined its own business model because you have different players involved—you have different systems, and you have different architectures.

I think there is a tendency to come up with this national ITS architecture, which would entail a tremendous effort, but on the other hand, if you deploy different models and initiatives, different architectures, then you're at risk at this stage. You have to develop differently suited business models.

STEVE HEIMINGER

Thank you. Mark. In your presentation I think at one point you said that the power-train revolution is coming, but then I think you laid out a fairly persuasive case that the internal combustion engine is still king, by a pretty strong margin. What do you think it will take to change this—is it consumer

preference, is it regulation, is it corporate guilt? What do you think it will take to make a significant change in the kind of power that is used?

MARK AMSTOCK

One of the, and probably the most, significant motivators for change, is absent here in North America, where a quart of water is more expensive than a gallon of gas. So the price of petrol is a big motivator—so long as we're paying $1, $1.10 a gallon, what's the motivation to move toward cleaner burning, more efficient vehicles? What's the motivation to go to a battery electric where you give up some range and some convenience? We see that as the prime factor in the popularity of these technologies.

Certainly global warming is going to have an effect on the introduction of this technology. But also, what you're finally seeing, is some of these technologies maturing enough to where they can compete with the internal combustion engine. We haven't had that in the past, so over the next few years, these technologies will become more mature, more cost effective, more adaptable, and can start taking shots at perhaps changing the world upon which this type of petroleum use is based.

STEVE HEIMINGER

Well, maybe we can talk Toyota into supporting our regional gas tax—that will get prices up a little bit.

Finally, my last question—and I'm glad we have time, because we have quite a few from the audience.

Ed, it's been mentioned several times that the Bay Area, Silicon Valley specifically, is populated by people who like technology and innovation—the early adopters. And yet Caltrans—at least in this area, the District IV office—it seems to me has been somewhat behind it's colleagues down in Southern California with a lot of these technological approaches—even fairly simple ones like ramp metering, and the like. Is there a good explanation for that?

HAMED BENOUAR

Well, as you know, Steve, we can't do it by ourselves—we need to work with the locals and with the regions and so on, to be able to deploy some of these things, both on the funding side and on the acceptance side—accepting the ramp meters and being able to understand what they are. As you saw in the GIS maps, we have plans to put a lot of those technologies in the ground, and we look forward to your support and the support of the locals.

STEVE HEIMINGER

So, to some extent, the enemy is us on that one.

HAMED BENOUAR

Well, I mean, in a lot of ways we need to work together to be able to quickly deploy those things.

STEVE HEIMINGER

Okay, that's a fair response—let's get to your, the audience's, questions.

The first two here, I think, might be for you, Hamed.

The first: "How can citizens and communities be involved in choosing which streets or routes are shown as alternative routes when a freeway is congested?"

I think the clear implication is: "How do we make sure our street doesn't become a dumping ground for a freeway that gets congested all the time?"

HAMED BENOUAR

That's why we don't give specific routes to take. You have two ways to do it—you've got the static road guidance, for example in the technology, so you can initially search for the shortest way to go. Later, when you get information from the infrastructure, you can see what the quickest way to get there is, and be able to select that. We don't give specific routes—I mean, Caltrans is not going to be giving specific routes to take to get out—you get the information yourself, and you make up your choice based on the information.

STEVE HEIMINGER

And this one is for, I guess Karsten or Mark: "Will the braking systems—the collision-avoidance systems—will they be fine-tuned to the extent that they can detect not only vehicles, but bicycles, pedestrians and others?"

KARSTEN FELS

Well, I think certainly, we will try to come up with technology that detects all of the potential collisions, be it pedestrian, cars or railways. This is, I think the common goal for all of us.

MARK AMSTOCK

The collision-avoidance systems are able to detect small obstacles in the roadway—a tree, a bicycle, a pedestrian—so the way the sensors have been

programmed, they are able to identify those objects and then apply the appropriate logic to either slow down in that lane, if there's no where to go, or to take an avoidance route. The engineers are working to solve those issues now.

STEVE HEIMINGER:

This next one I think, is for any of the panelists—and it's a good question... it's been bugging me all morning as well: "How do we ensure that the deployment of all these new vehicle devices doesn't become so distracting to the driver, that they reduce safety—which is the ostensible purpose of including many of them in there in the first place?"

KARSTEN FELS

Well, I guess that's certainly one of the major concerns for us as well: the man-machine interface, the human factor issue—and this is not only true for the ITS technology—this is also true for all the other in-vehicle devices. Engineers sometime tend to think that an automotive dashboard should look like a jet airplane cockpit, but I think it's up to us to challenge that and to streamline the design so that there won't be an information overload that leads to distraction.

One of the possibilities is replacing the car and visual dashboard with screens that show only that information that's really relevant at that time to the driver.

STEVE HEIMINGER

Mark, anything?

MARK AMSTOCK

I also think that voice control systems will go away. I believe this is a way to help the driver to fuse some of the issues at-hand. Of course, some of these issues would be very obvious to the driver—for instance when we take some of this controls out of the driver's hands and the vehicle is automatically sensing as well.

STEVE HEIMINGER

A Caltrans question: "Do we have a time-frame for completing the HOV lane system circling the Bay Area, and are you working with transit agencies to put bus service on those lanes?"

HAMED BENOUAR

I don't have an exact answer for you, but we do have an HOV system that allows you could get from our District IV area here, to Oakland, so I can provide you with that information.

But yes, the goal is to work with the transit operators to make sure that as we design the system, it can be used by the transit operators, for example, access onto the highway and being able to easily get to the HOV lane. We're looking at ideas where we could have drop ramps directly from local streets and then have that street as a dedicated entrance to the HOV.

So, I think until we have an HOV system, a complete system that can basically have easy access and safe access. Until then, we will not have as much transit use, but if we do get the complete system, then I think that will help to promote transit use, so we're working towards that end.

STEVE HEIMINGER

Here's a suggested business plan for you, Mark. The question is: "Will, in the future, the average family own a more expensive hybrid electric vehicle, but rent or share a short-term electric vehicle, so that they can have the best of both worlds—in other words, use those for shorter trips and other kinds of ventures?"

MARK AMSTOCK

We do see that scenario in the future—a kind of a hybrid family, if you will. It's very difficult for the battery electric vehicle to be the primary vehicle in a household fleet, but it could certainly serve quite well and be cost effective as the secondary tertiary vehicle in a household fleet. We think the Prius or hybrid vehicles are rather transparent today with the gasoline vehicle that you have in your driveway. So we see that car as competing against the internal combustion engine, while the electric vehicle may fill a different niche or role—and that as a very specific fixed range or fixed route application.

STEVE HEIMINGER

Unknkown question due to recording error.

KARSTEN FELS

Certainly the car manufacturers would like to see that their customers receive that service. I doubt that the car industry themselves will operate those services; however there might be communication newtork providers that try to

enhance their portfolio by providing additional services and enhancement to their peer communication with those information services. The government might want to deal with this in that sense that they are obliged to educate the public about what's going on the public streets. But from a business perspective, there are some service providers in totally different areas that are active already. Trying to get into the mobile services area comes down to the business model. What I mean is, whoever will generate enough revenue to make a profit will step into that business, and then competition will be generated, and the best one will win—like in all other areas. We will see. I guess it's one of those challenging and fascinating questions: "How do you set up the whole value chain?" Obviously the customer interface is going to be the service provider.

STEVE HEIMINGER

Thank you, Hamed.

I have two questions here, a quick one and a longer one: When will automatic toll collection begin on the remaining Bay Area bridges?

HAMED BENOUAR

We are hoping to have the system deployed on all the bridges by this coming summer. I don't have the latest details on it, but we're hoping that will happen. Obviously, before we accept the system, it must be fully tested. We're taking a phased approach, making sure that the one we deploy in the Carquinez Strait is working before we move on and let the contractor put the system on the other bridge. So, I can give you our hope that we will have them by this coming summer. But it will all depend on the contractor being able to finish the work.

STEVE HEIMINGER

I've changed my mind. I'm going to ask this second question not of you, or of me, but of our other panelists: "What role does state and federal government have in Intelligent Transportation Systems? Should it set standards and goals, and is government even capable or needed in implementation?"

MARK AMSTOCK

Well, in some cases, since the highways are controlled by both local and state governments, they're an integral part of this. It has to be a partnership; it has to be a cooperative effort between all these interested parties. There have to be agreements and consensus on which of these technologies are going to be the standard

standard—which frequencies are going to be used to communicate. And so you've seen Karsten talk about some of the industry consortiums that are out there right now. These are critically important to the development of the technology. We must reach consensus on these technologies. We must reach a consensus on how they're going to be delivered so that we can reach economies of scales faster and have implementation faster and more effectively. That is important so that we're not confronted with competing technologies or competing systems from one county to another, or from one city to another.

KARSTEN FELS

Well, Hamed pointed out in his presentation that there has to be a joint effort. I think that's how you phrased it. I wouldn't go so far as to state that there has to be shared development, but obviously the public sector has all the sensors out there, and the private sector would like to have access to those sensors and receive that information.

I think our goals are slightly different. The overall goal is to avoid congestion, but your goal is primarily to have a good flow of traffic. Obviously the private side has to target the individual because they are our customers, and we need to provide the best for them.

Ultimately though, I think we would like to see a discussion about an infrastructure rollout plan, one in which we can basically put forward our wishes and desires for the next implementation. However, as I pointed out, there is the concept of the floating car, and you pointed out that ETC—electronic toll collection—could be one of those ideas that will realize that. I don't think that we should neglect the fact that there are sensors and video cameras out there.

STEVE HEIMINGER

Another question for you, Karsten. "Do you feel that if the cost of ITS or other in-vehicle information systems were underwritten or partially paid for by advertising dollars from hotels and so forth, that we could have more rapid adoption of these technologies?

KARSTEN FELS

Well, I think that the first step toward adoption is to provide the technological solution. then we also have to look at the business plan, and as I said before, I think we have to look at the business model and look at it probably on a regional scale.

Advertising, for instance, depends on who is willing to advertise in that area, and it is certainly an interesting way to subsidize funding for the system operators and to the whole value chain—as well as to compensate it, or maybe to fully fund it with advertising. If anybody knows about a current project that's been introduced to the market, I'd like to hear about it.

STEVE HEIMINGER

Well, with advertising, we would have something else to look at besides the road.

Hamed, on incident prevention, this question has a little edge to it: "What's the secret to getting missing bots, dots, lane reflectors, and divider reflectors replaced? Four years of complaints haven't taken care of the problem on Highway 17."

I think the message behind the question is, we talk about all of these technologies 30 years away, but what can we do better with the very simple things we have out on the roads right now to make them safer?

HAMED BENOUAR

It's important to remember the slide that I projected that said "cooperation With Others Using the Latest Technological Solutions and Proven Technology." This is a very important part of our business to be able to respond quickly to replace those missing markers. So I'm taking note, it is between mile post one and mile post what?

AUDIENCE MEMBER

Between Los Gatos and Scotts Valley.

HAMED BENOUAR

Okay—all right—thank you. I'll take that to our maintenance crew so they know exactly where it is, thank you.

STEVE HEIMINGER

Mark, this one is for you: "If customers won't pay more for eco-friendly technology, what could be done in the way of subsidies or other incentives to make those technologies more cost-competitive, and would your company support those?"

MARK AMSTOCK

Right now, we do support incentives, both from the public sector, as well as from our own internal coffers. These technologies are expensive, especially in very, very low volumes, and when you consider a traditional gasoline-powered car, we usually do our planning at about at a 60,000 unit-level-per-year to build a profitable product. These vehicles are being sold in volumes that are significantly lower—in terms of the RAV4, it's perhaps only a thousand a year or less.

So the car companies—all the car companies that are marketing the electric vehicles are not making any money on it—in fact they are losing quite a bit of money. But they all look at this as an investment in the future, an investment in trying to get the technology out there in the hands of the customers so we understand how it works, how it functions, and how it adapts to the customers lifestyles. This allows us to make better products for the future and it's hopeful that through continuing development—continual progress—we can learn how to make cars that have greater economies-of-scale and can ultimately be profitable.

Incentives are a way that we can work with the local agencies—or state agencies, or even federal agencies—to provide a spark to the consumer, and provide the consumer some additional benefit, offset some of those higher costs, and get the product in the hands of the consumer that much faster. So we support incentives on electric vehicles, hybrid—any alternative fuel—and we think it's a good way to help the technologies become established.

STEVE HEIMINGER

Here's a non-technology question for you, Hamed: "Santa Clara County has about nine expressways; why don't we enlarge the expressways into freeways as a solution to traffic congestion?"

HAMED BENOUAR

Again, that's something we need to work with the county and with the local agencies on, to make sure that is part of a systems approach. We need to make sure that we're not just looking at spots—we need to look at the system and see what's the best solution for the area. So while that's one proposal, it's something that needs to be discussed with the region to see whether it will contribute to solutions that will reduce the congestion.

STEVE HEIMINGER

Here's one I didn't know about: "Today in Hong Kong, they're implementing a GPS-based toll collection system which eliminates the government-owned infrastructure we see for electronic toll collection in the U.S. and Europe"—I hope the government still gets to keep the toll revenue—"Will the Bay Area follow a similar direction?

HAMED BENOUAR

Well, at this time as you know, the approach that we have is the ETC, but obviously we need to look at that and see if that is something that could be applicable in the future. At this time we're using the ETC method for the Bay Area.

STEVE HEIMINGER

Mark, we have a second generation question—we have a rebuttal to one of the answers you've already given: "Raising the price of gasoline, registration fees, and insurance has not decreased the number of miles driven in Europe and Asia; why should more expensive gasoline make any difference in the U.S.?"

MARK AMSTOCK

Well, those of us who lived through the gas crisis look back and remember seeing people, as a result of higher priced gas and the inability to access gas, becoming motivated. The gas crisis was one of the issues that fueled our company's rise to prominence here in this country. People didn't want to be driving the bigger cars, they wanted to be more efficient—they wanted to spend less time at the gas pump. So we think that certainly, it is a motivator. Because of that inconvenience and cost, people went out and by the hundreds of thousands and bought of all things, diesel cars.

So when price really starts impacting North Americans—and we have been very spoiled—we're not paying the two, three, four dollars a liter for petrol here like they are in the rest of the world, we're paying $1, $1.10, maybe $1.25 if you don't put in yourself. So we think that the price of gas really is a motivator.

We also think that there may be another gas crunch coming soon—between maybe 2007 and 2014—whether it would be through global oil production or increasing competitiveness of these other technologies—and at Toyota we want to be in a position to make that transition as seamless as possible by offering these other technologies.

STEVE HEIMINGER

Karsten, here's a second generation question for you: The term "business model" is used often, but is loosely defined. "What specifically," the questioner wants to know, "in a business model sense, needs to be coordinated between the manufacturers and suppliers for intelligent transportation products to become a reality and available to the public? What are the biggest barriers to making this happen?"

KARSTEN FELS

I think there's a key problem here. It's not just between the vehicle manufacturer and the supplier, but there are many different parties involved in the value chain—from data collection, to the service operator, the service provider, and the communication network providers. Somebody has to pay for the communication.

You need the devices when the supplier kicks in. Then the vehicle manufacturer is a tricky part as well. Coming up with the business plan means that you have to meet all those different expectations, and certainly, advertising might be one issue that we'd have to look into; there is one project right now in Southern California that I think everyone is curious about.

It's more or less the quantity of hungry mouths to be fed, rather than the problems between the supplier and the vehicle manufacturer.

STEVE HEIMINGER

And finally, there are a couple of questions for me, so let me take one of them—and then we'll send you to scour the exhibits: "Vehicles generate two thirds of the Bay Area's air pollution"—well, that's not right, it's half and declining—"What specifically will MTC do to promote and finance the use of clean fuel vehicles?"

It's a good question, and we've spent a lot of time today talking about the role that vehicle manufacturers specifically have had in cleaning up the vehicles under government regulation. That accounts for the dramatic improvement in the region's air quality and the reduction in its emissions. These reductions have largely resulted from two areas: regulation on stationary sources of pollution such as industrial smokestack sources; and then the fact that the automobiles that people drive now are just dramatically cleaner than they used to be—but we get asked the question, well, "What are you doing about it?"

Well, what we can do about it is in many respects very limited—we're funding half of our regional transportation plans' resources over the next 20 years to

public transit—despite the fact that in the Bay Area only about 5 percent of the people use public transit. So that's 10 times the market-share, and our plan is going to public transit. That, I think, is an indication of our commitment to air quality and to transit, but infrastructure is really a very difficult tool to use.

I'm using the term "infrastructure" here in the old-fashioned sense—building roads; building rail lines; and so forth—to improve air quality is difficult, because so much of our system is already out there right now—and it's already built. We're spending so many of our resources just to operate and maintain that system, really not make many changes or improvements to it.

One thing I think that we can all do together—one component that I think could use some improvement in the Bay Area—is our vehicle inspection and maintenance program. I don't think it's very good. I don't think we get much out of it in the way of emissions reductions, and I think we can get much more. In the last couple of years, we did see an enhanced program implemented around the state, but not in this region, because our air quality status is not as poor.

And then you have the talk-show radio folks from the Bay Area yelling and screaming bloody murder about it, as if it were being implemented in their backyard. Imagine what their reaction will be when it actually is, or is threatened to be.

I frankly think that going to the state legislature and trying to get a better inspection and maintenance program for the Bay Area, perhaps relying on some of the kinds of technologies that these gentlemen know about—such as setting remote sensors out by the roadside to catch the folks who hook their catalytic converters back up a week before they go in to have their smog checked, and then take it back off a week later—here we could actually make some significant gains in air quality improvement. That is an area where we might be involved legislatively next year, and I'm afraid we're going to get our bridges burned a little bit by the talk-radio and other folks who are used to a system that really doesn't amount to much in terms of vehicle inspection and maintenance.

Well, enough about that, and thank you panelists for a very enjoyable and informative presentation.

DICK FITZMAURICE

Thank you, Steve.

We are going to break for lunch, we've a little extra time so you will have time to visit all the exhibits and talk to the people there. Lunch is a boxed lunch.

KEYNOTE SPEAKER—DR. STEPHEN VAN BEEK

CARL GUARDINO

I'm Carl Guardino with the Manufacturing Group.

It is a pleasure to have you here today at our all-day conference on transportation technology, *Driving Into the Twenty-First Century.* We hope you enjoyed the lunch—if there are any of those truffles left and you need to dispose of them, just pass them to my seat, we will dispose of them properly.

We are pleased at the exciting afternoon that we have for you and truly delighted by our keynote speaker, Dr. Stephen Van Beek. I believe many of us know that he is a local boy made good—again and again and again—so we're welcoming him home this afternoon.

Dr. Van Beek is Deputy Administrator for Research and Special Programs in the Department of Transportation, an appointment that he received in February of this year. In the past, as I think many of us knew him, Dr. Van Beek was a professor at San José State University; he is currently on leave from that position. He's also worked with the Norman Y. Mineta Institute for Surface Transportation Policy Studies, where the Honorable Rod Diridon is Executive Director.

Stephen has published often on American politics and policy; he's a graduate of the University of California, Santa Barbara; he received his Master's Degree as well as Ph.D., at the University of Virginia. He's a former staff person to Congressman Tony Coelho, and he's here today to share the Secretary's vision on technology deployment and federal partnerships—and I believe partnerships is a key word that we're going to hear repeatedly today.

Please join me in welcoming Dr. Stephen Van Beek.

DR. STEPHEN VAN BEEK

Good afternoon. It's a pleasure to be back in the Silicon Valley—although, everybody usually comes to the Silicon Valley after they've been in Washington saying how nice it is to be home, and that the city of Washington is full of partisanship and problems, I actually very much enjoy the job I've been entrusted to do there—but it's still fun to come home.

Last Friday I was at Kinder-Morgan Pipeline Terminal here in San Jose with our Office of Pipeline Safety, which is also part of our responsibility: to regulate three million miles of interstate pipelines in the United States—both natural gas and petroleum. But it's a real pleasure for me today to be here at the

Silicon Valley Manufacturing Group's conference on transportation. It has always been a great pleasure to work with Carl Guardino and the Manufacturing Group. Mr. Slater wanted me to pass on his personal regards. He was just here about two weeks ago before the election, and had the opportunity I know, to talk with Carl and Representative Tauscher, who was also there. I spent last weekend with him in Cambridge, Massachusetts, and he came back very excited about what's going on in this area.

As a public administrator, I know that one of the hot topics in the United States right now is regional government—pulling together the different state, local cities, counties, public and private-sectors, and academia into one region to cohesively address the public's problems. It's great to see that the Manufacturing Group was just across the street from me not too long ago, when Carl came back to visit with Secretary Cuomo, of Housing and Urban Development. In housing and transportation, in education, in economic competitiveness, the Manufacturing Group is a leader in the Silicon Valley, as well as the nation. It's very well thought of back in Washington. The secretary regrettably could not be here personally today, he promised me that he will be coming soon. This week we have a major marine safety conference in Warrington, Virginia, with all the major players in the country discussing the future of marine transportation. Marine transportation, by the way, definitely has a research and technology component as we look at things like fuel-cells for the next generation of marine vehicles.

Let me tell you a little bit about what I'm going to talk about today. There are three basic points that I thought I could communicate, and then I'll be happy to take any questions:

First off, I wanted to talk about the areas that the federal transportation community—and I'll explain that word "community" in a moment—those enabling research areas that are going to be the focus for federal transportation technology deployment. I'll start with that, then a little bit about the changing nature of public/private partnerships in the federal government right now, and what I believe is a healthy acceptance by all sides of the political spectrum and the cooperative agreements that can be reached between federal governments, departments, laboratories, state and local governments, industry, academia—all the players that are out there.

I think this is a real healthy, although not brand-new, part of American government. It is certainly one that's now much more accepted by all the players who are contributing to those partnerships. And finally, I thought I'd spend just one or two minutes talking about the Advanced Vehicle Program, a new initiative sponsored by my agency, the Research and Special Programs

Administration, as it transitions from DARPA in the Department of Defense and becomes an example of one of these public, private partnerships.

As I'll explain in a minute, we're also familiar with some of the other partnerships in the federal government, and if any of you have any questions about those, I would be happy to answer them.

I brought a couple of documents with me today. I have a few copies, and if we run out, perhaps we can start a list and Carl can get it back to me.

First off, is a summary of the major transportation legislation passed last year—a $218 billion piece of legislation. There is a lot of R&D in that bill, there's a lot of technology in that bill, and what we've been doing over the last three or four months, is holding listening sessions around the country to talk to people like yourselves who will really be implementing a lot of the provisions in research and development. This to make sure that we do it right. These information sheets provide really the best summary in one place of the bill's provisions overall and with reference to research and technology.

Secondly, I have the National Science and Technology Council's Transportation Science and Technology Strategy. This is really going to be the playbook for the rest of the Clinton administration and for the Gore administration to come, on science and technology—if you want to know where the federal government's going to go, here's the book that describes the pathway. It's the first real strategic plan that will not only guide the Department of Transportation's transportation work, but also will guide the work by the other agencies of the federal government that are involved in transportation. That's why on the front of this we have the Department of Defense, Energy, Commerce, EPA, and NASA. This new partnership we have with NASA, and in particular, NASA-Ames, is an exciting development for the federal government.

Let me start today with a little bit of a lexicon, a vocabulary for you. Carl introduced me as the Deputy Administrator of RISPA, Research and Special Programs in the Department of Transportation. There may be a few people from CALSTART here who know what RISPA is, but the rest of you probably do not. So let me describe in fact, what we do. We have, as I mentioned, the Office of Pipeline Safety. We write all the regulations for the movement of hazardous materials in the country, and with that, we actually write all the regulations for the cylinders in the United States—anywhere from the one that goes on your propane grill in your backyard, to a scuba tank, to the ones that move the type of very toxic, but necessary, gasses used in manufacturing in Silicon Valley. In fact, we're coming out with new regulations on those types of pie applications that no doubt will be of interest to many people.

We also have the very important Office of Emergency Transportation. This coordinates all transportation and preparation for natural and man-made disasters. Recently I was in Puerto Rico, Florida, Alabama, and Mississippi for the aftermath of Hurricane Georges, and right now we're offering the Secretary support with his work in the terrible tragedy in Nicaragua and Honduras. We also make sure that those charitable organizations that are able to offer goods can find a plane to put those in, and are accepted in those countries and for those people in need.

Finally, and I think most relevant for everybody today, the research part of our name. RISPA's most important function—well, maybe not the most, perhaps Rod would correct me—RISPA's most important function is to be what's called the Executive Agent of the National Science and Technology Council's Committee on Technology and Transportation. The NSTC is really the federal government's tool to coordinate all federal government activity and transportation. Much like the National Security Council does with the Departments of Defense, State and the other agencies involved in international affairs, the NSTC really is now starting to coordinate its strategy very effectively and that's why this blue book I brought today is such an important document. For the first time really, I think, the federal government is speaking with one voice in the way that it communicates about its priorities to the country. And the synergy that will be created by the partnering across federal agencies is, I think, something much to be desired and will reap us rewards. So the NSTC really is designed to further transportation's goals.

Now the Secretary of Transportation has identified five strategic goals, to which any R&D really should be attached. They are safety, of course; the environment, the protection or at least the mitigation of the effects on the environment; mobility, to make sure that goods through that commerce clause, Article I, Section 8 of the Constitution, move from state-to-state as seamlessly as possible; economic growth, so that transportation supports the continued growth in the country, and all trends show that the transportation sector will be a very vibrant contributor to economic growth in the 21st century; finally, and importantly, our role in national security, in supporting operations anywhere from NATO to providing protection for critical infrastructure in this country like cyber assets and transit terminals, and whatever else the case might be. The NSTC, working with the President's Technology and Science Advisor, really then legitimatizes and helps to prioritize the activities of the federal government.

Now over the past about two to three years, the NSTC and the Department of Transportation have engaged in a strategic planning process to identify the very critical areas where we want to have enabling-technology to improve the

transportation system, and to further each one of those five goals that I mentioned. Let me touch on six areas that we've identified in the report and elsewhere as critical to moving transportation forward:

First, human performance and behavior.

As we probably know, humans factor as part of transportation crashes—depending on the mode—about 85 percent of the time when a vehicle crashes and why fatalities occur. Our goal, therefore, is to reduce such incidents through technology such as fatigue detection, alertness enhancement measures, and any other ideas that might be out there. At our VOLPI system—VOLPI National Transportation System in Cambridge, Massachusetts, is actually a part of RISPA as well—we've had 500 researchers working on transportation and research issues.

Last weekend the Secretary of Transportation and I sat through some demonstrations where they're working on the communication between pilots and controllers, and asking whether the language—the shorthand that they now use to communicate—is effective, particularly as you get into the 21st century, because we know that 50 percent of the growth in the airline industry in the 21st century will be in airplanes piloted by people who speak Chinese. Now what impact will that have on aviation safety, on aviation capacity? That's a very important issue to understand. We need to make sure that we're doing things as effectively as we can.

They also demonstrated issues that occur concerning dispatchers, rail engineers, and the conspicuity of trucks at railroad crossings—that's a fancy way of saying, "Do the trucks have reflector tape or something on the sides that allows you to see it when you approach a grade crossing at a rural station?"

So, human performance and behavior is one key area of the department.

Second—and an issue near and dear to the Valley—is advanced materials. The transportation system continually needs new materials and design techniques that will make our roads, bridges, and infrastructure more durable and last longer. Bay bridges, for instance, are areas of great importance in this respect. So advanced materials and design are important in areas from better asphalt that can stand longer on the road, take more weight, and is more durable, to dealing with drivers, congestion, and the environmental impacts.

I was just down at Sandia Labs where this federal laboratory has designed a steering column that will be 30 percent lighter for Chrysler Corporation. That undoubtedly will help with advanced vehicles—keeping them lighter, and enhancing fuel mileage.

Thirdly, computer based technologies. These indispensable tools make travel safer, and shipping faster and more efficient. One of the areas that the federal government is looking at with alacrity now because of President Clinton's charge, is the area of security and confidence in these systems. These will have a great impact on the development of technology.

For instance, in the aviation area, where we ask if we move towards some form of fleet free-flight in the 21st century—where pilots have more control over their airplanes, can actually move themselves in air space, and get closer into other planes to increase aviation capacity—we need to know that the system will work. If there's somebody out there who wants to make it not work and who has the means—and with GPS right now we know its very vulnerable to interference with that type of system—a little hand-held instrument can cause great problems for GPS technologies.

The fourth area is energy and the environment. Here, obviously the issues of global climate change, of warming, of clean air, are subsumed for some people under the category of sustainability. Although in some areas, we don't need just to sustain, we need to improve. Sustainability is without question, a hot topic in the federal government. Although you might be interested to know that Congress has actually, in legislation, forbidden the Department of Transportation to use the word sustainability. This is because they think we're moving beyond roads, and we should actually be talking about the mitigation of the impact of roads on the environment. My answer to them is always, look—if we build roads that are more sustainable up front, then we'd worry less about NIPA on the back end, and environmental impact statements that later require mitigations and all kinds of money that companies and contractors and the public have to spend—so why not do it up front in a more reasonable, planned fashion? That argument has yet to fully catch on, except with the House Science Committee which doesn't have the money anyway.

So, the fifth area is sensing and measurement. Advanced microsensors and computers can continually monitor human and vehicle performance—they can help to prevent crashes. One of the areas I know the Federal Highway Administration is moving more toward is collision-avoidance in automobiles, and perhaps moving less in the direction of automated highways. So, collision-avoidance, I think in automobiles, is a big area of future research and one that undoubtedly will be supported. Many here may choose to participate in this effort.

Again, aviation capacity, I think is another area where you will see sensing and measurement play a big role.

Sixth and finally, we need improved tools for modeling, design and construction. New vehicle and infrastructure design models can optimize transportation system design and construction, undoubtedly. One of the great tools I saw last weekend at VOLPI, was a new simulation—it's probably familiar to some of you in the intelligent transportation are—a new simulation of the new Central Artery Project that's going on in Boston. This is a $10 billion project—and if you haven't seen Central Artery and go to Boston, please try to go see how much work is actually being done there. It's a quite spectacular project.

At VOLPI they actually have, in conjunction with the Massachusetts Institute of Technology, a large board that monitors not only the current traffic that's part of the Central Artery project, but what it will likely be like in 2003, 2004, when it is targeted to be fully operational. And one of the things they have used the simulator for is to actually locate where the on-ramps to the freeways will be, so as they put that on-ramp in, they can measure what the effect on traffic flow would be. Then they put in an incident and find out if that ramp is in the optimal place. It tells you where you need the sensors in the road to be able to tell you an incident has taken place, and where should you have the traffic signalization to close the lane off a half-mile before the incident, all in an effort to take full advantage of the efficiency of our physical infrastructure.

So these design tools really add a very crucial support module if you will, to the efficiency of these very impressive facilities that they're building.

Briefly, let me just touch on the area of partnerships that Carl identified—and there are a number of partnerships in the federal government right now—but let me kind of give you just a couple of general words about partnerships and why I think they are increasingly working in the federal government, and then I'll discuss one that RISPA and the Department of Transportation in particular is looking at.

The Council of Competitiveness for the White House earlier this year in February, came out with the report that documented what the United States needs to do to ensure that we have the research and the science capability that we have had and that has so supported economic growth. And without getting into them individually, I know a lot of the Manufacturing Group and some of the other groups in this area that have played both public policy roles and frankly, more blatant political roles, have actually looked at many of these issues to make sure that we have the engineers in this country who can actually support the high-technology sector.

But they highlighted one important area that we need to keep current—so as to keep science and transportation and research together—and that was the

expansion of university, industry, and government collaboration, to speed the commercialization of new ideas. I think the government has gotten that message. If you look at instruments such as CREDAs—and CREDAs, for those of you who don't participate in technology transfer very often, are Cooperative Research and Development Agreements in the federal government—these agreements between federal labs, state and local governments, universities and industry, are key to supporting innovative partnerships. One thing they allowed people to do, for instance, is oftentimes to take the license or patent for the innovation that was created by the partnership and license it directly.

To give you just one example, Stanford University in 1997 received $40 million for licensing—just one year at one university because of innovative patent and licensing techniques of the federal government. And that was out of a total of $43 million, so Stanford as one institution, a local institution, has certainly prospered from these new arrangements.

And frankly I think one of our areas that we need to strengthen is in the effort to get the message out there that now there are fewer legal barriers to government industry cooperation than there used to be, and that a lot of the problems that people think exist with those partnerships—for example proprietary information or, whether you can license a federal product—are being dealt with. What we need to do, frankly, is get specific examples of barriers that still exist and bring them before the NSTC, so that we can try to cope with those, and recommend legislation to Congress to fix them. I think most of you know that the federal government is a lot more responsive in this area than it has been. I've seen that cooperation recently in one particular place, because I'm tasked with a major slice of it, and that is the Year 2000 millennium bug issue.

Here we are dealing in particular, with the oil and gas industry. A lot of companies had great concerns about turning over data because of liability issues or proprietary issues of their companies to the federal government. Because we were sitting there trying to survey members of the oil and gas industry to find out what the problems are and how we could support them, and we were getting back information saying, "Well, we can't really provide that to you, because then that will make us liable," Congress at the end of last session passed some legislation to attempt to ameliorate that situation.

And I know there will be some additional legislation, hopefully this year—this coming year, FY 99—that will help to further ameliorate that situation. And I think this is one practical instance where cooperation across industry and the government—both executive and legislative—has worked to help solve the

problem. But barriers do remain, and the main thing is that we know about them so we can address them.

Just one word about one successful partnership—the Partnership for a New Generation Vehicle. This is a partnership between the three major automotive manufacturers in the United States—but of course even that frame of reference now is changing—and the federal government to create a vehicle that will get triple the gas mileage of the normal family sedan today—triple the gas mileage, without additional emissions to deal with, and with a focus on safety, performance, and maintenance issues. Each of these are supposed to be identical or better than the vehicles that are on the road today, and unlike most federal efforts in the past where we've built a sexy prototype that hasn't been adopted commercially, a lot of the technologies that are already part of this program have been adopted by the major auto manufacturers. And I envision by 2004 we'll actually have a car in production ready to be sold in the United States that will get the miles-per-gallon promised in the PNGV initiative.

One of the things we're doing right now in RISPA, is the advanced vehicle program—we're actually going beyond the auto that most of us drive to work or with our families, and looking at medium and heavy duty trucks. Those are, as you probably know, major contributors on the roads to air pollution. Here the goal is to increase fuel mileage by more than 50 percent by the year 2004, with no decline in performance, maintenance, and the other aspects of a car or truck that make it attractive commercially.

Now this effort, like PNGV, is managed through consortia, a couple of whom I know are represented here today. These consortia consist of business, public and private research organizations, state and local governments, and federal labs. Two of these that are eligible to receive funding are in California: the CALSTART group of Pasadena, and the Sacramento Electric Transportation Consortium of Sacramento. Two of the seven are in California.

Now the ABP program as I mentioned is transitioning from the Department of Defense where it helped to launch over 300 technology demonstration projects for military use on vehicles, some of which, again, have already been adopted for a civilian manufacturer. These include electric and hybrid-electric technologies, which are going to be two of the emphases, among many, of the new ABP program. This initiative will focus on the vehicles, the drive systems, and most importantly, the enabling technologies—the things that must go into those vehicles, the batteries, the charging stations, the other things that allow these vehicles to operate. There will be an emphasis on technology, such as batteries, flywheels, and fuel cells, under the ABP program, and I think the submission for the program is due what, in December, right, John?

JOHN

Papers are due November 30th.

DR. STEPHEN VAN BEEK

And then you sent them to us in December, right?

JOHN

Right, mid-December.

DR. STEPHEN VAN BEEK

Good. Now the program is perfect for a partnership because it has the following components that I think are important for any federal industry partnership:

First, the federal government has to help by providing money for research targeted at national priorities. Priorities that often present too much of a risk for one individual company, and that are often best when the federal government is involved when you either have a service that can be run profitably—perhaps like rural transportation, or accessibility for the disabled—or for a new and emerging technology; anything that venture capital finds too risky to put money into such as an individual business without some federal participation.

Secondly, the program is competitive. It requires cost-sharing, and the closer you get to deployment, the higher the cost-share part of the company must be in the program. So the more basic the research, the more risky the research, the greater the federal share.

Thirdly, the federal government will be an eventual customer of the vehicles, as will state and local governments. I think this is a critical part—to help jump-start the program from a technological development phase, to actually putting these vehicles in place on the roads and achieving the purposes of the program. That's why we're looking at partnerships with the Department of Interior and the National Park Service, to evaluate the vehicles that carry people in parks like Yosemite, to ensure that they have minimal environmental impact.

And fourth, the benefits of the initiative will eventually be spread in the private-sector, where manufacturers will then have a financial incentive to build the vehicles and to actually profit from the vehicles that they have built. That last part, I think, is a part of the changing culture of Washington.

You know, for a long time, partnerships between government and industry got attacked from both sides of the ideological spectrum.

The left in the country frequently saw partnerships as a government giveaway to the private-sector, not realizing that if you don't have private-sector participation, you're not going to have a vehicle that people are actually going to purchase: You might build a nice, sexy prototype vehicle that will go in a museum somewhere, and we'll all walk by it in 10 years and say wasn't that a great idea. So, you have to have the element of private-sector participation.

Secondly, I think the right in the country has also come around. Before the federal government provided any assistance to industry, it was seen as industrial policy, as though the United States were the only government in the world, and the only one providing support to its manufacturers. I think one only needs to look at the aviation area and some of the assistance that competitors to Boeing receive to understand that industrial policy exists in the world, and if we don't have partnerships that itself becomes an industrial policy.

What we need to do is to have partnerships that protect the public interest and the taxpayers, and partnerships that also are profitable to individual corporations to ensure that they are used.

So, I bring a message back from Washington, that there are exciting things going on—we have some areas where we want all of you to work with enabling technologies. It really is a new federal government that has gotten the message about public-private partnerships, and wants to continue to play with good people like you in the room.

Thank you very much.

CARL GUARDINO

Thank you, you want to take a couple of questions?

DR. STEPHEN VAN BEEK

I'd be happy to.

CARL GUARDINO

We have time for just a couple. Anybody have a question? In the back.

AUDIENCE MEMBER

With our funding of highways and improvements dependent upon gasoline tax, and the fact that we're going to be doing two or three times the mileage in our vehicles, won't this erode our funding base?

DR. STEPHEN VAN BEEK

That's a very good question. One footnote or corollary to that is, I've noticed the states are now going around the country holding seminars to make sure people aren't evading their vehicle taxes and their gasoline tax—before that was never as much of an issue.

Of the $218 billion in the transportation bill, $198 billion is so-called guarantee contract authority that comes from the federal highway trust fund, and 90 percent of that must be—I think it's 90 or 90.5 percent—must be returned to the states. The best thing I can say is that by the time this bill ends, which is 2003, I don't think it's going to be a problem. After 2003, we are going to have to look at some pricing alternatives or other ways to raise capital to replace that kind of money, because it is far easier to spend money from the highway trust fund, and we now have a rational argument to finally say the money that people put into the trust fund is truly a trust fund—it should come back to the state and local government.

So, we now have a logic outside of the direct appropriations process to help provide support for transportation. And what I wouldn't want to do is to have the unintended effects of scores of electric and hybrid vehicles lowering the amount of gasoline. Actually, in a way I would like to have that problem, because that would make other issues like greenhouse gasses and global warming a little bit easier to cope with—but that's certainly something that they will be examining, particularly the Federal Highway Administration, Ben?

BEN

Do you think that the federal commitment that's been brought forth in TEA-21 will continue in future years, or is there a sense that we've made our investment in the infrastructure, bringing us to certain level, and then go on to something else?

DR. STEPHEN VAN BEEK

No, I think it will continue.

The next area to actually keep watch on is the FAA re-authorization. What I didn't mention was that in the research and technology area, we have just signed a very, I think, exciting agreement between the Department of Defense, NASA, and the Department of Transportation to come together—to have NASA do a lot of the research for the FAA in the aviation area. We see now the aeronautical division of NASA, and the FAA's division, kind of coming

together, and this is something that if you look out and ask, "What's the air space of the 21st century going to look like?"—it becomes very important. I think here you will see an indication of their commitment, in that you will see them using the aviation trust fund and other resources indicating what the federal government commitments are going to be.

But you've got to give Chairman Shuster of the House Transportation Committee credit—he got it put in contract authority, which will protect the bulk of that spending. And I think people really now see a moral commitment that's been made to the American people to spend down that money. Still, you have that extra $20 billion in authority that must be appropriated, and year-to-year then, it becomes very important that people keep the pressure on so that as other priorities come into view, we don't lose that money. But I think we crossed a threshold, and I think we're going to have more money for transportation as we go forward.

One more?

AUDIENCE MEMBER

I personally would like to see an offset in the federal income tax for a federal gas tax—in other words, why shouldn't I be able to—why shouldn't the nation—pay less on income tax, if we are paying a large amount for a federal tax that motivates us?

DR. STEPHEN VAN BEEK

Before February of this year, I would have said I absolutely agree with you. Since February of this year, I would put it this way: I would say that the chief barrier to a gas tax or a measure like that, is not the executive branch of our federal government these days. And in all seriousness I think that message is quite far from the agenda, right now of the political process in Washington. I think we should keep it, I think we should keep it out there and talk about it until that point in time when becomes more acceptable to put it forward.

But I also think there are scores of marginal things that we can do in energy consumption short of a large gas tax to create incentives for people to do the right thing. And as soon as we can clear the deck on those first, then perhaps we can get to that issue.

But if the Kyoto Agreement is not a hard agreement, then there's not going to be the motivation for us to take that kind of measure—which is really what you probably need to get to the limits that people set in that legislation.

But, as I've said, unfortunately that is not really on the short-term agenda of this federal government right now, and for very practical reasons.

CARL GUARDINO

Thank you very much.

DR. STEPHEN VAN BEEK

And again, I left several of these publications up here. Believe it or not, this costs my agency some money, so please take them—both the summary of the bill, and the National Science and Technology Strategy.

CARL GUARDINO

Well, thank you again, Stephen, I appreciate your coming home and talking to us today.

We're going to regroup here and take about five minutes before we get to our third panel which is entitled, "Paving the Virtual Road." You'll want to hang out for that and also the EV demonstration. In the meantime, would the panelists for the next session come on up and get set up here—and don't forget the evaluation forms, the yellow sheets that are in front of you. We would like to have those before the end of the day.

"PAVING THE VIRTUAL ROAD"

DICK FITZMAURICE

Okay, we're about ready to start. If you would like to take your seats, we'll get our third panel started.

Welcome to our final panel discussion of the day. We want to get the panel started here so that we can wrap up and get you out of here on time. And, besides that, we want to save some time for the EV demonstration. That will give you a chance to test-drive one of those slick new electric cars.

So, welcome to the final panel discussion of the day. Our moderator for this panel is a 35-year resident of San Jose, a woman who is currently in her second term as a San Jose City Council member. Her transportation credentials include Chair of the Santa Clara Valley Transportation Authority, and she sits on the Metropolitan Transportation Commission. Transportation is certainly a key component of economic development, and she has that topic covered as well as Chair of San Jose's Housing and Community Development Committee and member of the Housing Community and Economic Development Committee at the League of California cities.

Please welcome Charlotte Powers.

CHARLOTTE POWERS

Thank you.

I personally want to thank Stephen—it was nice to see him back in San Jose, and he really had a lot of scintillating ideas that made us start to think outside the box and that's really very important.

It seems in listening today that you've had a very intense day, and you've listened to an awful lot of input, and maybe haven't had enough time to do the networking and the talking in between.

You've heard about alternative fuels in vehicles, and how they've become a piece of solving our transportation puzzle, ideas about car-sharing, and the new technology that's now available in cars.

You've also heard that consumers are going to help shape what that technology is going to look like in our cars in the future.

You've listened to opportunities for technology and transportation which are now focused on individual automobiles, and not necessarily on public transit.

You've heard how we need to move some of these things into the public transit arena, and that there is some opposition to government regulation—which is always there. But I also heard the other side of that from Dr. Van Beek, who explained how our transportation system is an asset and not a total liability—it has expanded with population congestion and miles traveled, and some of the goals also, I understand, of Caltrans.

This is a regional effort—obviously, we can't solve it within each city's borders, but I think each person that has spoken today has emphasized the need for public and private collaboration partnerships. There are many underway, but there are certainly more to be undertaken. And perhaps those are some of the issues that this panel will address on "Paving the Virtual Road"—an analysis of the challenges and opportunities that are available before us.

Our panelists today are Dan Sperling, from the University of California at Davis; Rod Diridon, the Executive Director of the Norman Mineta International Institute for Surface Transportation Policy Studies at San José State University; Jim Beall, the incoming Chair of the Metropolitan Transportation Commission Board; and Robert Ratliff, the Executive Director of CATS.

Sitting in for Mike Gage is Bill Van Amberg from CALSTART, and we will begin with Dan Sperling—Dan?

DAN SPERLING

Thank you very much.

I've taken it that my job here is to emphasize some of the challenges and opportunities—to highlight some of the things we've heard—and to propose some new ideas and concepts. Well, first of all, let me emphasize one thing that we've heard about—the kind of reality that we face—and that is we have a system that has free roads, mostly free parking, cheap fuel, and low-density land development. With that setting, with those conditions, it's going to be very difficult for new technologies to have a very large effect, especially in the near term—but I am hopeful, and I'm going to discuss where my hopes lie.

There's also a related problem and that is, we have what might be termed a transportation mono-culture—we have a system that's dominated on the passenger side by light-duty vehicles: cars and light trucks. All cars serving all purposes, virtually all using petroleum, and virtually all roads serving all vehicles. The result of this is that we have public transit accounting for two percent of passenger travel, and ride-sharing accounting for a smaller and smaller percentage as well. So, we will take a look at this.

To begin we will go back to some of the presentations.

Jim DeStefano and Mark Amstock, in particular, laid out some what I thought were some very innovative and promising technologies that do provide opportunities to enhance, and even to transform our transportation system eventually. And what they're referring to is this revolution that we see going on in electronics and materials and energy storage, energy conversion, and communication technologies. There really is a lot of innovation happening that can be taken advantage of in the transportation sector, and basically looking at it from the Silicon Valley-perspective or the California-perspective, we can see two sets of opportunities:

One is a business opportunity.

There's a huge consumer market out there for all of this electronics information technology, and even for manufacturing. Creating some of the modules as the auto industry goes towards more modular manufacturing, the electronics industry and some other high-tech industries can play a larger and larger role.

But what I would like to focus on is the second set of opportunities, and that is attaining the public goals of reduced congestion, less expensive transport, better access to goods and services, less environmental impact—in a sense more livable communities. And when I focus on this, the conclusion I come to is that what we need, and what I haven't heard very much today, is a commitment to experimenting with different options, and pursuing a diversity of options.

Now we've heard many of these ideas—we've heard them discussed—but what's missing is that commitment to actually implementing or pursuing some of these various options. Some will thrive, some will not.But if we don't try, we'll never move down those alternative pathways to those cities of the future that we've been hearing about, that the speakers have been talking about.

So let me go through just very quickly some of these options—I'm going to start off talking about Smart car-sharing.

You've heard it several times, but Susan Chihein who works with me, we have what we think is one of the real innovative car-sharing projects in the U.S.—perhaps the most innovative—and I'm bringing it up to emphasize some points I want to make.

One of them that we keep hearing about is this idea of partnerships. Okay, now there's many ways of conducting car-sharing, and there are many kinds of partnerships—just using this as a kind of illustration for the types of ideas

we're talking about—the one we're working with has three different applications where people are who located in neighborhoods use them, access them in neighborhoods, and take them to a BART Station. The car is then picked up by someone else—and in our case, that is the Lawrence Livermore Lab—and it can use it as a fleet vehicle there. There are many technologies associated with that, and this is just a kind of a way to characterize it, so, you can think about it.

In Europe, the car-sharing is mostly residential-based, but there are many, many ways of doing this, and Jim DeStefano talked about some other ideas as well.

As we talk about partnerships, it's a lot of work doing partnerships—we talk about it but, there has to be a real commitment—real leadership to make these kinds of things happen.

In our case, we've been working with BART, with Honda Motor Company, Lawrence Livermore National Laboratories, and a couple of technology suppliers. Honda has provided the vehicles for this—12 natural gas vehicles—and in addition to those partners, there are funding agencies involved, and PAT, which is represented here has been one of the major sponsors, as well as BART, and some others.

The set of options that we are talking about includes Smart car-sharing. In other words, car-sharing which uses a lot of these reservation communication technologies. There's a whole realm of communication technologies that can be used for activities including telecommuting, teleshopping, teleconferencing for the satellite offices, and telecenters. There's all these traveler information technologies However in terms of types of vehicles, basically we have a system in which there's nothing between bicycles and full-size cars. Part of the challenge is that we need is to fill in that spectrum.

And there are vehicles like Toyota's E-Com—Honda also has a vehicle which is something like that. And then we go all the way down to smaller neighborhood vehicles—Bombardier produces one—there's a company that's been used for the station-car project in the Bay Area—Pifco—and then all the way down to electric bicycles and electric scooters. There's a role for all of these.

We have Smart car-sharing—we have telecommunications and traveler information, and new types of vehicles. But the other item—the last major category—is that we also have to fill in another element of the spectrum: that between the car and conventional transit.

We have a land-use system—especially here in the Silicon Valley—which is essentially too dense for the car, and not dense enough for conventional transit. And so there's all of these paratransit and ride-sharing type options—Smart-paratransit, if you will—to fill in that gap, updating the old dial-a-ride technologies from the 70s—and there's a whole realm of opportunities there.

So, the point is here, that there are a lot of new technologies becoming available—they've made a lot of new options viable.

However, despite all of these options that I just mentioned, none of them are flourishing. We don't see all these cars out there, we don't see the Smart-paratransit out there, we don't even see telecommuting being used nearly as much as we thought it would be. Each by itself is inferior to today's private gasoline vehicle. What we need to do—the challenge—is to start clustering these different options together, to link them creatively. Conrad Wagner from Switzerland gave us a good example, when he talked about partnership management—that's what partnership is all about: bringing together the different technologies, the different services in a creative way. It's going to be different in every community and in every region—you can't just take a model from Washington, D.C. or Atlanta and superimpose it on all other communities—it won't work.

And so to conclude, I would lay out three principles that we need to be thinking about and pursuing:

One is that we have to start seeking synergies between all of these different options and technologies we've been hearing about—not pursuing them individually, but seeing how we might cluster them together.

Number two is we've got to start providing more choices—more diversity—if we don't do that, we won't do anything.

And number three is, we do have to think about how to price our system more rationally—it doesn't necessarily have to be $2 a gallon for gasoline, but there are many other ways of pricing the system—pricing transportation services in a way and it can even be done indirectly through emission trading and other kinds of provisions—there are many ways of doing it.

And so on that note, I look forward to what ideas my fellow panelists might have to add.

Thank you.

CHARLOTTE POWERS

Our second panelist is Rod Diridon, who assures me that he has an electric vehicle to drive, so Rod?

ROD DIRIDON

Thank you, Charlotte.

Indeed I do have an electric vehicle: I have had a darling little 914 Porsche for the last 20 years; I rebuilt it three times, and concluded that it wasn't cost-effective to do it again, so I converted it to electric power in February. I haven't been in a gas station since and don't miss it—and I am enjoying driving that car very, very much. It isn't as fancy as the EV—I'd love to have one, if anybody wants to donate one to a poor old suffering politician, ex-politician—but it runs very well. It would go 100 miles an hour if policemen aren't watching—and the traffic would allow—and it goes 60 to 100 miles on a charge, which is okay for my 14-mile commute. I would highly recommend that course of action to you if you really want to do something about the problems you're hearing about today.

Let me talk quickly, if you'll listen quickly. My message is going to be a little different. I'd like to note that you're talking about technological ways of solving the problems that we have here in Silicon Valley—and of course, have throughout the metropolitan areas of the United States—which would affect the world in a very dramatic way, both by example and by direct impact.

You know that there are technologies available—it isn't brain surgery anymore—we know the kinds of things we have to do to fix the problems. So, it's a matter of doing them—just a little icing on the cake of technology, and then I'll get off that kick. Here's a very nice magazine from ITS International that talks about the advanced design vehicles that zoom around in the air and look wonderful and perform remarkably well without environmental impact—I'll leave this here in case anyone wants to have a look at it.

Let me diverge now, though and talk about the macro situation:

It's an immoral circumstance—and, of course, we in Silicon Valley are not immoral—but it's an immoral circumstance to know that we're affecting the potential future of life on earth, and not doing all we can to fix it. So rather than have us be immoral, let me talk down through some solutions that are within our grasp now to implement:

The elimination of bottlenecks on our freeway systems—fine, we ought to do it as quickly as we can.

The maintenance of that system more effectively—you bet, we need to do it much more effectively.

ITS, Intelligent Transportation Programs, Smart Corridors, all the rest of those things—yes, we ought to implement those things as quickly as we can.

Mass transportation—certainly, that's the ultimate mode of transportation that will carry the majority of people—the U.S. is the only industrialized country in the world that doesn't carry the majority of their trips each day on mass transportation, and we certainly need that mass transportation system in the United States if we're going to survive through the next century.

Electric vehicles, alternately-powered vehicles—certainly, we need that too, and as Dan just said, we need all of them—we don't need one out of the menu, we need all of them if we're going to survive through the next century.

Let me go on down and talk about this process.

The short-term problem is mobility: We've got to get people to and from work in Silicon Valley, and we've got to have products to and from the marketplace, otherwise Silicon Valley as we know it won't be here for several more decades. We can't keep our industry headquarters here if we can't get their people to work. And we're very close to not being able to get those people to work now. So we've got to find corrections quickly; that's the short-term issue: mobility.

The long-term issue, is survival—survival for life on Earth as we know it.

Dan and I are involved in a panel—a national panel on global warming. We've been asked to do some preliminary research on what can be done, applying sustainable transportation policy to combat the issue of international global warming. It was spawned, really, by the Kyoto Accords, which were a wake-up call for the United States.

The Kyoto Accords say, first of all, that global warming is real. Don't you doubt it—global warming is real—and it's serious—and it's progressing rather rapidly.

The second thing that it says is that the various countries of the world—the industrialized countries especially—have to be responsible for a reduction in greenhouse gas creation—a significant reduction if we're going to be able to survive. Five percent was applied to most of the other industrialized countries; the United States got a seven percent reduction from the 1990 levels by the year 2010. Why did we get seven percent and everybody else got five percent? Well, let's see here...I have this interesting text, it's fairly credible, the *National Geographic* magazine, there's a nice little map in here, which you can't read, but I'll leave it up here so you can take a look. It quotes the very best scientific

evidence and says that 22 percent of the greenhouse gas in the world is created by the United States. The United States has 2.5 percent of the population—is that moral? It says that Asia, which has 51 percent of the population in the world, creates 2.5 percent of the greenhouse gasses. We were only asked to have a seven percent reduction in our greenhouse gas levels from the 1990 level.

The *National Geographic* says global warming is real, serious, and progressing. The Transportation Research Board of the National Research Council, that's the National Science Foundation, says global warming is real. Dan and I have been on a panel that's recently been involved in seeing research—a new accumulation of research that hasn't yet been published, it has to go through peer review yet—and that is emphatic about the problem.

I clipped this out of yesterday's *Mercury News*, it says "Global Warming Meeting Ends in Successful Note," and then a little paragraph down at the bottom says that the United States will never meet the required seven percent reduction levels. Well, the rest of the world isn't going to allow us to destroy this planet. It isn't going to happen, folks. When the crunch time comes, we're going to be required by world opinion to fix our problems. Fixing those problems means applying all of the tools that you've been hearing about today—not one or two, but all of them—and it we don't apply them all quickly, then we're not going to be able to fix it in time.

So, I suggest to you that the technological information—both in terms of hardware, as well as policy, and software—needs to be pursued by you, your corporations, and your associations aggressively, as a number-one policy—in the short-term for mobility, and in the long-term to support survival.

We've got another session tomorrow at San José State University that's sponsored by the Manufacturing Group, and by the Mineta Institute, the Commonwealth Club, and the Metropolitan Transportation Commission, that's going to talk about how to finance those programs. Because that's the missing ingredient: We've got the technology, we've got the need, we've got the growing concern, but we don't have the money.

During the period of the 1990's, Europe is going to spend over $10 trillion on improving their transportation systems: better highways, more smoothly-operating highways, a network of 200-mph high-speed trains, better feeder and distribution systems, and all sorts of tax incentives for alternatively-fueled vehicles. Japan will have spent over $3 trillion dollars in that same period of time for a tiny country. In that same period we're going to be spending several hundred billion but not quite a trillion, for an area that is larger and has more dilapidated transportation systems than those other two. The funding is not

available right now—somebody talked about gas taxes—indeed, the rest of the world taxes gasoline very heavily and it becomes a major source of funding—the United States doesn't. And that isn't the only source of funds—there have to be others—but somehow we also have to realize that there's no free lunch, and in this case, the bottom line is survival.

We owe a debt to our youngsters and to theirs, to make sure that they can enjoy the end of their century as much as we're enjoying the end of ours. This is the time to pay that debt.

Thank you.

CHARLOTTE POWERS

Thank you, Rod; that was very interesting. I'm glad to hear that you do have your electric vehicle. The real question with electric vehicles is how are we going to develop batteries, or when are we going to develop them so that we can go further than 60 miles—you've got to have greater distances.

ROD DIRIDON

It's just a commute-car. If we took care of the commute problem, we'd have no air pollution problems.

CHARLOTTE POWERS

You're talking about transportation systems, and we've got to talk about getting people distances.

JIM BEALL

You know, this is very interesting. I'm on the County Board of Supervisors, and we have a meeting at 2:00, so I just want to let you know that I might be leaving a little early. I happened to take Rod Diridon's place on the Board of Supervisors after he retired and went to San José State, but we had a chance to serve together for eight total years on the Metropolitan Transportation Commission dealing with these issues, and when you hear my talk, you'll understand why we're a team, because we have maybe different approaches but we get to the same place.

And that's what I'm going to talk about today. I think today we have a transportation system—especially in the Bay Area, this metropolitan area—that's really stretched to the limit. And we're really getting to the place where we're running out of room. Space—as somebody that has looked at the physical system, there really isn't much room to expand it in terms of space—

there's just not enough room to continue to expand the transportation system. It's even difficult to get transit systems into major urban cities like San Francisco, Oakland, and San Jose It becomes so expensive due to the property values and so forth. The prices are just becoming beyond our reach in terms of the financial capacity of government, and even the private-sector, to deal with in terms of major regional transportation systems.

But, despite this, especially in Silicon Valley, we have to meet the challenge. And I think given the morality of what we're doing here, as Rod pointed out on a national and international level, I think we must. So for me, when you look at Silicon Valley, you hear a lot of approaches in the business world—where they talk about more memory with less space, more power with less heat, more speed with less power—and I would like to add one for the transportation system: more people moved through our transportation corridors.

In fact, right now in terms of the Metropolitan Transportation Commission, that's one of our key initiatives: how we're dealing with the problems in the Bay Area. And the other side of it is more personal with me—the policy side is important, but for me, what drives me is the fact that I have family here, I was born and raised here. I have nine brothers and sisters, and I hear the stories from them about their lives here, and what they're like. I hear the stories about getting up early in the morning, the burnout, the massive amount of time it takes them to get to work, and so forth. I hear the concern in my family in terms of not able to spend time with their families and children, Grandma and Grandpa, my mom and dad, doing things with the kids and so forth.

I think this is the current calling for life in the Silicon Valley. This is what we're talking about, the fact that part of the solution has to deal with quality of life. That's kind of the base that we're dealing with here—when we talk about solving transportation problems we have to remember that what we're trying to do is to improve the quality of life and ensure that it will continue. We want to continue the good quality of life that's been here in the past for so many of us growing up here. So we must look at the solutions that we have to work with—and most of my family worked for the various high-tech companies in the area represented in the room today.

And guess which one I worried about the most, of the nine? Yeah, the youngest, my youngest sister, I'll give you her day: She gets up like at 4:30, and she drives about 30 miles to work. But first she has to get up, get the kids ready, get the kids to a childcare provider, take the 11-year-old to one childcare provider, and the 2-year-old to another child car provider, because the childcare for the 11-year-old doesn't provide child care for the 2-year-old. So

she has to kind of move around, and then she finally gets to her job in Palo Alto.

She drives from San Martin in South County—that's where she and her husband live because the cost of housing is so high elsewhere in the county. She works for Sun—by the way, anybody here from Sun? Anyway, I'm just giving you her little story, and she's the one that we worry about the most because it's not only tough on her, it's tough on the kids. And so you can see kind of the morality of that from my perspective as the eldest son in the family, and to have to worry about all the younger brothers and sisters. I learned to spend most of my time listening to them rather than trying to prescribe answers to them about what the solutions would be. But it helps me in my job here, to just listen to what they're going through.

It's becoming worse and worse, so what we're dealing with and working with are transportation solutions. Of course, trying to get more people through the corridors with the limited resources we have. I'll give you an example of one application—it's called the Silicon Valley Smart Corridor, and this is not some expensive, costly proposal, it's a really simple proposal that uses the state-of-the-art in terms of traffic management. It's an intelligent transportation system that blends the information highway and the asphalt highway.

It takes Highway 17 and 880—and most of you that live in the area know that's one of our worst corridors—it takes that and all the nearby arterials, and it combines a plan to develop the operational efficiency not only in the freeway corridor but also in the arterial corridors. It manages congestion resulting from things like accidents, road repairs and other traffic impediments.

By the way, for those of you who are concerned about the quality of life, in this county, 5,055 people were injured in 1997 due to auto accidents, and 243 people were actually killed in auto accidents, so I think if you want to think about quality of life, let's look at some of those things, and talk about some of those kinds of issues as things we need to focus on for quality of life.

The Smart Corridor takes all the cities, the county, the state government, and the MTC, and increases the information available to all the traffic agencies. It utilizes the regional traffic signal synchronization system to maximize the capacity of the corridor. It is unique, because it not only develops a solution to a regional problem, but also maintains some local economy on the part of the municipalities in the county government.

It has four components that I'm going to list:

First, we used closed circuit cameras and vehicle detectors to measure congestion at the freeway interchanges and the key intersections along the

corridor including San Tomas Expressway, Montague, Bascom, Winchester and other main arterials.

Secondly, the information is sent to the local agencies via the high-tech fiber-optic network that's included—it is peer-to-peer, it does not have to pass through a central unit, so it goes right into the local systems. The fiber optic network will be analyzed with a software, and solutions are then granted to it.

Thirdly, the county uses a signal—we have a signal synchronization plan for the complete transportation system in terms of the county expressways which is funded through the Measure A and B recent court decisions that grant us that.

Finally we use message signs, alternate routes, and indications of congestion levels. This is all made available to the commuter, and it's all available on the Internet, as well as through the Bay Area's travel information center, TravInfo, where you can get the information through either the Internet or on the phone system by calling in. I invite you to look at this kind of solution—it's not expensive, it doesn't cost a lot of money—but I think we ought to start looking at these things that we can do quickly in the Silicon Valley.

Over the last four years we've added about 250 thousand workers in Silicon Valley, and government spending levels can't keep up with that kind of rapid pace. So, we need to come up with some really quick, easy, common sense solutions to make people like my family and my sisters, my brothers and all of us together that live in the Valley maintain our quality of life and living for our families and our children.

So, thank you very much. I think that's one answer, and I hope to hear more from you, thank you.

CHARLOTTE POWERS

Thank you, Jim. That presented us with some good challenges, and yes, we are stretched to the limit—it seems maybe that we need to look at ways to use our limited dollars more effectively, but also perhaps, we need to be looking beyond just getting people to and from work. It seems to me now that transportation on the weekends, getting around the Valley has become almost as bad as going to work. So we may be need to be looking at a full transportation system.

Our next speaker is Robert Ratliff, the Executive Director of CATS. Robert?

ROBERT RATLIFF

Well, thank you. After listening to all the speakers today, one thing I did do is I throw out my canned presentation. I think I'd like to just make some off-handed remarks on the ITS industry overall—describe some opportunities both general and specific for your region here—and then list some specific actions as well.

We haven't talked ITS market too much today—we've hinted at it, and I know we're going to get into arguments about numbers—but CATS just sponsored another study to look at market size and the results of that study came to me last week. It indicated that the cumulative market for California in this area between 1998 and 2010 is expected to be $10.8 billion. About $890 million of this is going to be in transportation-management technology, such as Hamed Benouar talked about today, and $170 million will be in electronic-payment technologies. Thirty million in regulatory activities for commercial vehicles, $2.5 billion in fleet management systems such as those at Outreach, $4.4 billion in traveler information—we've talked to you a lot about that, and $2.9 billion in advanced vehicle control and safety systems—collision warning and those types of things.

Of those numbers, and I'll get a lot of arguments about this as well, 90 percent of that is expected to be paid by consumers, not public-sector taxpayer dollars. The theme I'd like to follow here then, is one of looking at creating transportation solutions with business solutions instead of taxpayer dollars. I think it's the best way to leverage our money, and I'm inclined to do it after listening to Rod say, "Let's just do it"—and I think that's the best way of doing it.

Another thing I'd like to quickly mention, is that I spent four hours traveling three miles down in Orange County the other day due to a traffic accident. I was at Caltrans for 20 years—Orange County is probably from my experience the best; I better be careful of what I say—one of the better-equipped districts in the state, both from technology out there, and the facilities they have: Traffic Management Center, CMSs, and other things out in the field. But even with all that technology, I sat on the freeway for four hours with nowhere to go—there were two or three CMS signs that tried to tell me things to do, but they really couldn't tell me much over the freeway there—helicopters flying over my head, they probably knew much more about it than anybody else—and I determined that the only thing that could have helped me in that situation was a device in my car, and I didn't have it—and I want to get this system out there. The technologies are out there, again, as Rod said, "Let's just do it." I need that technology in my car.

So, those are my frustrations, my general thoughts.

Some other things that came out of this report that I just received, included some surveys of industry that we did, and there were two or three things that perhaps are common sense, but they bothered me.

I'll present them to you:

The biggest investment risk in entering the ITS market, so said our survey of industry, was public agency cooperation, perception, openness and approach to the market. Now that bothers me—again coming from Caltrans, I understand those public bureaucracies—but we've to go to overcome that to some degree on that issue.

At CATS, we're doing a statewide ITS plan—we're working with the NPOs, the RTPAs, private industry—and we're really seeing a lot of cooperation there. So, maybe by that, we will begin to address this general cooperation issue. We hope to build a consensus approach so we can present to industry, and say, "Here's where we're going, and here's how we're going there." It bothers me that that's the perception of industry.

The other issue is the myth that ITS and Transportation are exclusively a public agency responsibility—and again, that's part of my theme here today. Hamed earlier talked about perhaps the use of vehicle probes replacing his infrastructure. I think that's going to happen definitely. I think that's happening already with the GM OnStar product, and other things out here.

I also think public agencies should perhaps look at spending monies in areas they historically have stayed away from, particularly the vehicle collision warning devices. Perhaps there should be a public subsidy, public incentive, to put those in vehicles. If traffic accidents truly are the biggest cause of congestion, why not? You'd probably get more bang for the buck than some of the other things that we're currently doing.

But the other thing that bothered me—and I really would like to bring it up in Silicon Valley today—the other thing that came out of the survey is that size is the only distinguishing characteristic of the California ITS market, so say our surveyed folks, and the technology sector of Silicon Valley has no impact at all in causing ITS to occur faster or over a more wide-scale scope in California. That bothers me. We've got the best technology in the Valley here, and there's no connection between that technology and transportation currently—or very little. And in many cases California is behind other states in the nation, so we've got to leverage that—and again I appeal to you here and I want to work with the Silicon Valley Manufacturing Group to see if we can make that happen.

As for some general opportunities, you're well-positioned with many, many strengths. You have a Bay Area ITS early-deployment plan. You know where you want to go. You've got your regional transportation plan, a variety of funding in that plan—the many existing deployments you've heard about today. Again Silicon Valley technology is very well-positioned to move this ahead.

Some other basic opportunities also exist as there's more money in the state than there ever has been—coming from TEA-21. There's a surplus of funds that came to the state that could be used in moving this agenda forward.

The other general opportunity that I see has to do with my time here during the Loma Prieta Earthquake. Again coming from Caltrans, during emergencies like the earthquake, many of these entities came together for the day, and they managed the system as one. They made decisions like telling you to get out of your car, jump in BART—do all kinds of things. We don't do that on a daily basis. These technologies would allow these agencies to truly manage the system as one. I think again, that if you can do that in earthquakes, I think you should do it on a daily basis.

Some specific opportunities I think you can pursue, include a regional traveler information system. You have TravInfo up and running—it's doing quite well. I would build upon it—I would enhance its data collection system, through public infrastructure. I would find some money to help Hamed and others put infrastructure in here, per his plans. It was very discouraging to look at the GIS map he showed of unfunded activities. And I would very seriously look at vehicle probes.

Jim DeStefano talked about emissions monitoring—distributed monitoring systems—a lot of intelligence going out there again in private-sector activities that you can use to supplement and/or replace the infrastructure needs. Once you do that, I would add dynamic route guidance to it. Again, I want a device in my car so I don't have to sit there for four hours not knowing what to do.

Implement car-sharing and door-to-door services—I'm very pleased to see what BART and others are doing, including UC Davis. I'm also very pleased to understand that in Switzerland, it actually has a business model that pays for itself. So apparently there is a viable business there to be had. Door-to-door services—I believe that's one of your best opportunities for increasing ridership and resolving congestion. I worked some on the Outreach project back at Caltrans, and I think there's some tremendous technology out there making a viable, cost-effective door-to-door service that could compete with a private auto. So I would encourage both the Switzerland car-sharing model and

the Outreach model—take those technologies, build upon them, and try to deliver some cost effective door to door services to the general public at large.

I would then work on deploying a intermodal regional transportation management center. I would link up the Caltrans-TMC, the Smart Corridor, the various city TMCs, San Jose, the BART center, the transit centers. I would give them the communications they needed so that they could do this interaction communications and intermodal management on a daily basis, rather than only during earthquakes with walkie-talkies and cell phones. I would leverage private-sector communication lines wherever possible for that, and I would leverage private-sector data collection sources wherever possible, to bring those costs down. Hamed indicated he's got a $600 million unmet need for infrastructure, but he can bring those costs down again with private-sector data collection and communications.

I would implement Translink—you already are. There's a transit fare care in the Bay Area here, but I would expand its use for use on the toll roads as well. I'd give you a multi-use card for transit fares, parking, etc. You're very well-positioned in this state—you've got Title 21 which enables the same card to be used on all 12 toll bridges in the state. That card has now been used on the toll roads—that's SR 91 down south—there's even some parking lots in Los Angeles that are now using that card for parking lot access. So, you have a multi-use card in the state currently, you just need to recognize that, and develop it, and use it.

I would like to conclude with some specific actions—and this one sounds silly, but after listening to Mr. Van Beek there are a lot of things happening at the federal level. The barriers are coming down, but they're not, perhaps, being implemented at the state level.

Again coming from Caltrans, we've got some long-standing contract processes that indicated that no matter how creative you get, you just can't get through. We tried doing it creatively, we tried to do some other things. The old regime didn't understand it. So I would develop some legislation that authorizes collaboration and transportation partnerships between the public- and private-sectors. Caltrans tried to do that about a year ago, they failed.

I would authorize the ability for private- and public-sector entities to function together so that we could point out to the bean counters that this is a viable approach to use. AB680 did that for the state toll roads, and they've been very successful. Primarily I'd adopt a business perspective. Again, if 90 percent of this money is going to come from consumers, let's try to develop these as business approaches and get these systems out here now.

And lastly, I would develop a range of incentives. We've heard about some tremendous ones: electric vehicles; car-sharing; even collision warning in vehicles—and funding to deploy the unfunded initiatives that Hamed had for the infrastructure.

Thank you.

CHARLOTTE POWERS

Thank you, Robert.

I couldn't agree with you more that we need to implement some ways to speed up the process of getting our projects done from beginning to end. I think that's one of the greatest frustrations in both public and private enterprise that we face.

Our last speaker today is Bill Van Amberg from CALSTART, and he's using technology.

BILL VAN AMBERG

I figured in the Silicon Valley you might as well do that. I'll stand up from here in deference to my arm.

I think Jim definitely pointed out very early on that there are market opportunities for us aging baby boomers with diminishing skills. This injury came from coaching soccer—so anything that gives me a heads-up display would be good.

Now, what I would like to do, because I'm agreeing with the speakers, is provide a good summation here of what's been going on.

We have had experience at CALSTART with partnerships for the last six years—we know that they work. Public/private partnerships—working with the universities; working with private organizations that want to take things to the marketplace; working with the federal, state, regional governments who have a stake in trying to get some measurement out there; setting some standards and having some goals that they want met; and finding the middle ground to push this forward.

When I see things like with what BART is doing, it's very innovative. It's what we talk about in transit districts in general—get out of the mode of thinking of yourself as basically carrying people in buses or trains where you feel like you're in the cargo business. Start getting into the service business. And what kind of service do people want? The end result is mobility.

I would like to highlight some of the trends here at the beginning of this, and discuss reasons why this is so important in Silicon Valley.

When we look at the trends, I think it was pointed out by the folks at Toyota, and also at Daimler-Chrysler, that the interaction between electronics and vehicles is only increasing. It started out with things as simple as the radio and ignition, but now it's starting to go through the roof. The content value of what is going into these vehicles is going to be more and more electronic, no matter what we do. But what we need to have is more Smarts aboard those vehicles and more integrated solutions to make them work towards the goals we have. We also talked, and I think Rod pointed this out quite well, a lot of the discussion today was about some of our problems with congestion. But we haven't talked as much about what that congestion causes and the very damaging pollution that our vehicle transportation creates.

In the United States, vehicle-related emissions accounts for about 50 to 65 percent of urban air pollution. It can be as high as 80 percent in Mexico City. It is also responsible for one-third of the global warming emissions problem, and it is the fastest growing segment of what causes global warming.

And I cannot log onto my Internet server—now this is a problem we also have to deal with—you don't want to have to reboot your car when you're halfway down the freeway, so you've got to get operating systems that are working well.

We also have to be able to deal with fuels and cleanliness of the vehicles that are out there. I mean, you can't just replace the existing vehicles with clean vehicles, because then you'll have clean vehicles in congestion. We haven't solved this whole picture, but you do have to solve that piece of it, because that will at least cut down on pollution. It will mean more efficiency at least in what's driving these vehicles.

I put these statistics up because of the tremendous pressure in California and the United States because of its particulate emissions. Research has indicated that particulate emissions in diesel are carcinogenic. They're toxic air contaminants and most of the buses, except for one in the entire Bay Area, run on diesel. That's something you need to think about.

What's missing from the observations that we've heard, as Karsten pointed out, is there's no integrated intermodal system. We've all kind of focused on our little pieces of it around here. What is the killer app? As Jim pointed out, we needed a killer application. I think there is no one single killer application, I think offering a suite of services is the killer app—the integration of those services into some useful whole may well be the killer application.

There's no one solution and no one vehicle type—Kent Harris from PG&E pointed this out. We're going to see what we call the "sneakerization" of vehicles and transportation in the future. You don't have just one tennis shoe now, what you've got is a tennis shoe and a soccer shoe and a cross-training shoe and a bicycle shoe. Well, the same thing will be true for vehicles down the road. More and more we're going to see transportation options that solve specific things very well, but don't do everything at once.

There's a continuum of service offerings and again, the specific vehicle roles will also be different depending upon what service-niche you're trying to serve. We need cleaner technology, but as I pointed out, it can't just be in a vacuum. You can't just put cleaner technology out there without integrating it into a more intelligent system and maybe creating a more valuable service. You need transportation delivered as a service—not just selling hardware, not just selling a piece of steel as a vehicle—but more and more as an integrated piece of a mobility system. And you need to link services or access.

In Silicon Valley, I think most people agree—and although there isn't good market research to back it up, everybody has this gut feeling and I agree with it—this is the ideal launch and test point: It has the need, it has the technology, it has a population that has tended to embrace new technologies. It would seem to be the ideal place.

I think that as Rod and the others have pointed out, we also need some short-term solutions. We at CALSTART have made ourselves a reputation for putting the "rubber on the road," but I think what we need here even more than that. It's the next step and that's putting silicon in the solution. We need to integrate all of this. There's all these clean technologies and the smarts to use them in the best way out on the road. I love the idea of—and this should get some venture capitalists' juices flowing—mobility.com equaling access.com: It's linking up the users with the service, and that's part of the business model that should be implemented.

I know when I flew up here—and I was born and raised in the Bay Area—but I couldn't recognize the Silicon Valley from one year to the next, because it changes so much. So of course, I logged onto the Internet, and I booked in my hotel, and then I had to get maps to get to all the locations. Well it would have been wonderful if I could have sent ahead to my rental car that I also booked on-line, and counted on the fact that it had the navigation set up to give me my exact directions. As I hopped in the car knowing where I wanted to go—and indeed having been given the best, cleanest, most efficient route to get there—and if I could have been given the car that matched my mode because I only

went 15 miles from the airport to get up here—that would have been the ideal solution—built upon the Smarts that we can put in the system.

We don't really have regional transportation funds set for clean fuel vehicles—I think that's a failing in the Bay Area, and I think it's certainly a failing as it's dedicated to the Silicon Valley. I think we can make use of targeted funds in this area for a really interesting project. Silicon Valley has the most unhealthy air in the Bay Area—the Bay Area has just gone back into noncompliance—this is the part of the region where the air is the worst. And, I mentioned this before, but there's only one clean-fuel transit bus operating in the central part of the Bay Area, way up in northern Sonoma County. Now the Bay Area is therefore behind Houston, it's behind Tempe, it's behind Los Angeles, I don't think that's the position it wants to be in.

Congestion pollutes, as well as robs, productivity. There are economic opportunity arguments here, not just in making the technologies and then selling them, but in the savings we would achieve. This is the economic engine in our region, in fact, I daresay in California. The Silicon Valley, and what comes out of it, is so valuable that we cannot afford to let it start to stumble and disperse into other regions. IT technologies, information technologies including the powertrains, really are the connective tissue, because they are using an awful lot of the same technologies, although for different things. An electric drive train and the Smarts to make it work right, as well as what connects it into the system and gets it to the right place.

Now, I'll just run through some other things quickly. There are other solutions. It's not just clean cars, and Smarter buses, and interconnective technologies to get vehicles places. There are new technologies for how you move the people physically that are coming on-line.

We are testing the Cybertrain up in our Alameda office right now, which really owes its existence to the Silicon Valley. It uses basic, off-the-shelf technology in many ways for what drives it. It's a fairly simple, electric-drive system on rail, but there is no driver aboard this. It's a networked system that takes people anywhere they want to go in the network. It is demand-responsive, so somebody would go up to one of these small stations, and this very lightweight car would roll in on-demand, then take the rider anywhere they want to go on the network—not necessarily sequentially, along the set path—but anywhere that it's connected to within the network. It builds on what we've already started in Silicon Valley in terms of computers.

QUESTION AND ANSWER SESSION—"PAVING THE VIRTUAL ROAD"

BILL VAN AMBERG

If we're going to do this from scratch, how do we do it in a different way? They're looking first of all, at putting clean-fuel shuttle buses around the campus to make sure that the students and anybody on this enclosed campus can get anywhere they want to go. Well you add into that the fueling sites for say, electric bikes, electric station cars, and natural gas vehicles, and then link that with electric bicycles, multi-user cars, station cars, and shared vehicles, then set up places for remote parking lots including shuttles to bring people in—and then use clean vehicles as well to perform campus functions.

This is not brain surgery, but it starts to integrate all the things that are out there right now. With just a little bit of Smarts, with a little bit of silicon involved in it, you can make these things operate together.

I won't go through this, again. I stole the map off the Internet, and I'm happy to say it came from NAFTECH. They're in the building here today.There are lots of integrated options the Bay Area can start looking at as well. We've got the huge infrastructure out there that's unused in the Bay. We can use natural gas, run across that link with station-cars or shared-vehicles as part of the mobility solution. You could attach these systems to BART—such as the Cybertrain that could be operated in the South Bay—or anywhere you don't want to necessarily want to have to pay to extend the BART system. You can put in clean airport operations and link the airports more fully, and then have clean ports. The technology is there, but it's not being linked and integrated together.

I think that's the main thing that we're hearing today is that it can be done. Let me just give you a few ideas. I know, I've gone over my time.

John Lozell and Mark Crane are here from our Alameda office, and there are tremendous opportunities right now. As Dr. Van Beek mentioned, for the short-term, there are $14 million available to do some interesting foot-in the-water-projects. So, let's get something going!

The companies that have technologies want to move forward—maybe partner in the transit—partner in the vehicle design. There's a tremendous opportunity to potentially do something in the Silicon Valley with some of those vehicles—maybe put some Smart technology aboard. That's coming up on the real short-term—and the short-term opportunities often at least raise visibility and let people start thinking about what's possible in the longer term.

Also, we have some money in our partnership in the Department of Transportation to help transit districts in the Bay Area to phase-in, figure out which clean fuels make sense to them, and which don't make sense. After this, we need to then help them get there real fast.

There are opportunities in these public/private partnerships right now to do some good things—so let's do it!

CHARLOTTE POWERS

One of your suggestions that happens to have been initially begun, is that the Bay Area Forum is working with the task force led by the three mayors in completing a feasibility study on our ferry system, and ways that we can increase the use of The Bay as a transportation system.

Are there any questions? I have one here: "Please comment on the impact of seemingly costly ITS solutions and hardware on mobility access by economically disadvantaged citizens?"

UNKNOWN RESPONDENT

Well, probably nobody wants to touch that one. So, I'll jump in first so I can get it out the way.

We actually think that the Internet may facilitate this. Currently, not everybody has the Internet, but people are working on options to bring that into housing developments and other sites, so that people can have open access to information. I think that Conrad Wagner talked about access being important. Once you're on the Internet, a lot of the solutions we're talking about now can be made available to people.

The advertising model for business can create a way to pay for some of these services. Access can be created. I think that information delivery to people can be made almost free.

Now, not all of these transportation options are going to be available to everybody, but we're working on some technologies that can help—for instance, welfare-to-work programs, and work shuttle programs to take people downtown to work. A lot of what these new technologies are attempting to do is to take the other 95 percent of our population that doesn't ride transit, and provide a more efficient system that also gives them the quality service that will prompt them to take this step right now. Most people still drive their cars because it's a better option. If you can personalize transit—not mass transit, but personalized efficient transportation mobility using transit as part of it—

then you may get people more out of their cars because you're giving them a better service.

CHARLOTTE POWERS

You're not going to comment, Rod?

ROD DIRIDON

I would like to comment on that because I think the key here is that what we're talking about is not elitist. It is a very important elemental aspect of the overall package—but by itself it isn't considered elitist. ITS as part of the overall program that Dan talked about, and that each one of us have mentioned that you heard presented earlier—including everything from eliminating highway bottlenecks all the way through to ITS—has improved transportation and mass transportation systems. That then is very egalitarian, because the mass transportation systems are available to those regardless of their economic capacity. So, the whole integrated system needs to be implemented, and then we'll all be served effectively.

CHARLOTTE POWERS

Thank you.

"Can we create vehicle insurance that can be bought in small increments to reduce the incentive to use, as and always, insure a vehicle?" I'm not quite sure what that means—in other words, can you buy insurance in small increments, so that your vehicle is not always insured, but it's insured when you are using it.

UNKNOWN RESPONDENT

Well, there have been proposals also for pay-as-you-go insurance—where you pay a certain amount as a fixed-fee, and then the rest is added onto the gasoline price at the pump—and that's actually very attractive because you're converting fixed costs into variable costs—that's one way we talked about sending the correct price signal without changing the overall net cost to anyone.

CHARLOTTE POWERS

Any other comments from anybody? Nope? Ok.

Gary Richards—Mr. Roadshow—said in an article on Saturday that we have to stick our necks out and be willing to try something different, but by what

means do we have to get something different considered? In other words, how do you create that change?

UNKNOWN RESPONDENT

Well, I'll just chip in again.

I think there is the opportunity—what we found is you've got to have a long-term map that you're kind of heading toward, but then you better get some short-term successes or nobody's going to pay any attention to you. And you need people to buy-in by saying, "Oh, okay, I get it. Those things work," and then there's a next phase that shows they can do more. I think what you want to start, especially in the Silicon Valley, is something on the road, on the map, that's starting to show opportunities. It isn't going to be the total solution at first, but it has begun. It's a known that you can build from, so I would say work on some short-term successes.

I think there's a feeling of what some of the long-term goals should be, but get some initial projects on the ground and running, to demonstrate that it's possible.

ROD DIRIDON

I would like to climb on that bandwagon if I could, by noting that has always been the mode in Silicon Valley. We began in 1976 with Measure A, and saw the transit system, the Guadalupe Corridor project, develop. In 1984, Measure A then saw the three highway projects developed on budget and ahead of schedule. Now we have the 1996 AB which is in the process of being implemented very efficiently—the difficulty with that is that we're taking little steps—we need a completed system within the next 10, 15, 20 years at the most, and at the rate we're currently going it, will take 50 to 60 years to get that completed system. So somehow we're going to have to accelerate that process.

It's all built around funding, and somehow we have to have that, because Charlotte and her board have a master plan. It's been approved, it includes highways, everything down to bike trails, and what we need is the funding to implement that master plan.

DAN SPERLING

To take Rod's comments a little further, I think part of the problem is that we need new players, and new institutions involved in taking some leadership. Perhaps that's why this meeting is being held. Perhaps it's the larger companies and some of the smaller companies in Silicon Valley that need to play a much

larger role getting involved in some of these partnerships—creating these new services—because there's a lot of institutions that have been doing a lot of things.

More money doesn't necessarily mean they're going to do the creative kinds of things that we've been talking about here. They'll do some of the very fundamental things—traffic management systems, yes. But some of the more creative ones that probably show a lot more potential, all the transit options for instance, are a good illustration of that. All of these para-trends including Smart para-trends and options, need new players, new institutions, and new leadership.

UNKNOWN RESPONDENT

Can I just add to that just a point? I think Dan is right on with that. I sometimes frustrate my friends in the automotive industry when I point out that we see a potential shift.

Mark pointed this out a little bit with shifts in what's going on with out-sourcing. A lot of the R&D, more pressure on the tier-ones—the suppliers to the automotive industry—there may be some new "Big Threes" developing and they may not be in automotive—and one of the reasons to come to the Silicon Valley is to encourage the Suns, the HPs, and the others.

You know what, you guys, you may not realize it, but you're also in transportation. You may be in a bigger piece of transportation than you realized. And that's not to say the automakers aren't, or that the transit district's aren't—but there are new players now who can bring new pieces to this pie and in fact, that's specifically why we're in the Silicon Valley today, I think.

CHARLOTTE POWERS

This is a question that's kind of related to—oh, did you want to jump in?

UNKNOWN RESPONDENT

If I could add a few other things briefly. I'd like to stress the business perspective again. Obviously the private-sector has to make a profit. I'm not arguing against that at all—but I am challenging the private-sector to be far more entrepreneurial when it comes to transportation.

I believe there is a very large market out there. We can argue numbers, but I'd say 10 billion over the next several years. But you're in this business anyway—travel services on the Internet is supposed to be a $7 ½ billion market over the next three years. It's rampant already—airline ticketing and

reservations. It is competition that's going to drive all the way down into real-time traffic conditions, whether or not Caltrans centers play at all.

In electronic payment, I've talked to SmartCard vendors where they come in and deploy all the equipment at no cost in transit. There are a variety of things happening out there that you can do right now, and I think in the main-stream markets these things are happening. You just have to reach out to those industries, show them there's business in transportation, and give them the opportunity to make a business out of it.

I mean, for instance, I would not have imagined before today that there was a viable business doing car-sharing at this point, but apparently there is. I would argue that for any ITS application, you can make a viable business if you're entrepreneurial enough and are given that opportunity by the public-sector.

CHARLOTTE POWERS

Some of those issues that you just mentioned are things that are in the master plan for the Valley Transportation Authority. Somebody asked me how can you do that? I have this little card here. The Santa Clara Valley Transportation Authority has the master plan for Santa Clara County, but we're also a part of the regional transportation plan which was just approved by the Metropolitan Transportation Commission in Oakland. So those pieces of information are there—and one last one that goes right along with this:

In Silicon Valley, people work on product lifecycles of months, but in the automotive world, the cycles are in five years, and the infrastructure for these cycles take decades. How do we draw these three sectors together with such radically different planning horizons? That's the $60,000 question.

UNKNOWN RESPONDENT

I can comment, Charlotte—and you and I have had some of the same bruising experiences with the construction life cycle—the Guadalupe Corridor project, first studied in 1973: The project was finally in full operation in 1991. The problem wasn't studies—it was a lack of funding. Now, there were some study requirements, certainly, but if the funding had been available at the time the first study began—and all we were waiting for was a selection of a mode and contractor—that project would have been under construction in 5 years, not 18. So, I don't want to beat the drum of funding too much now, but you have to realize that we are not spending the money that the other industrialized countries of the world are spending on transportation—and industry has to be more deeply involved in this, not only in terms of assisting and financing, but in terms of leadership.

We've been extremely fortunate with the Manufacturing Group in the Valley, and the leadership they've shown in terms of leading the charge on our Measure As and the various other financing programs—and also in terms of attitude. The very enlightened attitudinal projection coming from the Manufacturing Group—but we certainly need to be even more aggressive.

Thank you, Charlotte.

CHARLOTTE POWERS

I just kind of think about when I moved to the Valley in 1963—the current Highway 85 was on the maps, and it got built 40 years later. So I think some of it has also been "where there's a will, there's a way." We haven't necessarily exercised that will, which brings us back to the partnerships that we need to have. Rod mentioned the Manufacturing Group and their help, and the businesses that have been a part of this. We need to look at new ways to face these challenges in the Valley. And we have to look at all the Smart ways that we can do that.

I want to thank all of our panel members for being with us this afternoon, I really appreciate it, and I will turn this back over to our host, Dick.

ROD DIRIDON

As our host is coming up, may I say as a closing comment, that the Mineta Institute is very pleased to be a co-sponsor of the effort today, and we will be transcribing and publishing the proceedings and will make them available through the Manufacturer's Group—and also to the state legislature and to Congress, hoping that maybe we'll find some leadership at that level.

Thank you.

A summary will be on the Internet as well.

DICK FITZMAURICE

Thank you for that kind of support—we appreciate that.

Charlotte, thank you very much for serving as the MC for this panel.

A couple of notes—one is the evaluation forms. The Silicon Valley Manufacturing Group would really like to have your feedback on today's proceedings, so if you could fill that out and then pass them to the outside perimeters, we'll get somebody to pick them up after you're gone.

Also, our keynote speaker today had some information from the National Science and Technology Council, if you haven't seen this document, it's up

here with Kirk. You can sign the list to receive a copy on your way out, and we will send you that information.

It has been a fascinating day for me, and thank you for inviting me to come and take part in the day today. I think a round of applause is also in order for our other moderators, Steve Heiminger and Russ Hancock.

Also, to Carl Guardino and his staff at the Silicon Valley Manufacturing Group for developing the topic and putting on the workshop today, and we should also thank HP and Camelia Nelson for being our hosts today.

And thank you for being here today.

The meeting is adjourned—don't forget to drive an EV before you leave today.

Thank you.

LIST OF TERMS, ABBREVIATIONS, AND ACRONYMS

3Com: 3Com Corporation, Santa Clara, CA – Developer and manufacturer of networking equipment for Local Area Networks (LAN) and Wide Area Networks (WAN), including Intranet and Internet applications, for further information, see http://3com.com on the World Wide Web

AB: California State Assembly Bill

AB680: California State Assembly Bill 680;

ABP program:

ABS: Anti-Lock Brake System

Adaptive Control System (Toyota): An ITS (see below)

Advanced Vehicle Program: An initiative sponsored by the Research and Special Programs Administration of DOT

Advanced Highway

Systems Office (Caltrans): A department of Caltrans New Technology and Research Program; for further information, see http://www.caltrans.ca.gov on the World Wide Web

AMIC: Automotive Multimedia Interface Consortium

Automated Highway System (Toyota): An ITS (see below)

BART: Bay Area Rapid Transit – A medium rail system that operates throughout various locations in the Bay Area

Bay (The): The San Francisco, CA, Bay

Bay Area (The):The San Francisco, CA. Bay Area; roughly includes from Sonoma County in the north, to Santa Clara County in the south, to Alameda County in the east (Alameda, Marin, Santa Clara, San Francisco, San Mateo, Sonoma counties)

Bay Area Council: A council concerned with business development in the Bay Area

Bay Area Forum:

Big Three (The): In this context, the three leading U.S. automobile manufacturers: Ford, GM (See below), and Chrysler

Bombardia:

bots, dots, lane reflectors, and divider reflectors: Different types of lane markers

CALSTART: A State of California economic program founded in 1990 to help "jump-start" the economy during the recessionary period of that same time; part of its funding was directed toward transportation programs; for further information, see http://calstart.com on the World Wide Web

CALSTART of Pasadena: One of two California consortia eligible for funding through RISPA (see below); the other being the Sacramento Electric Transportation Consortium
(see below); for further information, see http://calstart.com on the World Wide Web

Caltrans:California Department of Transportation; for further information, see http://www.caltrans.ca.gov on the World Wide Web

Caltrans New Technology and Research Program: for further information, see http://www.caltrans.ca.gov on the World Wide Web

Caltrans Traffic Operations Program: Manages eight transportation management centers statewide; for further information, see http://www.caltrans.ca.gov on the World Wide Web

Carquinez Strait: The strait between San Pablo and Susuin Bays (both of which bays together with San Francisco Bay make up the San Francisco Bay estuary); north-east of San Francisco, CA; the Carquinez Bridge spans this strait

CARB: California Air Resources Board, Sacramento, CA; for further information, see http://www.uscusa/transportation/zev.html on the World Wide Web

car-sharing: A business service which provides a multi-level means of accessing automotive vehicles for use to consumers without these consumers actually owning the vehicle; similar in concept to an amalgam of vehicle renting and leasing; may be employed on either the individual private party to multi-user business level; currently implemented in parts of Europe, especially Switzerland

Cash-Car: Berlin, Germany's car-sharing agency

CATS:

CCTV: Closed Caption Television

Central Artery Project (Boston):

Cisco: Cisco Systems, Inc., Santa Clara, CA – Developer and manufacturer of networking equipment for Local Area Networks (LAN) and Wide Area Networks (WAN), including Intranet and Internet applications; for further information, see http://cisco.com on the World Wide Web

CMS:

Convergence 98:

Consumer Electronics Manufacturers Association:

community vehicle: Synonymous with personal car (see below)

commuter vehicle: Synonymous with personal car (see below)

Council of Competitiveness for the White House:

County Board of Supervisors: In the context of this document, the Santa Clara County Board of Supervisors

CREDA: Cooperative Research and Development Agreements in the federal government

CRV (Honda): A hybrid, personal car

Cybertrain: A rider-demand-responsive electric-drive system on rail with no driver; a networked system that takes people anywhere they want to go in the network; currently implemented in Alameda County

DOT: U.S. Department of Transportation

Dynamic Autopilot:

dynamic route guidance:

E-Con (Toyota): A hybrid, personal car

Electric Vehicle Association:

Electric Transportation Coalition:

ETC: Electronic Toll Collection

EV: Electric Vehicle(s); a.k.a. – Battery Electric Vehicles; for further information, see http://www.ucsusa.org/transportation/avances.html on the World Wide Web

FAA: U.S. Federal Aviation Administration; for further information, see http://www.faa.gov/ on the World Wide Web

Fastlink:

Federal Highway Administration:

foot-in the-water-projects: preliminary projects

Ford Ballard Benz:

fuel-cell vehicles: Vehicles powered by fuel-cells which combine hydrogen and oxygen to produce electricity; for further information, see http://www.ucsusa.org/transportation/avances.html on the World Wide Web

GIS maps:Geographical Information Systems maps; maps generated from computer software designed to "store, analyse, model and visualize geographical data." (Grigorius Tsoumakas); for further information, see http://egnatia.ee.auth.gr/~grigorius/gios.html (Grigorius Tsoumakas, webmaster) on the World Wide Web

GM: General Motors Corporation, Detroit, MI; leading consortium of American automotive developers and manufacturers

GPS: Global Positioning Satellite (System)

green technology: Environmentally concerned technology

GSM: Global System for Mobile Communications, which is the European cellular phone standard; for more information, see http://gsmworld.com/ on the World Wide Web

Guadulupe Corridor Project (The):

HDTV: High Definition (Digital) Television – television technology based on digital rather than analog signals

HOV: High Occupancy Vehicle

HP: Hewlett-Packard Corporation, Palo Alto, CA; one of the oldest and highly regarded developer and manufacturer of semi-conductor-based electronic products in Silicon Valley

hybrid vehicles:a.k.a. – "hybrid car" and "hybrid electric vehicles;" vehicles powered by a combination of electric and combustible fuel, e.g.: gasoline; methanol; methane; propane; hydrogen; etc.; for further information, see http:/

/www.ucsusa.org/transportation
/avances.html on the World Wide Web

Highway 17:California State Highway 17, which runs north and south between San Jose, CA and Santa Cruz, CA; notorious for its dangerous curves

House Science Committee:

House Transportation Committee:

Intel: Intel Corporation, Santa Clara, CA – Developer and manufacturer of semi-conductor computer chips; holds largest market share of personal computer chip applications; for further information, see http://www.intel.com on the World Wide Web

intelligent vehicle: Vehicles with artificial intelligence designed to "help drivers of cars, trucks, and busses operate more safely and efficiently." (*Intelligent Vehicle Initiative: Strategic Planning Overview*, Draft, April 29, 1997)

ICDN: ITS Cooperative Deployment Network; for further information, see http://www.nawgits.com/jpo/ on the World Wide Web

infratronics:

Intelligent Vehicle Initiative (IVI):Passed by DOT in 1997 "to accelerate the development, availability, and use of integrated in-vehicle systems that help drivers of cars, trucks, and busses operate more safely and efficiently." (*Intelligent Vehicle Initiative: Strategic Planning Overview*, Draft, April 29, 1997); for further information, see http://www.tfhrc.gov/
pubsrds/pr97-10/p18.htm on the World Wide Web.

ITS:Intelligent Transport Systems; a DOT project dedicated to intelligent vehicle development as per the IVI (see below); for further information, see http://www.its.gov/ on the World Wide Web.

Kinder-Morgan Pipeline Terminal:

Kyoto Agreement: a.k.a. – "Kyoto Accords;"

Lawrence Livermore:Lawrence Livermore National Laboratories, Livermore, CA – research laboratory operating under the auspices of the U.S. Department of Energy (DOE) to study energy; for further information, see http://www.lln;.gov/ on the World Wide Web

League of California Cities

Housing Community and

Economic Development Committee:

LEV: Low Emission Vehicle

lithium ion (Li+):Battery technology using lithium ionic electro-chemical reactions to power mechanical devices, including vehicles

lithium polymer (LiXn):Battery technology using lithium polymer electro-chemical reactions to power mechanical devices, including vehicles

Lockheed Martin:Lockheed-Martin Missiles and Space, Bethesda, MD – 0ne of the leading aerospace engineering businesses in the world, with main branches in Silicon Valley; for further information, see http://www.lmco.com on the World Wide Web

Loma Prieta Earthquake: The October 17, 1989 earthquake centered along the Loma Prieta Fault, located immediately south of San Jose in the Santa Cruz

Mountains; 7.1 magnitude on the Richter scale; caused extensive infrastuctural damage, some of which still has not been corrected ten years afterward

Los Gatos: A city along Highway 17 (see above)

Low Jack: A type of theft-detection technology used in Europe

Mayday systems: Systems that automatically reports accidents, call for assistance, and remotely identifies the car and driver to authorities, who can then pinpoint the precise location of the emergency using GPS satellites

McKenzie and Company: Helped PG&E look at some of the strategic opportunities in electric transportation in about 1990

Mercury News: The San Jose Mercury News daily newspaper

MTC: a.k.a. – "METROCOM;" Metropolitan Transportation Commission in Oakland, CA

Mobility Car Sharing:a.k.a.: Mobility – A Swiss car-sharing business, currently operating in Switzerland

Internet Multimedia on Wheels Concept car:

NAFTECH:

NASA Ames: NASA Ames Research Center, Mountain View, CA; for further information see http://www.arc.
nasa.gov/index.html on the World Wide Web

National Automated Highway Systems Consortium:

National Intelligent Transportation Society of America:

National Science and Technology Council's

Transportation Science and Technology Strategy: NSTC's (see below) strategic plan through the year 2000

National Science Foundation:

National Research Council:

NIPA:

nickel metal hydride (NiH):Battery technology employing nickel metal hydride electro-chemical reactions to power mechanical devices, including vehicles

NOW satellite:

NPO:

NSTC: National Science and Technology Council

OEM: Original Equipment Manufacturer

Office of Emergency Transportation: A division of RISPA (see below); coordinates all transportation and preparation for natural and manmade disasters in the United States

Office of Pipeline Safety:A division of RISPA (see below); regulates all manner of pipes in the United States, including the transportation of gas cylinders

off-the-grid: Obtaining electrical energy from the public utility electrical source to power mechanical devices, including vehicles

on-demand services: Telecommunications services such as program selection, which allows users to place and order and receive response in a short period of time

OnStar (GM):

Orange County: Orange County in Southern California

Outreach: A service of the VTA that offers the elderly and disabled in Santa Clara County a full range of mobility options; see http://www.outreach1.org/index.htm on the World Wide Web for further information

Pac Bell: Pacific Bell – Public utility; telephone service provider for California

Palm Pilots: Personal Digital Assistant (PDA), manufactured by 3Com

PAT:

PDA: Personal Digital Assitant (see Palm Pilot, above)

Peninsula (The): The San Francisco, CA, Peninsula – From San Francisco in the north, to Menlo Park in the south; San Francisco and San Mateo counties

personal vehicles: a.k.a. – "personal car;" small—one to three person carrying capacity—internal combustion engine-powered vehicles

Pifco:

PNGV: Partnership for a New Generation Vehicle – A partnership between the three major automotive manufacturers in the United States and the federal government to create a vehicle that will get triple the gas mileage
of the normal family sedan today without additional emissions

Prius (Toyota): a hybrid car

Progress (Toyota): Vehicle with electronic feedback from the navigational system to the power train which automatically slows down the vehicle in anticipation of curves in the road

PG&E: Pacific Gas and Electric – Public utility; electrical and gas service provider for California

"putting the rubber on the road": Slang expression meaning to begin something

RAV4 (Toyota): a.k.a. "RAV EV;" used in the context of this document, indicates this model as a hybrid car; however, Toyota also makes RAV 4s which powered solely by internal combustion engines as well

RISPA: Research and Special Programs in the Department of Transportation; a department of DOT

RTPA:

Sacramento Electric

Transportation Consortium:One of two California consortia eligible for funding through RISPA (see above); the other being the CALSTART of Pasadena (see above)

Sandia Labs:

San Jose's Housing and
Community Development Committee:

Scotts Valley: A city along Highway 17 (see above)

shared vehicle: Any vehicle used in car-sharing; often a personal vehicle

Shuster, : Chairman House Transportation Committee

Silcon Valley: a.k.a. – "The Valley;" formerly, the Santa Clara Valley; the area south of the San Francisco, CA, Peninsula, where semi-conductor and computer-related enterprises were largely founded, developed, and remain today as the largest business concern; home to corporate headquarters for the world's leading semi-conductor and computer-related enterprises; primarily located in the South Bay (see below), though the definition is somewhat flexible and can include any area where semi-conductor or computer-related enterprises exist, from as far north as Marin County, south and west as Watsonville, and east as Livermore

Silicon Valley Manufacturing Group:A local business council concerned with semi-conductor and computer-related business manufacturing development in the Silicon Valley

Silicon Valley Smart Corridor: That portion of Highway 880/17 that runs through Santa Clara County, and the arterial roadways such as the San Tomas/ Montague Expressway, Winchester Road, and Bascom Avenue, to name but a few

Smart:When capitalized in this context, means the refenced item has computerized-intelligence

Smart-Car: a.k.a.: Smart; a personal car, with a two- to three-person capacity, developed and manufactured by DaimlerChrysler and currently being marketed throughout Europe; for further information, see http://www.daimlerchrysler.de/products/products_e/index.html on the World Wide Web

Smart-Card: a.k.a. – "Smart-Pass;" a sensor-readable plastic card, capable of having monetary, security, and other transportation-related data encoded into its infrastructure

sneakerization of vehicles: Multi-dimensional vehicular solutions using the metaphor of the many different types of sneakers, for example, tennis shoes, running shoes, cross-training shoes, etc.

South Bay:The area south of the San Francisco, CA, Peninsula, in which Silicon Valley is primarily located – key cities include: Cupertino; Los Altos; Milpitas; Mountain View; Palo Alto; Santa Clara; San Jose; Sunnyvale; most of Santa Clara County

South County: Southern Santa Clara County; the southern part of San Jose (south of Tully Road); Gilroy; Morgan Hill; and San Martin

Station-car: synonymous with personal vehicle; see above

Sun: Sun Microsystems, Mountain View, CA – Leading developer and manufacturer of UNIX-based work stations such as the SPARC series; for further information, see http://www.sun.com on the World Wide Web

Super-ULEV: Super-Ultra Low emission Vehicle

SUV: Sports Utility Vehicle

TEA-21: a.k.a. – "Title 21;"Federal transportation funds allocated to the MTC for though 2005

Tauscher, Ellen O.: U.S. Congressperson, 10th District, of which the Silicon Valley is a part; for further information, see http://www.house.gov/tauscher in the World Wide Web

Telematic for Flexible Vehicle Use:

TMC:

Translink:

The Transportation Research Board

of the National Research Council:

Trapeze:

TravInfo: MTC's (see above) traveler information system; for further information, from any area code, dial 817-1717

TSC: The Telematic Supplier Consortium, a group that addresses the link between the fixed service providers and the in-vehicle user interface defined by the AMIC

ULEV: Ultra Low Emission Vehicle

Valley (The): The Silicon Valley

vehicle infratronics:

vertical integration:

Vehicle Roadway Warning System (Toyota): An ITS (see above)

Vistion (Ford):

VOLPI system: VOLPI National Transportation System in Cambridge, Massachusetts

VTA: Santa Clara County Valley Transportation Authority Board – provides bus, light rail, and other public transportation services throughout Santa Clara County

VMT: Vehicle Miles Traveled

WebTV:

Zap/Zappy: Zappy Power Scooters –

ZEV: Zero Emission Vehicle; in 1992, CARB (see above) established a program designed to facilitate research and development of ZEVs; for further information, see http://www.uscusa/transportation/zev.html on the World Wide Web

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