U.S. DOT
ITS STRATEGIC PLANNING WORKSHOP
JUNE 4, 2009

SYNTHESIS REPORT OF FINDINGS

U.S. Department of Transportation
Research and Innovative Technology Administration
ITS Joint Program Office

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By

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16. Abstract

The United States Department of Transportation (U.S. DOT) conducted a day-long workshop on June 4, 2009 in National Harbor, Maryland to solicit stakeholder input on the strategic direction of the Federal Intelligent Transportation System (ITS) research program. The workshop was one of several mechanisms to solicit input from external stakeholders and followed a Request for Information (RFI) issued by U.S. DOT on April 20, 2009. Total workshop attendance was 180, demonstrating strong stakeholder interest. The diverse representation included the private sector, state and local agencies, academia, industry associations, and U.S. DOT personnel

As background for the stakeholder discussions that followed, ITS JPO Director Shelley Row presented information about the DOT's strategic planning process for ITS and the development of five goal area initiatives: Safety, Mobility (Data), Mobility (Applications), Mobility (Payment), and Environment. The Multimodal Team Leaders for each goal area then presented preliminary versions of proposed programs. These program proposals, eleven in all, were the focus of two rounds (one in the morning and one in the afternoon) of 90-minute facilitated breakout sessions organized by goal area. In each breakout session stakeholders were asked to react to the overall theme of the proposed program and to identify roles and engagement mechanisms for stakeholders, key technologies, and measures of research program success.

All breakout sessions were well attended and stakeholders provided many useful comments. Workshop results include the major themes of stakeholders' comments as well as key comments related to goal area initiatives and specific programs. Eight overarching themes emerged from multiple breakout sessions. They range from continuing stakeholder involvement to Federal role to ways to catalyze the market.

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LIST OF ABBREVIATIONS

AAA   American Automobile Association
AAMVA   American Association of Motor Vehicle Administrators
AASHTO   American Association of State Highway and Transportation Officials
ACLU   American Civil Liberties Union
ADAPT   Achieving Dynamic and Proactive Transportation
AERIS   Applications for the Environment: Real-time Information Synthesis
APTA   American Public Transit Association
ATA   American Trucking Association
ATI   Alliance for Toll Interoperability
ConOps   Concepts of operation
CVISN   Commercial Vehicle Information Systems and Networks
CVO   Commercial vehicle operator
DMV   Departments of motor vehicles
DOE   Department of Energy
DSRC   Dedicated short range communication
ECMT   European Conference of Ministers of Transport
EMS   Emergency Medical Services
EPA   Environmental Protection Agency
FHWA   Federal Highway Administration
FTA   Federal Transit Administration
GHG   Greenhouse gas
HMI   Human-machine-interface
HOT   High occupancy tolling
HOV   High occupancy vehicle
IBTTA   International Bridge, Tunnel and Turnpike Association
IFTA   International Fuel Tax Association
IP   Integrated payment
IRP   International Registration Plan Inc.
IRS   Internal Revenue Service
ISTEA   Intermodal Surface Transportation Efficiency Act
IT   Information technology
ITS   Intelligent transportation systems
IVHS   Intelligent vehicle-highway system
JPO   Joint Program Office
MBUF   Mileage-based user fee
MPO   Metropolitan planning organization
NCAP   New Car Assessment Program
NCSL   National Conference of State Legislatures
NHTSA   National Highway Traffic Safety Administration
NWS   National Weather Service
OECD   Organization for Economic Cooperation and Development
OEM   Original equipment manufacturer
POC   Proof of concept

R&D	Research and development
RFI	Request for information
RFID	Radio frequency identification
RITA	Research and Innovative Technology Administration
ROI	Return on investment
SAE	Society of Automotive Engineers
SDO	Standards Development Organization
SPAT	Signal phase and timing
SWAT	Special weapons and tactics
TLPA	Taxicab Limousine and Paratransit Association
U.S. DOT	United States Department of Transportation
UTC	University Transportation Centers
V2I	Vehicle-to-infrastructure
V2V	Vehicle-to-vehicle
VMT	Vehicle miles traveled

EXECUTIVE SUMMARY

The United States Department of Transportation (U.S. DOT) conducted a day-long workshop on June 4, 2009 in National Harbor, Maryland to solicit stakeholder input on the strategic direction of the Federal Intelligent Transportation System (ITS) program. As work is concluding on a number of the major initiatives that defined the program over the last several years, U.S. DOT is now developing a plan for the "next generation" of ITS research, taking into consideration major opportunities in technology, the next "leap forward," updated definitions of the Federal role, the best uses of resources, and strategies for moving forward while building on today's systems.

The ITS Joint Program Office (JPO) within the Research and Innovative Technology Administration (RITA) is leading the strategic planning process in partnership with representatives of modal agencies in the form of Multimodal Teams. The DOT's ITS Strategic Program Group, consisting of Associate Administrators across the modes, has partnered with the ITS JPO to provide input, review, and confirmation that the content is implementable. The ITS Management Council (Deputy Secretary and Modal Administrators) reviews and provides direction to the strategic plan. The June 4 workshop was one of several mechanisms to solicit input from external stakeholders and followed a Request for Information (RFI) issued by U.S. DOT on April 20, 2009.

DOT has followed a structured process in developing the ITS Strategic Plan, beginning with vision and mission statements and continuing with strategic initiatives (each containing one or more proposed research programs) and goals and objectives associated with each initiative. The initiatives are: Safety, Mobility (including subsections corresponding to Data, Applications and Payment), Environment, and Policy. Policy considerations will be addressed through activities within the other initiatives and no separate policy programs are being developed.

Program proposal drafts (informed by stakeholder input from the June 4 workshop, the RFI, and other sources) will undergo further development and definition during the summer of 2009. An ITS Management Council composed of the U.S.DOT Administrators will make the final selection of new programs that compose the ITS Program. The new programs are scheduled to be initiated at the start of Fiscal Year 2010 on October 1, 2009.

Workshop Participants and Process

Total workshop attendance was 180, demonstrating strong stakeholder interest. Fifty-six (56) participants were U.S. DOT personnel or members of the workshop team, leaving 124 "external" stakeholders. Among those 124 external stakeholder representation was diverse: 53 percent were from the private sector, 24 percent from state or local agencies, and the remaining 22 percent from academia, industry associations or unclassified.

The focus of the workshop was two rounds (one in the morning and one in the afternoon) of 90-minute facilitated breakout sessions. Those sessions were organized around the five areas within which the Multimodal Teams are developing proposed programs: Safety, Mobility (Data), Mobility (Applications), Mobility (Payment), and Environment. Prior to the first breakout session, ITS JPO Director Shelley Row presented background information and then each of the

Multimodal Team Leaders summarized the preliminary versions of the proposed programs. Figure ES-1 lists the 11 proposed programs, organized by goal area.

Figure ES-1. Proposed Programs

Goal Area	Proposed Programs
SAFETY – Transformative safety through vehicle and infrastructure connectivity.	1. IntelliDrive^{SM} Vehicle to Infrastructure (V2I) Communications 2. IntelliDrive^{SM} Vehicle to Vehicle (V2V) Communications 3. Harmonization of International Standards and Architecture around the Vehicle Platform 4. Vehicle Control Assistance for Safer Travel 5. Human Factors for IntelliDrive^{SM}
MOBILITY (DATA) – Capture complete, real-time information on all roads and all modes to support transformational system performance.	1. Real-Time Data on All Roads and All Modes
MOBILITY (APPLICATIONS) – Achieve transformational transportation management and system performance through applications of vehicle and infrastructure connectivity.	1. Achieving Dynamic and Proactive Transportation (ADAPT)
MOBILITY (PAYMENT) – Realize "next generation" electronic payment systems that support transformational system performance.	1. Mileage-Based User Fee 2. Integrated Payment System for All Modes
ENVIRONMENT – Enable environmental management through vehicle and infrastructure connectivity.	1. Applications for the Environment: Real-time Information Synthesis (AERIS) 2. Exploratory Research in Community Transit Service

For each proposed program and in each breakout session stakeholders were asked to react to the overall direction of the program as reflected in the theme statement included in the Multimodal Team Leaders' presentations. Stakeholders were also asked to identify roles and engagement mechanisms for stakeholders, key technologies, and measures of research program success.

Workshop Results

All breakout sessions were well attended and stakeholders provided many useful comments. Workshop results include the major themes of stakeholders' comments as well as key comments related to specific goal area initiatives and programs. Eight overarching themes, shown in the sidebar, emerged from multiple breakout sessions. They range from continuing stakeholder involvement to Federal role to ways to catalyze the market. Highlights of some of the most significant stakeholder comments associated with the five individual goal areas consist of the following:

Stakeholder Comments on Proposed Safety Programs

- Program themes need to be "problem based" rather than based on communication mode and revised to include crash scenarios. The highest priority should be given to the most significant causes of crashes.

- Vehicle technologies and infrastructure systems will likely be deployed on related, but different time lines. Milestones where equal levels of vehicle systems and infrastructure will be deployed should not be expected. Infrastructure systems may take more time to deploy than vehicle systems.

- Liability is a crucial issue, especially in the Vehicle Control Assistance program. Resolution of major liability issues, possibly in part through defining requirements and then certifying systems as satisfying requirements, is necessary to ensure public acceptance and should be a key measure of U.S. DOT research success.

- USDOT should establish specific, quantitative performance standards (or definitions of success) as goals or targets, e.g., to decrease crashes of a specific type by X%. Such clearly defined goals or performance standards will provide system developers, including private industry, a focus for their efforts.

> **Major Themes**
> - Stakeholder involvement—public, private, national, international—is critical and should continue
> - A lot can be learned by looking around the world and across industries at what has been and is being done
> - Programs should be structured around key milestones and "check points"
> - Many programs are related and should be closely coordinated
> - All programs should use of a structured, systems engineering process that emphasizes requirements, architecture and standards
> - Architecture and standards are key to catalyzing the market
> - Policy issues significantly impact research direction and need to be addressed; if not resolved, at least by investigating solutions associated with each of a range of policy options
> - General agreement that the Federal role is to resolve issues and stimulate public and private innovation and deployment

Stakeholder Comments on Proposed Mobility (Data) Programs

- The "all roads and all modes" scope might be too broad and inconsistent with the criteria of "few, focused" in DOT's "Parameters for Future Research." Data needs and applications should be prioritized, which could include close coordination with the other research programs that may rely on data (such as the Mobility (Applications) program) or provide data (such as the IntelliDrive^{SM} portions of the Safety area).

- The Federal role should be multifaceted, including "grand facilitator," enabler of innovation, regulator, and funder.

- Research should be driven by clearly defined needs and requirements, which in turn stem from the applications being considered across the other research programs.

- A critical need, and appropriate Federal focus, is to develop a variety of standards and guidelines addressing interoperability/data exchange, data quality, and metadata and for those standards to be adopted by public and private sector stakeholders.

- The National Weather Service and the cellular telephone industry provide informative models.

Stakeholder Comments on Proposed Mobility (Applications) Programs

- The proposed program theme needs to be broadened to include real-time control, adaptive learning systems and mobility definitions that go beyond travel time, e.g., environment and access.
- Research needs to focus on clarifying public and private roles.
- The "iPhone model" is a good one: focus on defining standard data models and platforms and then the marketplace will apply its ingenuity and expertise to develop useful applications that fulfill users' needs.

Stakeholder Comments on Proposed Mobility (Payment) Programs

- Mileage-Based User Fee (MBUF) research should investigate both highway-finance related objectives as well as other potential objectives related to mobility and environment. The objectives of an MBUF will drive all of the more specific research into requirements, architecture, technologies, and standards, and, therefore, it is essential to define the range of MBUF objectives for consideration at the outset.
- Early on, a scan should be conducted to document existing systems and research. The scan would help to establish state-of-the-practice, identify gaps, and identify stakeholders.
- In addition to stimulating deployers and entrepreneurs, a major objective should be in articulating "day-in-the-life" scenarios or use cases and using them, and other research results, to educate the public and other stakeholders and generate awareness and interest— "buzz."
- One or more major field demonstrations—potentially multiple demonstrations with each including thousands of participants—should be conducted.

Stakeholder Comments on Proposed Environment Programs

- Promoting environmental benefits and applications along with safety and mobility as a package strengthens the message.
- The logical initial environmental focus should be on air quality, greenhouse gases and climate change.
- Government participation at all levels is needed for progress on environmentally sustainable transportation. At the Federal level, U.S. DOT should be the lead but the Environmental Protection Agency and Department of Energy should also be involved. State and local agencies that should be involved include state departments of transportation, state and regional environmental/air quality agencies, metropolitan planning organizations, and transit agencies.

- Raising awareness about "eco-transportation" among the public, policy makers and other groups is needed. Eco-transportation should encompass the full range of environmental issues associated with travel, which go well beyond the issues associated with driving.

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1.0   INTRODUCTION

Since the establishment of the United States Department of Transportation (U.S. DOT) ITS program in 1991 as part of the Intermodal Surface Transportation Efficiency Act (ISTEA), the ITS Joint Program Office (JPO) has fulfilled its legislative requirement to prepare a strategic plan to guide the Federal ITS program. The first strategic plan was produced in 1992 as the Intelligent Vehicle-Highway System (IVHS) Strategic Plan, and the most recent plan was the Five-Year ITS Program Plan developed in 2006. The strategic plans have typically covered a five-year period and have been renewed to reflect new thinking and new technological developments. Under the leadership of the JPO, U.S. DOT is once again updating the strategic direction of the ITS program as current research initiatives launched in 2004 come to a close. This report summarizes the results of a stakeholder workshop conducted by U.S. DOT on June 4, 2009 to solicit stakeholder input on the 2009 ITS program strategic direction update.

1.1   U.S Department of Transportation ITS Strategic Planning Process

The ITS strategic planning process is a partnership with key stakeholders within and external to DOT. Within DOT, the ITS JPO staff is leading development of the strategic plan in partnership with representatives of modal agencies in the form of <u>Multimodal Teams</u>. The DOT's <u>ITS Strategic Planning Group</u>, consisting of Associate Administrators across the U.S.DOT modal administrations, has partnered with the ITS JPO to provide input, review, and confirmation that the content is implementable. The <u>ITS Management Council</u> (Deputy Secretary and U.S.DOT Modal Administrators) reviews and provides direction to the strategic plan.

Input from stakeholders outside DOT has been sought for their thoughts on coordination, content and execution of the plan. While input has been gained through a variety of informal means such as discussions and conferences and other meetings over the last year, DOT issued a formal Request for Information on April 20, 2009 with comments due by May 20, 2009.[1] In addition, the DOT conducted a day-long stakeholder workshop on June 4, 2009 in National Harbor, Maryland following the ITS America Annual Meeting. This report comprises the findings of the June 4 workshop. Technical support for the workshop was provided by Battelle, and ITS America provided logistical support.

DOT has followed a structured process in developing the ITS Strategic Plan, as illustrated in Figure 1-1. The strategic initiatives now being developed derive from the ITS vision and mission statements, which in turn are congruent with those of U.S. DOT and the Research and Innovative Technology Administration (RITA). Emphasized are the goal areas of safety, mobility, and environment around which the next set of ITS strategic research initiatives are designed. Actions related to the policy goal area will be addressed within the framework of each of the three other goal areas and no separate programs are in development in the policy area. Table 1-1 restates in more legible form the goals and objectives of these the goal areas.

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1 Federal Register link: http://frwebgate5.access.gpo.gov/cgi-bin/TEXTgate.cgi?WAISdocID=600319365274+0+1+0&WAISaction=retrieve
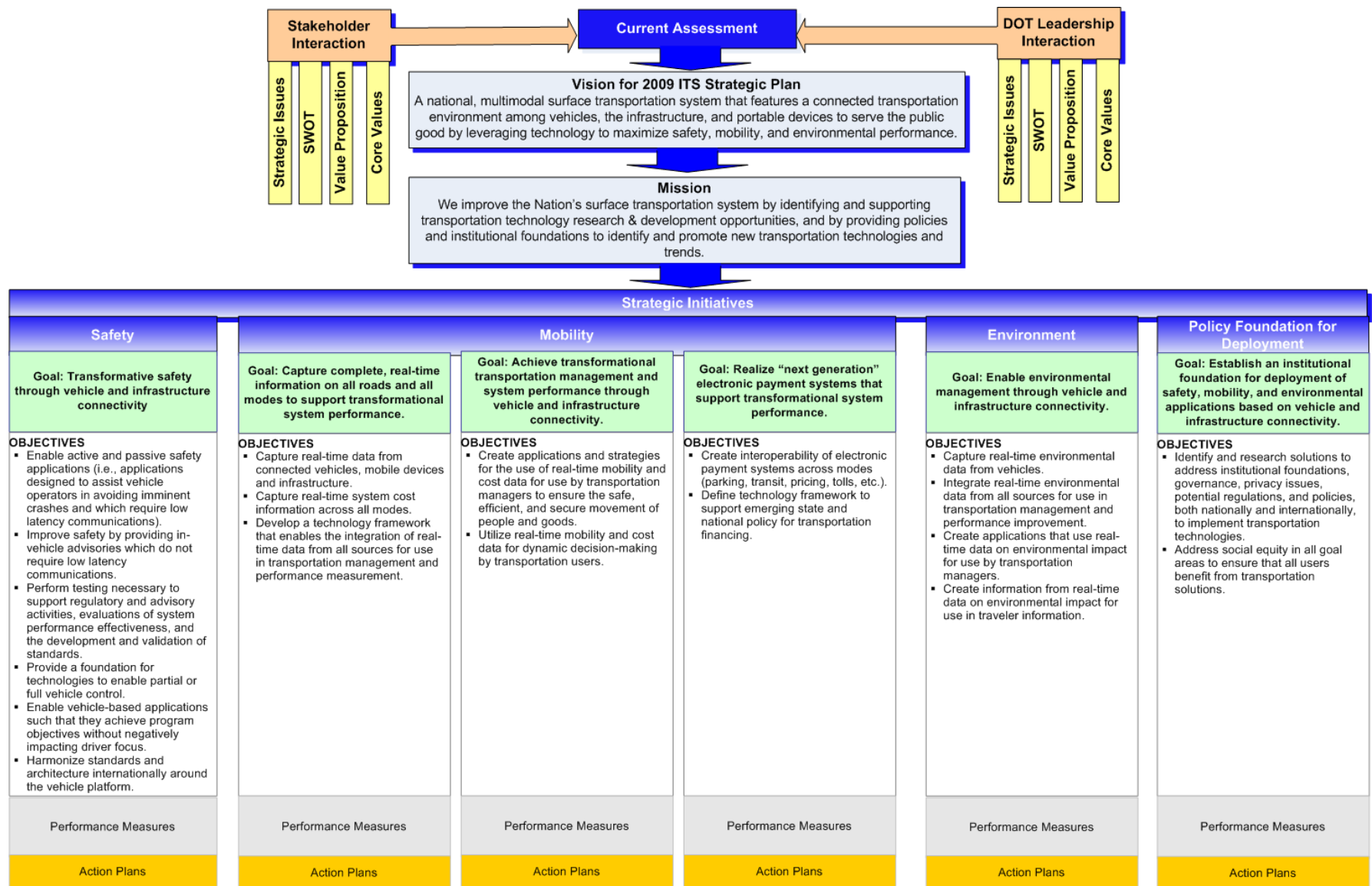
Stakeholder Interaction

Strategic Issues | SWOT | Value Proposition | Core Values

Current Assessment

DOT Leadership Interaction

Strategic Issues | SWOT | Value Proposition | Core Values

Vision for 2009 ITS Strategic Plan
A national, multimodal surface transportation system that features a connected transportation environment among vehicles, the infrastructure, and portable devices to serve the public good by leveraging technology to maximize safety, mobility, and environmental performance.

Mission
We improve the Nation's surface transportation system by identifying and supporting transportation technology research & development opportunities, and by providing policies and institutional foundations to identify and promote new transportation technologies and trends.

Strategic Initiatives

Safety

Goal: Transformative safety through vehicle and infrastructure connectivity

OBJECTIVES
- Enable active and passive safety applications (i.e., applications designed to assist vehicle operators in avoiding imminent crashes and which require low latency communications).
- Improve safety by providing in-vehicle advisories which do not require low latency communications.
- Perform testing necessary to support regulatory and advisory activities, evaluations of system performance effectiveness, and the development and validation of standards.
- Provide a foundation for technologies to enable partial or full vehicle control.
- Enable vehicle-based applications such that they achieve program objectives without negatively impacting driver focus.
- Harmonize standards and architecture internationally around the vehicle platform.

Performance Measures

Action Plans

Mobility

Goal: Capture complete, real-time information on all roads and all modes to support transformational system performance.

OBJECTIVES
- Capture real-time data from connected vehicles, mobile devices and infrastructure.
- Capture real-time system cost information across all modes.
- Develop a technology framework that enables the integration of real-time data from all sources for use in transportation management and performance measurement.

Performance Measures

Action Plans

Goal: Achieve transformational transportation management and system performance through vehicle and infrastructure connectivity.

OBJECTIVES
- Create applications and strategies for the use of real-time mobility and cost data for use by transportation managers to ensure the safe, efficient, and secure movement of people and goods.
- Utilize real-time mobility and cost data for dynamic decision-making by transportation users.

Performance Measures

Action Plans

Goal: Realize "next generation" electronic payment systems that support transformational system performance.

OBJECTIVES
- Create interoperability of electronic payment systems across modes (parking, transit, pricing, tolls, etc.).
- Define technology framework to support emerging state and national policy for transportation financing.

Performance Measures

Action Plans

Environment

Goal: Enable environmental management through vehicle and infrastructure connectivity.

OBJECTIVES
- Capture real-time environmental data from vehicles.
- Integrate real-time environmental data from all sources for use in transportation management and performance improvement.
- Create applications that use real-time data on environmental impact for use by transportation managers.
- Create information from real-time data on environmental impact for use in traveler information.

Performance Measures

Action Plans

Policy Foundation for Deployment

Goal: Establish an institutional foundation for deployment of safety, mobility, and environmental applications based on vehicle and infrastructure connectivity.

OBJECTIVES
- Identify and research solutions to address institutional foundations, governance, privacy issues, potential regulations, and policies, both nationally and internationally, to implement transportation technologies.
- Address social equity in all goal areas to ensure that all users benefit from transportation solutions.

Performance Measures

Action Plans

Figure 1-1. ITS Strategic Plan Development

Table 1-1. ITS Goals and Objectives

Safety Strategic Initiative
Goal: Transformative safety through vehicle and infrastructure connectivity.
• Objective—Enable active and passive safety applications (i.e., applications designed to assist vehicle operators in avoiding imminent crashes and which require low latency communications).
• Objective—Improve safety by providing in-vehicle advisories which do not require low latency communications.
• Objective—Perform testing necessary to support regulatory and advisory activities, evaluations of system performance effectiveness, and the development and validation of standards.
• Objective—Provide a foundation for technologies to enable partial or full vehicle control.
• Objective—Enable vehicle-based applications such that they achieve program objectives without negatively impacting driver focus.
• Objective—Harmonize standards and architecture internationally around the vehicle platform.

Mobility Strategic Initiative
Goal (1): Capture complete, real-time information on all roads and all modes to support transformational system performance.
• Objective—Capture real-time data from connected vehicles, mobile devices and infrastructure.
• Objective—Capture real-time system cost information across all modes.
• Objective—Develop a technology framework that enables the integration of real-time data from all sources for use in transportation management and performance measurement.
Goal (2): Achieve transformational transportation management and system performance through applications of vehicle and infrastructure connectivity.
• Objective—Create applications and strategies for the use of real-time mobility and cost data for use by transportation managers to ensure the safe, efficient, and secure movement of people and goods.
• Objective—Utilize real-time mobility and cost data for dynamic decision-making by transportation users.
Goal (3): Realize "next generation" electronic payment systems that support transformational system performance.
• Objective—Create interoperability of electronic payment systems across modes (parking, transit, pricing, tolls, etc.).
• Objective— Define technology framework to support emerging state and national policy for transportation financing.

Environmental Strategic Initiative
Goal: Enable environmental management through vehicle and infrastructure connectivity.
• Objective—Capture real-time environmental data from vehicles.
• Objective—Integrate real-time environmental data from all sources for use in transportation management and performance improvement.
• Objective—Create applications that use real-time data on environmental impact for use by transportation managers.
• Objective—Create information from real-time data on environmental impact for use in traveler information.

Policy Foundation for Deployment Strategic Initiative
Goal: Establish an institutional foundation for deployment of safety, mobility, and environmental applications based on vehicle and infrastructure connectivity.
• Objective—Identify and research solutions to address institutional foundations, governance, privacy issues, potential regulations, and policies, both nationally and internationally, to implement transportation technologies.
• Objective—Address social equity in all goal areas to ensure that all users benefit from transportation solutions.

DOT's update of their ITS strategic direction is guided by lessons they have learned and by parameters they have established. Key lessons learned that are shaping the strategic plan development include the need to focus the program, have an overarching direction, be vocal, engage stakeholders, put forward a vision, and the need to leverage private sector investment. One of the most important parameters guiding program development is to have few, focused, high value and bold initiatives. Other parameters are that programs should have the potential to make a significant national impact, provide a positive, measurable return-on-investment, provide a clear justification for Federal involvement, and serve as a catalyst for private sector action.

DOT plans to finalize the ITS Strategic Plan by October 2009.

Parameters for Future U.S. DOT ITS Research Programs
• Consistent with U.S. DOT Goals, ITS Program Vision
• Few, focused, high value, bold
• Potential for significant impact at a national scale
• Generally address issues that support multi-modal vision
• Address a clear research question that would not otherwise be addressed because
o Too big or too risky for any one entity alone
o Too many players and no clear ownership
• Expected to offer a positive, measurable return on investment
• Offer a justifiable or clear Federal role
• Appear to be implementable, technically feasible, and have a clear champion, with supportive partners
• Will be a market catalyst

1.2   Organization of this Report

The remainder of this report presents the findings of the June 4, 2009 stakeholder workshop. Section 2.0 describes the overall process for the workshop and the stakeholders who attended. Presented in Section 3.0 are the preliminary program proposals that were developed by the Multimodal Teams and which were the primary focus for stakeholder input. The findings of the breakout group discussions comprise Section 4.0, and Section 5.0 summarizes the findings of the workshop by highlighting overarching observations and themes and key stakeholder recommendations in each proposed research area.

2.0   WORKSHOP PROCESS AND PARTICIPANTS

2.1   Process

The day-long workshop consisted of plenary and breakout sessions as shown in the agenda in Figure 2-1. In the plenary session in the first half of the morning, the presentation by the ITS JPO Director Shelley Row provided background information and context for the strategic planning effort.

Highlights of the preliminary program proposals by the Multimodal Team Leaders followed Ms. Row's presentation, and set the stage for the breakout sessions that followed. The eleven program proposals were organized around five goal areas, with one breakout group per goal area. The subjects of the morning and afternoon breakout groups were identical—that is, all of the proposed programs in a given goal area were discussed in both the morning and afternoon sessions and the same questions were posed to stakeholders. That approach allowed stakeholders to participate in discussions of two different research areas over the course of the day. The exception was the safety goal which contained more proposed programs than could be discussed in a single session (it included five programs compared to one or two programs in each of the other goal areas). Three of the proposed safety programs were discussed in the morning and the remaining two in the afternoon breakout group.

A Battelle team facilitator managed the discussion in each breakout session, with a note taker recording the discussion. The Multimodal Team Leaders (identified on the agenda in Figure 2-1) were present in their respective breakout groups to address questions about the program proposals raised by the participants. The discussion was organized around the four topics shown in Figure 2-2. Participants were provided with a handout of each proposed program's theme and key activities to assist in their discussion of the questions.

Prior to the afternoon breakout sessions, the facilitators reported highlights of the morning sessions. In the final segment of the agenda the Multimodal Team Leaders provided brief reactions to what they had heard over the course of the day.

AGENDA

ITS Strategic Planning Stakeholder Workshop
June 4, 2009
8:00 AM – 4:00 PM
National Harbor 3 Room

8:00 – 8:15 – Coffee

8:15 – 8:30 - **Welcome and Introductory Remarks** (Carol Zimmerman, Battelle)
- Workshop purpose and intended products

8:30 – 9:00 – USDOT Remarks (Shelley Row, ITS JPO)
- History of USDOT's ITS program
- ITS Strategic Plan development process
- Vision, mission, goals and objectives
- The Request for Information

9:00 – 9:15 – Question & Answer Discussion of USDOT Remarks

9:15 – 10:15 – ITS Goal Areas: Progress by USDOT Multimodal Teams (James Pol and Multimodal Team Leaders, ITS JPO)
- Safety -- Mike Schagrin
- Mobility (Data) -- Ben McKeever
- Mobility (Applications) -- Brian Cronin
- Mobility (Payment) -- Kate Hartman
- Environment -- Marcia Pincus

10:15 – 10:30 – Charge to the Breakout Sessions (Carol Zimmerman)

10:30 – 10:45 – Break

10:45 – 12:15 – Facilitated Break-out Group Discussions on Multimodal Teams' Progress to Date
- Group 1 Safety (National Harbor 3)
- Group 2 Mobility (Data) (Chesapeake 7)
- Group 3 Mobility (Applications) (Chesapeake 9)
- Group 4 Mobility (Payment) (Chesapeake G)
- Group 5 Environment (Chesapeake H)

12:15 – 1:45 – Lunch

1:45 – 2:00 – Report from Morning Breakout Discussion (Group Facilitators)

2:00 – 3:30 – Facilitated Break-out Group Discussions on Multimodal Teams' Progress to Date

- Group 1 Safety (National Harbor 3)
- Group 2 Mobility (Data) (Chesapeake 7)
- Group 3 Mobility (Applications) (Chesapeake 9)
- Group 4 Mobility (Payment) (Chesapeake G)
- Group 5 Environment (Chesapeake H)

3:30 – 4:00 – USDOT Reflection on Stakeholder Input (ITS JPO Team Leaders)

4:00 – Adjourn

Figure 2-1. Stakeholder Workshop Agenda

Figure 2-2. Breakout Group Discussion Topics

2.2   Participants

ITS America solicited participation in the stakeholder workshop though its website and e-mail communication to ITS America members and attendees of the ITS America Annual Meeting. Preregistration was required to ensure sufficient space and materials used at the workshop. Approximately 230 people preregistered, and the actual attendance numbered 180. Given the workshop occurred at the end of a three-day conference, the level of attendance was surprisingly high. Moreover, most of the participants stayed for the entire day.

The workshop drew a diverse audience, which helped contribute to a range of perspectives in the input received during the breakout session. Of the 180 attendees, 56 were either U.S. DOT staff or part of the Battelle team supporting the workshop. Therefore, 124 can be considered true external stakeholders to whom the workshop was targeted, and they can be characterized as follows:

- 53% were from the private sector, including technology providers, consultants, transportation engineering and planning firms, and vehicle manufacturers,
- 13% state agencies,
- 12% local and regional agencies (including transit operators, metropolitan planning organizations, city and county government),
- 10% universities,
- 8% industry and professional associations, and
- 3% unclassified.

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3.0 PROPOSED RESEARCH PROGRAMS

Stakeholder input during the breakout sessions responded to the eleven preliminary program proposals, spread among five goal areas, that were presented by the ITS Multimodal Team Leaders. This section highlights the proposed program information that was shared with the stakeholders.

The eleven program proposals are presented in Table 3-1 along with the associated Multimodal Team Leaders, organized by goal area.

Table 3-1. Proposed Programs

Goal Area	Team Lead	Program Names
Transformative safety through vehicle and infrastructure connectivity. (SAFETY)	Mike Schagrin	1. IntelliDrive^{SM} Vehicle to Infrastructure (V2I) Communications 2. IntelliDrive^{SM} Vehicle to Vehicle (V2V) Communications 3. Harmonization of International Standards and Architecture around the Vehicle Platform 4. Vehicle Control Assistance for Safer Travel 5. Human Factors for IntelliDrive^{SM}
Capture complete, real-time information on all roads and all modes to support transformational system performance. (MOBILITY –DATA)	Ben McKeever	1. Real-Time Data on All Roads and All Modes
Achieve transformational transportation management and system performance through applications of vehicle and infrastructure connectivity. (MOBILITY-APPS)	Brian Cronin	1. Achieving Dynamic and Proactive Transportation (ADAPT)
Realize "next generation" electronic payment systems that support transformational system performance. (MOBILITY-PAYMENT)	Kate Hartman	1. Mileage-Based User Fee 2. Integrated Payment System for All Modes
Enable environmental management through vehicle and infrastructure connectivity. (ENVIRONMENT)	Marcia Pincus	1. Applications for the Environment: Real-time Information Synthesis (AERIS) 2. Exploratory Research in Community Transit Service

The summaries of proposed programs presented by the Multimodal Team Leaders included statements describing the overall direction of the program—the "theme"—and lists potential key research activities. This information was also provided to stakeholders as handouts in each breakout session and served as a reference throughout the discussions. Table 3-2 presents the proposed themes and key activities.

Table 3-2. Preliminary Program Proposal Themes and Key Activities

Goal Area	Program	Themes	Activities
Safety	IntelliDrive^{SM} Vehicle to Infrastructure (V2I) Communications	Facilitate the accelerated development of effective and deployable V2I communication based safety systems that enhance safety across the nation's vehicle fleet. This may be done through a combination of: • Advisories, Alerts, and Pre-emptive control Key application areas: • Intersection safety, Run-off road prevention, Speed management, Enforcement and operations for commercial vehicle operations	• Crash causation study • Interoperability standards • Application development • Human factors studies • Benefits assessment • Policy framework • Tools for practitioners
	IntelliDrive^{SM} Vehicle to Vehicle (V2V) Communications	Facilitate the accelerated development of effective and deployable V2V communication based safety systems that enhance safety across the nation's vehicle fleet.	• Crash causation study • Interoperability standards • Application development • Human factors studies • Benefits assessment • Policy framework • Tools for practitioners
	Harmonization of International Standards and Architecture around the Vehicle Platform	Reduce costs to industry and consumers • Hardware and/or software development cost spread over larger user base leads to reduced unit cost • Minimize differences between vehicles manufactured for different markets Speed deployment of connected technologies • More people working toward common goals • Leverage expertise across borders • Overall public benefit	U.S. DOT modal organizations working with International organizations and vehicle and equipment manufacturers to maximize the extent to which common standards are adopted for V2I and V2V technologies.

Table 3-2. Preliminary Program Proposal Themes and Key Activities (Continued)

Goal Area	Program	Themes	Activities
Safety (cont.)	Vehicle Control Assistance for Safer Travel	Develop a concept for safer travel ("managed lanes") that avoids driving situations that often lead to crashes and that allows proactive partial control of vehicle movements where drivers can benefit from it Foster broad partnerships with automobile, telecommunications, traffic control industry, and public agencies to research and develop these concepts	• Crash causation studies to identify specific crashes that might be avoided • Driver behavior studies to understand how driving actions and partial vehicle control strategies can avoid these crashes • Development of concepts of operations and supporting technologies • Deployment planning and business model research • Early demonstrations and field testing of the safety services in one or more urban areas
	Human Factors for IntelliDrive^{SM}	Measure distraction due to new applications and systems Develop real-time monitoring and performance guidelines and countermeasures that will minimize distraction and other unsafe driver behavior	• Sponsor collaborative research • Develop guidelines and standards in collaboration with stakeholders • Implement voluntary standards or regulations • Develop compliance guidelines

Table 3-2. Preliminary Program Proposal Themes and Key Activities (Continued)

Goal Area	Program	Themes	Activities

Mobility (Data)	Real-Time Data on All Roads and All Modes	• Facilitate maturation of technologies and sustainable business models
		• Ensure that essential data needs are met
		• Promote quality, consistency and accessibility of data
			• Lead research and develop technology framework
			  o Standards for data collection, quality, archive and exchange
			  o Enable data integration and data sharing
			• Develop large-scale data sets to support research and applications development and testing
			• Conduct multi-state and regional field demonstrations on all modes and all roads
			• Assess effectiveness and viability of business models
			• Implement rules (or mechanisms of encouragement) to ensure basic level of real-time information is available throughout the US

Mobility (Apps)	Achieving Dynamic and Proactive Transportation (ADAPT)	• Leverage data from vehicle to infrastructure connectivity to create applications that enable dynamic and proactive decision making by operators and travelers.	• Foundational research on application needs and concept of operations
			• Development of tools, such as algorithms and decision support systems
			• Demonstrations of:
			  o Application of robust data set in a regional context
			  o Modeling of benefits to be achieved if applications widely deployed
			  o Potential large scale field demonstration with sizeable vehicle fleet

Table 3-2. Preliminary Program Proposal Themes and Key Activities (Continued)

Goal Area	Program	Themes	Activities

Mobility (Payment)	Mileage-Based User Fee	• Investigate and demonstrate technology applications that:
		  i. Support mileage-based user fee highway financing
		  ii. Appropriately advance other related objectives such as safety and mobility
			• Will be significantly shaped by the approach Congress takes in the next transportation act; could include:
			  o Defining a core set of policy options that are enabled by various technologies
			  o Develop systems requirements and standards

	Integrated Payment System for All Modes	• Stimulate development of a viable, fully integrated transportation electronic payment system by identifying and promoting the most effective technological solutions and developing national policy that will stimulate public and private shareholders to deployment	• Bring together all travel-related fee collection stakeholders/entities
			  o Listening sessions to identify issues and specific needs
			  o Establish business case satisfying "what's in it for me" for all modes and entities
			  o Proof-of-concept testing

Table 3-2. Preliminary Program Proposal Themes and Key Activities (Continued)

Goal Area	Program	Themes	Activities
Environment	Applications for the Environment: Real-time Information Synthesis (AERIS)	• Enable environmentally-beneficial choices by travelers and system operators • Demonstrate the most effective uses of ITS technologies to reduce negative impacts of transportation on the environment • Invest in research consistent with long-term departmental and National environmental goals	• *Undertake foundational research and analytics* to build the foundations for a rigorous and innovative research program • *Develop effective technological solutions, applications and implementation opportunities;* conduct up to 6 research programs ranging from technologies that improve and support eco-driving, development of an automated tool to support real-time operational decision-making regarding tradeoffs between system performance, air quality and GHG issues, reducing emission around freight hubs due to idling and other inefficiencies, to technologies that support transit agency decisions to optimally employ fleet resources to maximize energy efficiency. • *Exploration of policy and regulatory issues* that will help to achieve the objectives of this goal area and support the implementation and commercialization of technologies, tools and approaches. • *Documentation and dissemination of research results and products*
	Exploratory Research in Community Transit Service	• Explore whether emerging vehicle automation technologies can enable an innovative new transit service that can significantly shift travel from cars to buses.	• Assess vehicle configurations, propulsion systems, control, and automation systems • Assess traffic signal control and other intersection strategies • Development of operational strategies • Investigate institutional issues and barriers • Conduct a field demonstration

4.0   WORKSHOP RESULTS

This section summarizes the discussions that took place in the breakout sessions. The results, merging the morning and afternoon sessions, are presented by the five goal areas. The summary of stakeholder input for each goal begins by highlighting the overall themes of the discussion. Next, stakeholders' response to the goal area's program proposals is presented according to the topics of the four questions posed by the facilitators—the program theme, who does what, technologies, and defining success. A final section notes any linkages to other programs.

4.1   Safety

Both the morning and afternoon breakout group discussions on Safety were well attended, generally drawing more participants than the other breakouts. There were a total of five program proposals in the Safety area. The morning discussion covered three program proposals, the IntelliDrive^{SM} Vehicle-to-Infrastructure (V2I), the IntelliDrive^{SM} Vehicle-to-Vehicle (V2V), and the Harmonization of International Standards and Architecture. The afternoon session covered the two remaining program proposals, Vehicle Control Assistance for Safer Travel and Human Factors for IntelliDrive^{SM}. The participants attending both the sessions were identical for the most part due to the fact that there were five distinct program areas covered during the breakout sessions. The participants included a diverse set of expertise including industry (auto and suppliers), academia, consultants, government agencies from all modes of transportation, and private after market product suppliers. In program proposal consideration was given to each of the four major discussion topics.

A number of major themes surfaced in the Safety breakout discussions. First, many stakeholders commented that the program proposal "themes" need to be revised to include crash scenarios and focus the safety research on the top percentage of crash causes. Comments centered on addressing themes from a problem-based perspective and issues relating to mapping, positioning, and better vehicle sensing technologies incorporated into connectivity.

A second theme was that many stakeholders felt that the safety research for all programs has to consider distinct deployment strategies for vehicle and infrastructure instead of parallel deployment. The stakeholders commented that different time frames from the vehicle side could advance deployment of aftermarket products while slow to moderately paced deployment from the infrastructure side can focus on installation of communications equipment.

> **Safety Overall Stakeholder Input Themes**
>
> - Consider crash scenarios and top crash causes to define themes
> - Progressive deployment strategies for vehicle and infrastructure
> - Liability issues – can we have "fail-safe" systems/applications?
> - Results from safety programs need to advance public and industry acceptance
> - Include demonstrated quantitative targets/goals
> - B/C analysis for each crash scenario
> - Success matrix with milestones to ensure concept is still viable for deployment

A third theme is that these programs would need to address how to manage liability. There was a strong consensus that these systems can be certified and show that they are "fail-safe" to a

specified requirement to mitigate liability issues. The liability issue was especially critical to the Vehicle Control Assistance program which needs to address how the public will accept their vehicle taking over control while driving. However, an overarching theme from all the programs is that the results from these research programs need to mitigate liability and lead to public acceptance and industry (e.g., OEM's, NHTSA, SAE, AAA, APTA) acceptance of these systems and applications.

A final theme that resonated throughout the five program areas in the morning and afternoon sessions was that the research in the safety areas should include a success definition with a demonstrated quantitative goal. For example, "decrease collisions at a specific crash area or intersection by 90%." The stakeholders felt that a measurable goal defined by U.S. DOT and other government entities promoting this research will enable the industry and technology experts to deliver a solution that meets those requirements. An overarching theme was that there needs to be benefit-cost analysis for each of the crash scenarios including specific details on performance measures such as accidents vs. costs, and lives saved.

One final thought considered critical to the safety area is to have a success matrix with "check points" and "milestones" during the life of the program. Such a matrix would help assess whether the concept and deployment remains viable due to rapid changes in technology of these systems and applications.

Specific comments on each of the five programs are synthesized below.

4.1.1   IntelliDrive^SM Vehicle-to-Infrastructure (V2I) Communications for Safety

This section summarizes the findings of the stakeholder input on V2I.

Program Theme. There was extensive discussion of the proposed program "theme"—and how the theme addressed accident and crash notification scenarios. Many comments and questions focused on the themes to be "mapped" based on crash scenarios and addressing themes based on high crash areas and crash problems (i.e. single vehicle crashes, intersection crashes, etc). Some participants focused on detailed technical issues more so than the overarching theme. There was interest in investigating enhanced mapping and vehicle sensing technologies for location information. There was also considerable discussion on looking at potential mechanisms for accessing and porting vehicle data bus information to the private sector to enable and advance the development of after-market products. Participants commented that these products and information when fed back to the driver could provide a feasible option of allowing the interest in convenience to be deployed, and leverage that interest into safety.

> **Highlights of Stakeholder Input on Program Theme**
>
> - U.S. DOT should consider revising the "themes" based on "crash scenarios"
> - Address enhanced mapping and vehicle sensing technologies
> - Define what the end outcome is in terms of "quantifiable measures"
> - Consider progressive deployment strategies for "vehicle" and "infrastructure"
> - Address interoperability for "network" and "V2V" systems

Several stakeholders also felt that this program and the themes should be tailored to address distinct deployment strategies for vehicle and infrastructure instead of parallel deployment.

From the vehicle perspective, accelerated deployment from the auto manufacturers, mandatory requirements for new cars, and retrofits for older vehicles were the key strategies discussed. From the infrastructure perspective, the stakeholders commented that the deployment strategies should focus on the types of low level latency communications available and applicable for different key safety applications.

There was considerable discussion on addressing interoperability issues and the co-relation and constraints between systems used in the V2I program and systems used in the vehicle–to-vehicle communications (V2V) for Safety. Stakeholders emphasized that interoperability needs to be addressed from both the vehicle and the network perspective for both the programs. The interoperability discussion also led to comments from stakeholders on considering other standards for applications not covered by SAE J2735, which has been the primary emerging standard for V2I applications. There was some discussion on what the role of the public sector was and some stakeholders felt that the theme needed to address how this program will benefit the public sector to progress towards deployment. Similarly, there were some stakeholders who felt that the program also needed to address who the "end user" was and how they plan to use these systems/applications.

Overall, there was a general agreement that the theme needed to address and define an "end outcome" and measure this outcome using quantifiable data to determine if the outcomes are achieved.

Who Will Do What? The discussion in this area considered the activities that should be performed, the stakeholders to be involved and ways to involve the stakeholders. Overall, stakeholders offered few comments related to specific roles except that the private sector would be responsible for building the hardware and supplying it and the public sector would be responsible for installation of this hardware (from the infrastructure perspective).

Technologies. Stakeholders commented on a variety of technologies for this program including Wi-Fi, radio frequency identification (RFID), cellular, satellite, and dedicated short range communication (DSRC). The consensus on the technologies was that they need to be selected based on the type of applications that are included in the program. There was also discussion that V2I connectivity should include multi-mode communications based on the type of applications selected and should consider an integrated solution based on coverage and latency requirements. For example, one stakeholder comment suggested that an integrated vehicle communications module could include:

- DSRC technologies for active safety applications that are latency-sensitive
- Cellular technologies for broad coverage applications that are non-latency-sensitive
- Satellite technologies for rural areas applications that are non-latency-sensitive

Apart from the suggested technologies stated above, the most significant "message" from the stakeholders regarding technology was that although there are several technologies available currently, but they are too expensive at the current volumes to be "deployable" from cost perspective. The message was that there needs to be some consideration given to addressing the commercialization of these technologies and to make them viable in terms of cost. Though this

issue was significant, there was some concern that this could be addressed as a policy issue rather than technology issue.

Defining Success. Stakeholders offered a number of suggestions related to what would constitute success for the U.S. DOT V2I research program, including the following:

- A clear definition on how this research will lead to some measurable benefits so that the investment from the private sector building and supplying the hardware is logical.

- Benefit and cost analysis for different crash scenarios/applications including specific details on specific performance measures such as accidents vs. costs and lives saved.

- A measurable target and goal defined by U.S. DOT and other government entities to enable the industry and technology experts to deliver a solution.

- Consider a success matrix with "check points" and "milestones" during the life of the program to assess the viability of the concept and deployment.

- Consider viable deployment strategies and time frames for future research analysis and transition. For example, deployment of DSRC to all vehicles will take a long time, and, thus consider focusing the program to high crash risk using both instrumented and non-instrumented infrastructure.

Linkages with Other Programs. The strongest message from the stakeholders regarding connections between programs pertained to the V2V program within the Safety area. Several stakeholders felt that the programs are closely related in terms of technology, applications and standards. The most significant message was that the V2I systems and applications will need to be "interoperable" with V2V systems and applications.

4.1.2 *IntelliDriveSM Vehicle-to-Vehicle (V2V) Communications for Safety*

This section summarizes stakeholder input on the V2V program proposal.

Program Theme. There wasn't significant discussion on the proposed theme for this program except that that the consensus of the stakeholders was that the theme needs to reflect a "propagation" of safety. There was discussion that the theme did not include key application areas and reverberated thoughts from the V2I discussion that the themes can be "mapped" based on crash scenarios. There was interest in vehicle sensing technologies for mapping and positioning and the reliability of these technologies for active safety applications.

Similar to the V2I program there was discussion on the progressive deployment strategies from the vehicle perspective on accelerated deployment from the auto manufacturers, mandatory requirements for new cars and aftermarket retrofits for older vehicles. This also led to the discussion on how data from this research will support the NHTSA New Car Assessment Program (NCAP) and assist in the deployment of V2V systems.

> **Highlights of Stakeholder Input on Program Theme**
>
> - U.S. DOT should consider revising the "theme" to add "key application areas"
>
> - Consider cross-fertilization of V2I and V2V programs

The most important message that resonated from the stakeholders was that there needs to be cross fertilization between the V2I and the V2V programs within the Safety research area of U.S. DOT.

Who Will Do What? The discussion in this area considered the activities that should be performed, the stakeholders to be involved and ways to involve the stakeholders. The breakout participants identified a list of stakeholders that should be involved in some capacity in this program and their potential roles as illustrated in Table 4-1.

Table 4-1. V2V Stakeholders and their Roles

Stakeholders	Roles
▪ Drivers of all ages	▪ Test subjects and profile
▪ Pedestrians and bicyclists	▪ Test subjects
▪ Emergency responders	▪ Provide unique data needs and requirements
▪ Enforcement agencies	▪ Provide data needs
▪ Road owners (i.e. state DOT, city)	▪ Own the infrastructure
▪ OEM (auto manufacturers)	▪ Requirements, liability, warranty, development
▪ Tier 1 suppliers	▪ Requirements, development
▪ Government	▪ Outreach, provide test bed
▪ Technology suppliers	▪ Requirements, Development
▪ Communication suppliers	▪ Products, development
▪ Academics & research organizations	▪ Innovation, fundamentals
▪ Consultants	▪ Requirements, test
▪ Insurers	▪ Potential resource mechanism, research needs
▪ Driver license agencies	▪ Data needs

Technologies. Stakeholders did not provide any significant comments on the types of technologies for this program. However, there was discussion that enhanced mapping and sensing technologies were critical to the success of this program.

Defining Success. Stakeholders offered a number of suggestions related to what would constitute success for the U.S. DOT V2V research program, including the following:

- Data from this research needs to support NCAP.
- Development of an objective test set to analyze and measure safety applications
- Development of human factors guidelines for safety applications
- Resolution of DSRC issues on range, reliability, and interoperability from VII Proof of Concept (POC) testing
- Roadmap on defining how security is managed and implemented to ensure "trust" in V2V communications

Linkages with Other Programs. As discussed in the V2I program**,** the strongest message from the stakeholders regarding connections between programs pertained to the V2I program within the Safety area. Several stakeholders felt that the programs are closely related in terms of technology, applications and standards. The most significant message was that the V2V systems/applications will need to be "cross fertilized" with V2I systems/applications.

4.1.3 Harmonization of International Standards and Architecture around the Vehicle Platform

This section summarizes stakeholder input for the program proposal on Harmonization of International Standards and Architecture around the Vehicle Platform.

Program Theme. The discussion on the proposed program "theme" focused on comments from stakeholders recommending that the theme needs to be "defined" and clearly "stated" as to why this program is necessary. Suggestions on the need for this program included the fact that harmonization of standards will enable the use of efficient resources and utilization and foster economies of scale. The stakeholders suggested that the theme should focus on "harmonization" rather than 'promotion" of individual national standards.

There was also discussion focused on making sure that different resources and allocations of technical expertise are working on the "safety" standards and that there is no duplication of work currently being developed by a variety of Standard Development Organization (SDO's) in the US and internationally.

> **Highlights of Stakeholder Input on Program Theme**
>
> - Define and state themes based on need for efficiency of resources, economies of scale, etc
> - Avoid duplications and allocate technical expertise efficiently
> - Theme should include testing and certification
> - Address data spectrum, data sets, interfaces and protocols

There was a strong consensus that the themes should include the development of testing and certification of systems and applications in relation to the standards. There was discussion that OmniAir currently provides DSRC certification and stakeholders proposed that they could also provide certification of vehicle safety applications. The last discussion on the themes included comments to address all facets of standards including the data spectrum, data sets for specific applications, interfaces and protocols and finally certification.

Who Will Do What? The discussion in this area considered the activities that should be performed, the stakeholders to be involved and ways to involve the stakeholders. Comments related to stakeholder involvement included the following:

- The European Union stakeholders developing standards need to be involved in the program.
- The U.S. DOT needs to have closer coordination and harmonization with European Commission/Union and other government agencies in Asia on some of the R&D trials and share these results with EU.
- Industry stakeholders like the OEM's and suppliers who use the standard need to play an active role in developing the standard.
- The Department of State can play a role as an enabler of the standards and provide legal framework to work with other overseas agencies within the research arena.
- The individual U.S. state agencies can provide a role in deploying standards and providing data from using the standards.
- The Federal Communications Commission and other certification entities can dictate licensing and provide technical guidelines and requirements. They can also define methods and allowable content for development of the standards.

- Research institutes can play a vital role in the development and verification of standards.

Technologies. Stakeholders did not provide any comments on the types of technologies for this program.

Defining Success. Stakeholders offered a number of suggestions related to what would constitute success for this research program, including the following:

- The development and delivery of an international testable standard.
- Ensuring that there are no redundant standards to avoid duplication and misinterpretation.
- Standards that support the intended requirements of the application desired.
- Agreements among participants (both national and international) to continue working on future standards.
- Benchmark interoperability among partners.

Linkages with Other Programs. There wasn't any specific discussion on this issue but standards were discussed throughout the other safety programs, and inferring that this program feeds into the V2I, V2V, and Human Factors programs in safety.

4.1.4   Vehicle Control Assistance for Safer Travel

This section summarizes stakeholder input for the program proposal on Vehicle Control Assistance for Safer Travel.

Program Theme. When asked about their reaction to the theme of the proposed ITS programs for vehicle control assistance for safer travel, the participants' responses focused around three main areas. These included defining the themes based on the types of crashes, addressing the actual concept of proactive control, and including other potential agencies for partnerships.

Highlights of Stakeholder Input on Program Theme
- Focus research on top percentage of crash causes - Clarify concept of "proactive/partial control" - Include transit and commercial manufactures, and academia for partnership roles - Liability concerns

With regard to the theme of the program, the stakeholders noted that it could be organized around types of crashes and focus on the research in the highest percentage of crash causes. One concern stated by stakeholders was that this research was concentrated on the urban areas, while statistics show that approximately 54% of the crashes occur in rural areas.

The second issue of discussion with regard to theme was focused on defining the "actual concept of proactive/partial control." The participants noted that there needs to be clarification on the definition of proactive/partial control, and the theme needs to state "what it is" and "what it's not." The stakeholders noted that the idea of "managed lanes" is very broad and that the concept needs to be refined to state specifically whether the vehicle control includes infrastructure components, an overlay of traffic management, intersections, or just vehicle systems.

The third discussion on the program theme was on the requirement for partnerships stated in the research program. Stakeholders noted that transit bus manufacturers, commercial vehicle

operators and academia need to be included as potential partners in the research program. The final part of the discussion on the theme focused on concerns that local agencies may not have the influence on the specifications or type of safety systems they desire. The decision on what is purchased is usually made by fleet operators who use a "low bid" method for acquiring these systems and may not include all the specifications required by an "end user."

Overall, there was an overwhelming concern regarding liability in this program. The stakeholders noted that these systems need to be "fail-safe" to reduce the liability issues and facilitate acceptance of the systems.

Who Will Do What? The discussion in this area considered the activities that should be performed, the stakeholders to be involved and ways to involve the stakeholders. Comments related to stakeholder involvement included the following:

- The owner/operator of the facility, such as a state DOT, can provide safer travel on the infrastructure. They could also be involved in installation of roadside equipment e.g. DSRC based.

- The commercial vehicle industry can serve several roles including:
    o Allowing managed lanes to separate cars and trucks and provide an incentive to the operators
    o Provide input to requirements and concept of operations
    o Integrate on-board safety systems.

- The commercial vehicle truck suppliers can play a role in testing and promoting standardization .

- There were several roles identified for emergency responders including:
    o Being the co-managers of the system – i.e. EMS, fire, rescue
    o Integrating the public safety responders to co-manage the roadway.
    o Being the "key" to early deployment of these systems. They can be used as recipients of early deployment as they are the only measurable success.

    To try and engage these groups the stakeholders commented that the U.S. DOT needs to reach out to them and make them aware of the research programs. Another avenue to engagement included reaching out to the trade associations that they are part of and invite them to these meetings

- Manufacturers of first responder vehicles/safety systems/emergency systems were also considered as potential stakeholders even though they may not play a significant role. The participants noted that they could be helpful in identifying specifications for the vehicles. Similar to the emergency responders, these stakeholders could be engaged through professional associations for safety.

- Conventional light vehicle manufacturers can play a role in:
    o Integration and deployment of on-board safety systems
    o Providing input to requirements and concept of operations.

- The government would play of the role of regulating the use of the safety equipment

- The research community, including academia, can play a vital role in providing policy guidance and defining underlying fundamentals and requirements.

- The <u>driver</u> plays an important role from the human factors and human machine interface perspective. The driver will also need to accept the technology, the cost of the system, and eventually provide feedback on the use of the system.

- <u>Insurance companies</u> were stated as potential stakeholders, but there was some skepticism that previous efforts by ITS America to engage this group has proven unsuccessful. These stakeholders wanted solid data to accept and play a part of these technologies, but the research has not provided enough data to convince them.

Technologies. Stakeholders commented on a variety of technologies for this program including:

- Location technologies
- Mapping technologies
- Human machine interaction/active audible warnings, visual indications
- Vehicle control systems
- Fail-safe technologies
- DSRC communications/5.9 GHz
- Security and authentication
- Vehicle perception and sensing systems

The consensus on the technologies was that they need to be selected based on the type of applications that are included in the program.

Defining Success. Stakeholders offered a number of suggestions related to what would constitute success for the U.S. DOT Vehicle Control Systems research program, including the following:

- <u>Benefit-cost analysis</u> for different crash scenarios and applications including details on specific performance measures such as accidents vs. costs and lives saved. The success will be measured by attaining a positive benefit-cost ratio for these systems.

- An <u>evaluation on the cost</u> of the devices, and the cost to operate and maintain these systems.

- Establishment of <u>key activities</u> including :
  - o Reliability requirements
  - o Performance requirements
  - o Testing and certification requirements

- An approach to <u>deployment liability issues</u> including:
  - o The need for legislation/rulings to limit the liability for these applications:
    - Intersection control
    - Signal phase and timing (SPAT) messages
    - Level of availability and reliability
  - o The need for a certification approach to quantitatively show that systems and applications are "fail-safe" to a specified requirement.

- <u>Public acceptance</u> and <u>buy-in</u> of these systems

Linkages with Other Programs. There wasn't any specific discussion on linkages but it is reasonable to conclude that this program feeds into the V2I, V2V, and Human Factors programs in safety.

4.1.5   Human Factors for IntelliDriveSM

This section presents stakeholder input on the program proposal for Human Factors for IntelliDrive^{SM}.

Program Theme. The stakeholder discussion on the themes focused on driver arbitration of messages given to the driver and keeping the theme of the research "positive." Most of the comments indicated that the theme needs to address how the driver inputs, accepts and responds to a multitude of complex message sets and information. This is particularly important when the user is being presented with a variety of applications and warnings that are of different levels of priority. The priority of messages and a rule set for types of messages presented to the driver needs to be addressed as part of the theme. The message sets also need to be consistent in terms of audible and visual indications and symbology.

> **Highlights of Stakeholder Input on Program Theme**
> - Keep the theme "positive"
> - Address "driver workload"
> - Address arbitration of driver messages from complex user set
> - Priority and consistency of messages/warnings

The second part of the discussion on the theme focused on addressing the usability and primary acceptance of this system from the drivers' perspective. Stakeholders also commented that the theme needs to clarify if the research is focused only on in-vehicle systems or if there are infrastructure components included.

The final part of the discussion focused on liability concerns and how to manage liability for this research effort, similar to the vehicle control assistance for safer travel program.

Who Will Do What? The discussion in this area considered the activities that should be performed, which stakeholders need to be involved, and ways to involve the stakeholders. Comments related to stakeholder involvement included the following:

- Commercial vehicle operators can be included as stakeholders as they can communicate their unique user needs and requirements. This group can be engaged through the associations and a starting point to get them motivated would be through some of the progressive fleet owners.
- Transit agencies and transit community as a whole are stakeholders that provide unique user needs for audible/visual warnings and human-machine-interface (HMI) issues. A good way to reach out to this group would be through the American Public Transit Association (APTA).
- Consumer Electronic Suppliers of Mobile Devices can be involved and provide definitions and some unique HMI aspects. These stakeholders can also be a vital resource in providing feedback on the devices from market research.
- The driver who is the main test subject of this research effort.
- Enforcement and governing agencies including law makers. Their primary responsibility would be "buy-in" to these systems.

- The state and local agencies that own/operate the infrastructure.
- The <u>auto industry and suppliers</u> who will play an important role in defining requirements and integration of these systems into other in-vehicle systems and components.
- The <u>FHWA Office of Traffic Safety</u> was also brought up as a potential stakeholder that could be involved in providing continuing education and training of these systems and applications.

Technologies. Stakeholders did not provide any significant comments on the types of technologies for this program. However there was discussion that driver engagement technologies and driver/traveler workload monitoring technologies were critical to the success of this program.

Defining Success. Stakeholders offered a number of suggestions related to what would constitute success for the Human Factors for IntelliDrive^{SM} research program, including the following:

- <u>Acceptance of results</u> and <u>valid buy-in</u> from key agencies and stakeholders and enablers such as NHTSA, AAA, and APTA
- <u>Acceptance by SAE</u> on user guidelines and industry acceptance.
- Development of easily and quickly understandable symbology and consistency of messages/warnings.
- Establishment of a framework and traceability of driver behavior and user guidelines for HMI. This framework should also include information on correlation to other modes.
- An <u>approach to managing</u> liability.
- <u>Public acceptance</u> of these systems.

Linkages with Other Programs. There wasn't any specific discussion on linkages but it is apparent that all programs in the safety area need to address human factors to get industry and public acceptance of IntelliDrive^{SM} systems and applications.

4.2   Mobility (Data)

The morning and afternoon Mobility (Data) breakout sessions were well attended. Discussion focused on the one proposed program in this area: "Real-Time Data on All Roads and All Modes."

A number of major themes surfaced in the breakout discussions. First, stakeholders identified a wide variety of roles for ITS-JPO ranging from facilitator, to regulator, funder, and enabler of innovation. Second, stakeholders were concerned that "all roads and all modes" might be impractical and in conflict with the strategic plan guidance to have few/focused programs. Third, stakeholders emphasized that the

> **Mobility (Data)**
> **Stakeholder Input Themes**
> - Multifaceted Federal role including "grand facilitator," enabler of innovation, regulator and funder
> - Reconciling "few/focused with "all roads, all modes"
> - Research driven by needs, requirements and applications
> - Need for standards and guidelines, including interoperability/data exchange, data quality, privacy and security
> - Learn from other business models, including the National Weather Service and the cellular industry

research should be driven by needs, requirements and applications (including the applications that are being developed as part of the other programs). Fourth, stakeholders identified the core need to develop data quality, metadata and interoperability standards and to have those standards adopted. Those standards should also address privacy and security concerns. Finally, stakeholders felt that ITS-JPO needs to learn from various existing models of data collection and data sharing from the public and private sector. The National Weather Service (NWS) was mentioned as a purely public system and contrasted with the cellular industry which is driven by commercial entities.

4.2.1 Real-Time Data on All Roads and All Modes

This section summarizes stakeholder input for the program proposal on Real-Time Data on All Roads and All Modes.

Program Theme. Uses of the data being collected was a major focus of stakeholder discussion, including the need to consider how we intend to change traveler behavior and the need to achieve public acceptance of the policy objectives so they will support the necessary data collection. Stakeholders cautioned that without clear requirements and business needs a lot of money could be spent collecting data that may not be useful. Stakeholders also acknowledged, however, that to some extent applications can spring up in response to available, high-quality data and that one of the challenges of the research will be in balancing this "chicken and egg" relationship.

> **Highlights of Stakeholder Input on Program Theme**
>
> - Data drives applications and applications drive data—"chicken and egg" relationship
>
> - Many, many data needs; research must be prioritized
>
> - Use existing data and data collection mechanisms to the maximum extent
>
> - Data quality and consistency may need to be traded off against cost
>
> - Heed the special needs in rural areas and on arterial roadways

Stakeholders felt that "all roads, all modes" was not focused enough. There was concern that that the community might never be able to capture all the data across all the modes and all the time and some prioritization might be required based on user needs and applications. The stakeholders also noted that it is important to understand what is available and how data might be derived existing systems. While there is data which is outside the public domain, the stakeholders noted that current data sharing between the public agencies can be improved greatly.

The stakeholders noted that the transparency of data is very important especially given that there are new players and new methods to collect data. Transparency of data should include information on how the data was collected and validated. There was a comment that the private sector might be reluctant to be fully transparent about the way data is collected.

Some discussion centered on the notion of "open data". Having open access to public data will allow the private sector to develop applications. Absent government involvement, data costs would be determined by the actions of a few key players; a mechanism to control costs is essential. It was also noted that the data is going to be available from multiple sources and common data models are a necessity.

There was considerable discussion of data quality, data sharing, and data standards. Stakeholders noted that the missing link has been availability of good quality data. It was noted that the quality of data differs by application. While data quality measures have been identified, they need to be defined and adopted. The data collection program has to be built on a solid foundation of security, privacy and ownership. While there are high-level policies on driver privacy, the issue is more complicated when several sources of data are combined. A method needs to be developed whereby the privacy of aggregated data is determined. One stakeholder noted that quality, cost, and compatibility might have to be weighed against each other. The need for consistent metadata was recognized and tabled by the stakeholders.

Stakeholders agreed that a very broad range of data should be considered in the research. There was specific discussion on data collection methods appropriate for arterials and rural areas and it was noted that rural data needs might be significantly different than urban area needs. Data requirements need to consider new and unusual applications and the program should look beyond traditional traffic data to consider weather and incident information.

Stakeholders expressed dissenting opinions on data ownership and fee issues. Some felt that data should be viewed as a public good, made easily available, and to let developers compete with one another over applications rather than data. It was noted that paying for data collection would be challenging under such an approach. Others felt that, while data access was important, it could be accomplished by users paying for the data, particularly if the private sector had added value to the data that had been collected.

In terms of data access, stakeholders said that timeliness is very important and latency can significantly impact the utility of various data. It was also noted that access to the data should be available to planning agencies through the means of an archive. The exact nature and operating concepts of the data archive are important issues for ITS-JPO to resolve as part of this program. As an aside to this discussion, a stakeholder noted the program is going to create very large datasets which present data management, data analytics and data mining challenges and opportunities. Universities and the private sector were noted as well qualified to look into these questions.

Stakeholders felt that innovation is inherently "messy." They suggested that ITS-JPO find ways to stimulate innovation at the local level where data collection will actually occur. Another general suggestion was that "checkpoints" or milestones are more appropriate than a fixed roadmap. A stakeholder noted that instead of research for abstract business models, the program should focus on a couple of end-states and look at similar systems in the public and private domain. Two systems were mentioned as examples

- Weather system – run largely by the Federal system.
- Cellular system – no government standards. Driven by the commercial market.

Who Will Do What? This portion of the breakouts focused on identifying roles and responsibilities. Discussion primarily revolved around ITS-JPO and the roles expected of them.

A wide variety of roles and responsibilities were suggested for ITS-JPO by the stakeholders. Ultimately, it was noted that the ITS-JPO has to be the "grand facilitator" for at least the next

five years after which the private sector can become implementers. As part of this facilitation role, the stakeholders noted the following activities:

- Establishing standards, whether developing new standards or promoting or adapting existing ones, including those outside of transportation.
- A more forceful role in encouraging public agencies to share data.
- Funding collaborative research, including fostering partnerships between private, public and academic institutions
- Assisting local agencies, who have limited IT resources, in developing large scale data collection and management programs.
- Coordinating this program with the USDOT Environment and Mobility (Applications) research and working with OEM on vehicle-based data collection.
- Determining policy objectives—a crucial role in so much as these objectives will influence technology choices and costs.

Several roles were mentioned for ITS-JPO to promote the availability of high-quality data:

- Developing standard data models (differences between data models have been the biggest barriers to data integration)
- Identifying key data sets for agency initiatives and activities
- Developing data warehousing guidelines
- Understanding and resolving data ownership and access rights, including developing fair access guidelines and access levels so that companies have equal access to public data
- Peer exchanges; looking at other Federal agencies operating similar data programs (e.g., Department of Defense, Federal Aviation Administration, National Oceanic and Atmospheric Administration)
- Research into managing, mining and analyzing large datasets
- Developing a comprehensive taxonomy of data: defining data items, data sources, data categories, potential uses, and costs

An institutional issue that was discussed but not resolved was whether there needs to be a regulator for traffic data who will set the boundaries on data collection and management. Stakeholders also identified the need for a certification body, an entity which would review datasets for quality and interoperability.

Transit agencies were recognized by stakeholders as an important source of data, including the potential of processing transit data to obtain measures of network performance.

Participants made few suggestions regarding specific mechanisms for stakeholder involvement, feeling that uncertainties preclude fixing a stakeholder involvement program at this time. Rather, they recommended that the research program build in check points where stakeholders are brought together at various points throughout the program. The one specific stakeholder involvement mechanism noted was development of regional partnerships such as the Washington, DC Regional Integrated Transportation Information System, a regional data clearinghouse operated at the University of Maryland.

Technologies. Stakeholders noted that technologies will depend on policy objectives, application types and requirements and the program should not exclude any technological options. It is likely that the program is going to collect data from a combination of technologies.

It was noted that increasingly open cellular networks are emerging which may provide new opportunities for data collection and collaboration between the public and the private sector. One stakeholder recommended that the program needs to leverage what the commercial technology industry is envisioning for their systems for traffic and transportation data.

Technology challenges identified by stakeholders include:
- Reducing latency and improving the accuracy of positioning devices (high accuracy for lane positioning is needed for safety)
- Extending wireless coverage by using cars as a transmission medium, communicating with each other using DSRC
- Filling coverage gaps (minimizing urban canyons, expanding coverage in rural areas)
- Reducing the cost of back-haul communications
- Improving resource-sharing between public and private networks

Defining Success. Stakeholders identified a wide variety of metrics in three categories to define program success: data collection and management, data use and sharing, and institutional issues. The following metrics were suggested for data collection and management:
- Amount of data transmitted (meet the goals for each data set)
- Number of users and data sources
- Number of applications (with success indicated by the growth in applications)
- Penetration of the data collection program
- Widely available, adopted data quality and accessibility standards
- Technologies available for purchase that can cost effectively collect data over a wide area

The following metrics were suggested for data use and sharing:
- A demonstrated advance in operations as a result of improved data
- A variety of data users, including value-added reselllers
- Demonstrated benefits of real-time data, including a positive impact on organizations' and travelers' "bottom line" and reduced congestion and pollution
- Establishment of regional data repositories containing public and private data that is accessible to private application developers at no cost
- State and local transportation agencies find their operating costs acceptable

The following metrics were suggested for institutional issues:
- Cooperative agreements between different Federal, state and local agencies on data sharing
- Acceptance of the data collection model by consumer advocacy and privacy groups

- A significant increase in commercial investment in response to USDOT research activities
- Definition of a viable business model
- Buy in and participation across modes, including parking, emergency management, freight, port authorities, and aviation

Linkages with Other Programs. Stakeholders indicated that research in this area should be coordinated with the Mobility (Applications) and Environment areas.

4.3 Mobility (Applications)

Both the morning and afternoon sessions of the Mobility (Payment) breakout group were well attended. The dialogue focused on the one proposed program: "Achieving Dynamic and Proactive Transportation (ADAPT)."

A number of major themes surfaced in the Mobility (Payment) breakout discussions. One was the concern that the statement as it stood was too narrow. To generalize these concerns: (a) there needs to be explicit reference to real time control applications, (b) the development of adaptive and learning systems should be considered, (c) the definition of mobility should not be restricted to travel time and should be expanded to include other focus areas such as environmental/green, enforcement, freight, accessibility, safety, and others.

A second theme was general agreement that a development environment similar to that of iPhone would be useful. That is, if standard data models and platforms are developed and defined first, the marketplace will utilize their ingenuity and expertise to develop useful, marketable applications that fill users' needs.

A third theme is lack of consensus on appropriate private and public sector roles. There was a lot of discussion about this topic, but it seemed that there was not a strong group consensus. In general, some agreement seemed to center around the concept of the public sector serving as a data warehouse and the private sector acting as a data retailer and leveraging the use of the data through applications.

> **Mobility (Applications) Stakeholder Input Themes**
>
> - Develop data models, define platforms, and allow entrepreneurs to develop the applications.
> - Broaden the focus to include: real-time control applications, considering development of adaptive and learning systems, and expanding the definition of mobility beyond travel time.
> - Lack of consensus on appropriate private and public sector roles.

4.3.1 Achieving Dynamic and Proactive Transportation (ADAPT)

This section summarizes stakeholder input for the program proposal on Achieving Dynamic and Proactive Transportation (ADAPT).

Program Theme. The ADAPT program objectives are to (a) create applications and strategies for the use of real-time mobility and cost data by transportation managers for the safe, efficient, and secure movement of people and goods and (b) utilize real-time mobility and cost data to enable dynamic decision-making by transportation system users. The discussion included emphasizing that applications need to focus not only on information going from the vehicle to the infrastructure, but also from the infrastructure to the vehicle. Additionally, vehicle to driver and infrastructure to driver interactions are also important to consider.

The applications are what takes the available data and supports decision making on the part of the driver or transportation manager. Applications can be considered the information broker. In fact, automated decision making processes should be considered as well, according to the participants. One potential example cited was an application that could determine in real time whether to allow road shoulder use as a through lane.

> **Highlights of Stakeholder Input on Program Theme**
>
> - Consider information going to and from the driver, vehicle, and infrastructure.
>
> - Applications broker the existing information into decision making processes – and lead to action.
>
> - Consider weather, surface condition, hazard, and enforcement-related information.
>
> - Leverage applications that meet multiple objectives.

Application areas that should not be neglected include weather, surface condition, and other hazards as well as those focused on enforcement. The latter could include providing general information about who is on the facility and identify such things as lost licenses and stolen vehicles. Some raised privacy concerns related to enforcement applications; however, there may not be much of a real distinction between using data obtained from license plate readers versus RFID transponders or other electronic means.

There was mention that there is an opportunity to achieve multiple objectives and that synergistic applications should receive a high priority. For example, various technologies common in trucking (computer-aided dispatch, automatic vehicle location) and data from the CVISN program (Commercial Vehicle Information Systems and Networks) could be leveraged for other uses.

Who Will Do What? The discussion in this area considered the activities that should be performed, the stakeholders to be involved, and the roles that each should play. Most of the discussion distinguished between public and private sector roles. A key issue was recognizing the public sector policy goals regarding information dissemination.

Public sector:
- Agencies function as <u>data wholesale</u>
- Can support free dissemination of real-time data
- Look for federal activities that can help energize application developers
- Fund development of new field hardware and systems
- Promote green technologies (an example that focuses on an infrastructure-to-vehicle application is using the signal phase and timing information to provide information to

the driver about (a) the best speed to catch the green phase or (b) to have the vehicle turn off the engine if it will be stopped at the intersection for long enough)

- Promote more involvement at the city, county, and MPO levels
- JPO can facilitate public/private agreements on applications
- Be careful if specifying green requirements as they might result in creating a more stifling application development environment

Private sector:

- Will increasingly assume responsibility for traveler information
- Entities function as <u>data retail</u>
- Provide freight dispatch data
- Develop innovative applications, e.g, via the iPhone model

Both sectors:

- Data acquisition
- Research should include a broad range of stakeholders
- Support examination of the data from a math/scientific perspective to identify novel applications that can utilize the existing data

Comments related to stakeholder engagement included the following:

- Use the recent Washington, DC, example to create a contest for innovative uses of available data
- Support development of platforms for public agencies to help disseminate data
- Develop legislation related to liabilities associated with broadcasting signal timing information; liability issues might hinder applications
- Develop an education and outreach to support public adoption of new technology, possibly incorporating regional workshops. Consider partnering with the University Transportation Centers (UTC) program.
- Support local adoption of innovative applications through appropriate funding and training, i.e., make sure local agencies have the tools for implementation
- Create an iPhone like development environment, where published standard data models and platforms enable the marketplace to develop useful applications that fill users' needs
- Promote agencies to work together to promote applications which provide societal value yet might be outside any one agency's priorities
- Learn from past crises that mobilized political buy-in; consider developing a series of case studies of cause and effect of major incidents. A SWAT-like team could examine the situation and how it changed the program in place at the time (such as whether they altered the deployed technology or operational practices as a result).
- JPO can support further information exchange and best practices through additional funding

- Develop improved models and tools, including standardization of models and inputs
- Encourage open source applications, perhaps through the use of pooled-fund development

Technologies. One key discussion item was the importance of fundamental enablers, which are the building blocks for innovative applications. As these enablers are not applications in themselves, they must not be overlooked when considering a short-term planning horizon, since they might support applications five or more years in the future. These enablers include:

- Lane accuracy
- Location-based digital maps
- Bidirectional communication
- Link-based travel time
- Provider interoperability
- Integration of in-vehicle systems
- Standard data models and vocabulary

There were many specific technologies that were raised by the stakeholders, but much of the discussion also reverted back to specific themes and actions for public or private entities to pursue, such as democratization of data for new applications and determining how to best utilize origin/destination data. Technologies mentioned included dashboard-based lane changing advisory for drivers, adaptive speed and headway control, traveler information systems with the ability to learn and predict best routes, non-intrusive enforcement, and railroad grade crossing integration.

Defining Success. Stakeholders offered a number of suggestions related to what would constitute success for the ADAPT research program, including the following:

- Development of a 10-15 year roadmap

- Availability of standards to make better use of data and the availability of data and applications themselves

- Existence of a return-on-investment (ROI) model

- Reduction in the use of public sector information technology funds

- Establishment of certain defined "targets" to measure performance, such as goals for the reduction in delay over time, the rate of adoption of certain technologies or applications, the degree to which industry leverages federal research spending, average network "velocity," and other user acceptance measures. One participant suggested that these measures could be organized around five elements: coverage, quality, procurement, usage, and cost. Procurement refers to business models to procure data for the public good; such models are lacking in the transit, parking, and freight areas, for example. A question remains as to whether performance measures should be relative or absolute.

- Implementation of a proof-of-concept program to evaluate results

Finally, a key point raised was the need to separate the success of the program as a whole from the success of individual components. In other words, some applications may prove to be a

success even if the program as a whole is not. These successful applications should not be abandoned.

Linkages with Other Programs. Obviously, the strongest linkage to the mobility applications area is the mobility data program. There was a lot of cross-cutting discussion about the development of data, the availability of data, and the funding mechanisms to enable them both. Some discussion focused on the use of applications as a driver for the development of new data.

In addition, the stakeholders often mentioned environmental-related application areas, including weather, emissions reduction, and even safety. The key was the use of applications to support mobility goals that would also produce benefits in the environment or safety areas.

4.4   Mobility (Payment)

Both morning and afternoon Mobility (Payment) breakout groups were well attended. In both sessions, consideration was given to each of the two Mobility (Payment) proposed programs—"Mileage-Based User Fee" and "Integrated Payment for All Modes"—and to each of the four major discussion topics. Many stakeholders found the two programs very closely related and so—especially in the afternoon session—the discussions of the two programs were not always strictly segregated.

A number of major themes surfaced in the Mobility (Payment) breakout discussions. First, as noted above, many stakeholders saw a number of linkages between the Mileage-based User Fee (MBUF) and Integrated Payment (IP) programs. For example, the same stakeholders and existing infrastructure associated with toll collection systems would need to be considered in both programs.

A second theme is that many stakeholders struggled to understand how MBUF technologies could be considered without implicitly addressing policy issues, feeling that policy decisions would drive data requirements and technology considerations. Most stakeholders ultimately seemed to understand that the proposed program approach would explicitly define policy options (but not decide them) and then analyze the alternative technology options relevant to each policy option.

> **Mobility (Payment) Overall Stakeholder Input Themes**
>
> - Mileage-based User Fee (MBUF) and Integrated Payment Systems are related
> - It is challenging to consider MBUF technology options separately from policy options
> - There are many and diverse stakeholders and legacy infrastructure that must be included
> - U.S. DOT needs to establish structure to promote but not stifle entrepreneurship

A third theme is that these programs would impact and can benefit from an extensive and diverse set of stakeholders and existing systems and research. The systems contemplated under these programs cut across a wide range of stakeholder groups; could impact many legacy payment infrastructures, institutions and processes; and can be informed by many lessons learned through existing related systems such as electronic toll collection and automated transit fare payment) and from related research around the world.

A final theme concerns the critical importance of a highly structured, systems engineering approach to program activities which produces just enough of a context and direction to stimulate but is not so prescriptive as to constrain market creativity and opportunity. There was general support for U.S. DOT serving an enabling role by sorting out major issues and establishing, via standards and architecture, a flexible framework within which private sector creativity can both flourish and which will build to an appropriately integrated and extensible system.

4.4.1 Mileage-Based User Fee

This section summarizes stakeholder input for the program proposal on Mileage-Based User Fee.

Program Theme. There was extensive discussion of the proposed program "theme"—the fundamental direction and focus of program. Overall, U.S. DOT's proposal that the program should consider both user fee highway financing as well as other related objectives such as mobility and environment resonated strongly with stakeholders. Many comments and questions focused on how technology options (as well as data requirements and other issues that impact technology selection) are driven by policy rather than the reverse. Although many stakeholders initially felt that policy decisions would need to be made before technology research could continue, most eventually understood and agreed with U.S. DOT's proposed approach of defining and researching a range of solutions associated with the range of possible policy decisions.

There was considerable discussion of the various non-highway financing objectives that could be associated with an MBUF, such as congestion pricing (e.g., varying charges by location and/or time of day) and emissions reductions (e.g., reduced charges for alternative fuel vehicles). However, that discussion focused mostly on how the varying objectives should drive (through a structured, systems engineering process) the construction of alternative business cases, "day-in-life" scenarios, concepts of operations, requirements definition and so forth, rather than on the merit of non-finance objectives per se.

> **Highlights of Stakeholder Input on Program Theme**
>
> - U.S. DOT correct in emphasizing both highway revenue and other possible (environment, congestion) objectives.
>
> - MBUF objectives (corresponding to alternative policy options) should drive research program
>
> - "Multi-modal" should be key part of theme
>
> - Impacts need to be distributed equitably across users

Several stakeholders felt that the theme for this program should recognize and reflect that there are many different modes and associated user groups (transit, trucking, private automobiles, etc.) that could be impacted by an MBUF. They emphasized that the issues and needs, and therefore possibly MBUF implementation options, differ significantly among these different users/modes. It is also important that fees be distributed equitably across different users. The importance of viewing MBUF through this multi-modal dimension seemed to be one of the factors that led a number of stakeholders to suggest that the MBUF and IP programs are closely related. A few stakeholders felt that the programs could be combined.

Who Will Do What? The discussion in this area considered the activities that should be performed, the stakeholders to be involved and ways to involve the stakeholders. Stakeholders identified the following activities as important:

- Conducting an <u>international initial scan</u> to identify, involve and learn from prior and on-going research as well as existing infrastructure/systems and the associated stakeholders

- Definition and investigation of alternative <u>business cases</u> and <u>"day-in-the-life" use cases</u> or scenarios that will both help define requirements and technology options as well as serve as a basis for communicating to stakeholders, including the general public (stakeholders emphasized that U.S. DOT should not reach out to stakeholders too early—before they had developed good, relatable use cases).

- Development of <u>concepts of operation (ConOps)</u>

- Development of <u>functional requirements</u> flowing from various policy options and their associated business cases, use cases/scenarios and ConOps).

- Development of <u>system architecture and standards</u> associated with various policy options and which address uniformity, adaptability to various states and regions, addressing uniformity, and scalability.

- <u>Modeling</u> of potential solutions followed by one more <u>field operational tests</u> of the most promising solutions. (One stakeholder noted that testing should be "auditable;" another emphasized the importance of careful "design of experiments" before testing).

- Exploration of <u>transition strategies</u> under various policy and technology options that will show how a future MBUF would be phased in and relate to today's processes and infrastructure (e.g., gas stations and "premium facilities" like toll systems).

- Include research on how <u>equity</u> (both in fee collection and distribution), <u>public acceptance</u>, <u>privacy/security</u>, and <u>auditabilty</u> (verification) can be addressed.

- In addition to technology considerations, identify <u>enabling legislation</u> implications of various options.

- The research program should be structured to include <u>"checkpoints" at key milestones</u> where progress and assumptions can be reassessed and mid-course corrections made as necessary.

Comments related to stakeholder engagement included the following:

- It will be important to involve and achieve buy-in from a <u>wide range of stakeholders</u> and it will be challenging to reach all stakeholders. It was pointed out that <u>trucking stakeholders</u> constitute a large, important and challenging user group to engage.

- Meetings and functions of <u>stakeholder industry groups</u> should be leveraged.

- A key objective of the outreach strategy—in addition to building support and gathering input—should be to <u>manage expectations</u> and that U.S. DOT should not promise more than can be delivered.

- The stakeholder outreach strategy needs to address <u>"what's in it for me"</u> for each stakeholder group.

Breakout group participants identified the list of stakeholders shown in Table 4-2 that should be involved in some capacity in this program.

Table 4-2. MBUF Stakeholders

- State departments of motor vehicles (DMVs)
- Internal Revenue Service (IRS)
- American Automobile Association (AAA)
- American Trucking Association (ATA)
- Motor carriers
- Tolling authorities
- Alliance for Toll Interoperabilty (ATI)
- International Bridge, Tunnel and Turnpike Association (IBTTA)
- Privacy interest groups, e.g., American Civil Liberties Union (ACLU)
- Heritage Foundation
- Transit authorities
- Public and private parking authorities
- Weight and inspections stations
- I-95 Coalition
- Government Councils
- Shippers
- Ports and terminals
- Warehouse operations
- Financial institutions
- Federal and state environmental agencies
- Associations of local governments
- Equipment/technology vendors
- Taxicab, Limousine and Paratransit Association (TLPA)
- Fuel tax legacy stakeholders, e.g., the Petroleum Marketing Association
- Petroleum equipment industry association
- Chambers of commerce
- Tax payer alliances
- State policy makers
- National Conference of State Legislatures (NCSL)
- American Association of State Highway and Transportation Officials (AASHTO)
- American Association of Motor Vehicle Administrators (AAMVA)
- Highway users associations
- Consumer electronics industry
- Petroleum marketers association
- National association of truck stop operators
- Convenience store operators
- International Registration Plan, Inc. (IRP)
- International Fuel Tax Association (IFTA)
- Shippers
- Ports and terminals
- Vehicle manufacturers

Technologies. Overall, stakeholders offered few comments related to specific technologies. Rather, stakeholders were more interested in the overall theme and direction of the program, including exploring the implications associated with various possible non-revenue generation MBUF objectives such as mobility (congestion pricing) and environment (price breaks for fuel efficient vehicles).

The most significant "message" from the stakeholders regarding technology was that technology solutions should not dictate policy options or conclusions. That is, the U.S. DOT research program, though focusing on technology (as opposed to policy decisions per se) should first define the range of policy options and then consider the technology options associated with the various policies. Though somewhat confused initially, most stakeholders ultimately seemed to understand that this is what U.S. DOT has proposed.

Dedicated Short Range Communications (5.9 GHz) was the only specific technologies mentioned by stakeholders.

Defining Success. Stakeholders offered a number of suggestions related to what would constitute success for the U.S. DOT MBUF research program, including the following:

- Involvement and buy in (on the final conclusions and recommendations) from a wide range of stakeholders, making the value of the recommended MBUF solution clear to all users and generating interest—"buzz"—among stakeholders, including the public.

- A clear understanding of the technology options associated with various possible policy directions and the merits and drawbacks of various technology/system solutions, including costs.

- Completion of a system architecture and development of standards flexible enough to avoid stifling private sector creativity and which will allow an MBUF to be scaled and adapted in various states and regions.

- Identification of MBUF system requirements and clear performance measures or metrics and evaluation of various options against those requirements and measures.

- Successful completion of one or more large field demonstrations—one stakeholder suggested 3 tests with 10,000 users/vehicles each.

- Identification of a viable road map for transition to the recommended MBUF strategy or strategies.

Finally, despite the overall emphasis on very careful structuring of the program and careful preparation before each step, one stakeholder recommended that U.S. DOT not "wait for the perfect system." The "do your best planning but be prepared to move forward even if all of the details are not resolved" philosophy that may be implied by this suggestion is consistent with the suggestion noted earlier to include milestones and check-points where mid-course corrections may be made.

Linkages with Other Programs. The strongest message from the stakeholders regarding connections between programs pertained to the MBUF and IP programs within the Mobility (Payment) area. Several stakeholders felt that the programs are closely related, even to the point of being difficult to separate or the MBUF being a subset of IP. Presumably, the logic there would be that MBUF is about paying for roadway travel and IP is about paying for all modes of travel and therefore MBUF is simply the "highway" portion of IP. Stakeholders' focus on other possible MBUF objectives like congestion pricing may have encouraged their concept of MBUF as primarily a payment rather than finance mechanism—a fine but important distinction.

Although not stated explicitly by stakeholders, one can infer other program linkages based on other stakeholders comments:

- Vehicle or traveler data required for MBUF (especially if congestion pricing and/or environmental objectives are included) could be collected via the systems associated with the Mobility (Data) and Safety areas.

- Congestion pricing strategies that could be included in an MBUF system might utilize the systems and mechanisms considered within the Mobility (Applications) area.

- To the extent that environmental objectives are included in an MBUF system there is a clear linkage to the Environmental area.

4.4.2 Integrated Payment System for All Modes

This section summarizes stakeholder input for the program proposal on Integrated Payment System for All Modes.

Program Theme. The theme for this program proposed by U.S. DOT emphasizes stimulation of stakeholders to deployment (rather than Federal deployment), system viability, full integration, and addressing both policy and technological solutions. Stakeholders generally expressed support for the proposed theme, with a number of comments aligning closely with various elements of the theme. Several stakeholder comments emphasized integration, both across modes and with existing payment systems.

Stakeholders agreed that U.S. DOT should play a facilitation role but that stakeholders, including the private sector, will play a key role in both research and deployment and operation. Federal research should stimulate and not stifle private sector creativity. U.S. DOT was advised to investigate solutions in a way that does not shut out any stakeholders and to not dictate a specific solution.

Stakeholders suggested that the overall direction of U.S. DOT research should focus on identifying a scalable solution or solutions that can be adapted to different deployment contexts. There is not necessarily a single solution that will work well everywhere.

Highlights of Stakeholder Input on Program Theme
• Integration across modes and with existing systems is an appropriate cornerstone of the research
• U.S. DOT as facilitator not deployer is appropriate— provide direction but do not dictate
• There may not be a single solution—research should focus on a scalable and adaptable approach
• There is a linkage to the Mileage-based User Fee program
• Minimization of money handling costs and promotion of traveler access and options should be objectives

Stakeholders agreed that viability—considering both technological as well as policy considerations—was an appropriate focus of the program. Stakeholders cited a variety of viability issues that should be addressed, including privacy, equity, public confidence (trust), and enforcement (theft).

Who Will Do What? The discussion in this area considered the activities that should be performed, the stakeholders to be involved and ways to involve the stakeholders. Stakeholders recommended that research activities be structured to address the following issues:

- Whether the payment mechanism is "bound" to a vehicle or to a person.
- How to integrate with existing payment systems, both public and private.
- Defining the boundaries of an IP, that is, how many modes/services to include and how much integration with non-transportation payment systems?
- A wide range of technology options, including wireless and traditional.
- Evaluate the costs of various options, including implementing a single, new technology/system versus building an integrated system primarily by integrating various existing systems and technologies.
- Pre-pay vs. post-pay vs. pay-as-you-go strategies.

- Privacy
- Enforcement (theft)
- Equity
- <u>Public acceptance and confidence</u>, which is especially challenging for "invisible" payment systems
- Accuracy (auditabilty)
- Open versus closed system options
- Real-time versus off-line transaction processing
- Control mechanisms for <u>who is paying for what</u>, e.g., if individual travelers may be carrying multiple wireless payment instruments and/or when there are multiple.

Comments related to stakeholder involvement included the following:

- Stakeholders and lessons learned from <u>related industries</u>, such as cell phones, should be included.
- Stakeholders and lessons learned should be drawn from both the <u>United States and internationally</u>—there is a lot to be learned from experiences outside the United States.
- <u>Private industry</u> stakeholders should be involved; they will play a role in research and a key role in deployment and operation; vehicle manufacturers will be particularly important if payment is bound to a vehicle.
- The <u>general public</u> constitutes a critical stakeholder group; building support and trust among the general public will be key.
- Including <u>industry competitions</u> in the development process can stimulate private sector interest and help resolve interoperability issues (the stakeholders did not note the connection, but such a strategy has been used successfully by U.S. DOT in the past such as with the parallel, multi-team approach to development of the initial National ITS Architecture).
- Use of <u>real-world demonstrations</u> to educate and stimulate stakeholders—"ride and drives" (the Intelligent Vehicle Initiative was cited as a successful example).

Technologies. Stakeholders provided few comments related to specific technologies. They did note that both wireless and traditional technologies should be considered, including dual mode, "tap and pay" cards, and that one of the major technology questions is whether devices should be bound to a person and/or to a vehicle. Stakeholders also noted that it may not be necessary to implement a totally new technology system for IP, but rather a fully integrated system could be fashioned primarily through the integration of various existing systems.

Defining Success. Stakeholders offered a number of suggestions related to what would constitute success for the U.S. DOT IP research program, including the following:

- Understanding the <u>costs</u> associated with various options
- Resolution of key <u>viability issues</u> such as privacy, enforcement and equity
- Development of a set of <u>standards</u> that have been adopted and which can be used by system developers

- Definition of the <u>boundaries</u> of an IP system (transportation modes; non-transportation transactions)
- Identification of an approach that will work for <u>a wide range of transportation modes/conveyances</u>, including cars, trucks, motorcycles, pedestrians, etc.
- Public understanding and support
- Willingness of <u>vehicle manufacturers</u> to include any necessary in-vehicle devices in their vehicles
- Accommodation of <u>travelers without credit cards or bank accounts</u>
- Participation by all <u>appropriate stakeholders</u>

Linkages with Other Programs. Several stakeholders noted that the IP program is closely related to the MBUF program, noting that MBUF for highways could be one component of an overall payment system.

4.5   Environment

The Environment breakout sessions were well attended, with a good mix of representatives from public agencies and the private sector. The discussion covered two program proposals, the major program proposal, "Application for Environment: Real-Time Information Synthesis (AERIS)" and the exploratory research proposal, "Exploratory Research in Community Transit Service." The discussions on the two program proposals blended together and, thus, are not separately reported here. In both breakout sessions consideration was given to each of the four major discussion topics

A number of general themes emerged from the discussions. One key theme was that environmental considerations should be part of all the ITS goal areas, with coordination among all the goal areas related to examining potential environmental benefits and applications. Promoting ITS to simultaneously benefit mobility, safety, and the environment is a strong message. Promoting ITS projects as a package to realize all of these benefits should be pursued. The logical initial environmental focus should be on air quality, green house gases (GHG), and climate change.

> **Environment Stakeholder Input Themes**
> - Environment should be part of all the ITS goal areas.
> - Government participation at all levels is needed for progress on environmentally sustainable transportation.
> - Outreach for developing research ideas and support should be as broad as possible.
> - Raising awareness among the public, policymakers, and other groups about "eco-transportation" is needed.

A second common theme related to governmental participation with ITS and the environment. At the Federal level, U.S. DOT should be lead, but the Environmental Protection Agency (EPA) and Department of Energy (DOE) need to be actively involved and play important roles. At the state and local level the involvement broadens to include state departments of transportation, the state and regional environmental/air quality agency(ies), metropolitan planning organizations, transit agencies, and communities.

Another general observation is that broad outreach and support is needed to advance the ITS and environment goal. For example, coordination with international groups provide an opportunity

to learn from what other countries are doing with ITS and the environment. There are also opportunities to involve the private sector (shippers/carriers, ITS industries, oil/energy companies, etc), public interest groups/environmental groups (Sierra Club, etc), and the healthcare industry, to name a few examples. These organizations could generate a very powerful support group, especially if the focus is on mobility, safety, and the environment.

A final common theme is increasing awareness about "eco-transportation" (more than just eco-driving, but eco-driving is an important part) among the public, policy makers, and other groups. Outreach and education in this area as well as other areas should be a key part of the DOT program.

4.5.1   AERIS and Community Transit Service

This section summarizes stakeholder input for the program proposals on "Applications for the Environment: Real-time Information Synthesis (AERIS)" and "Exploratory Research in Community Transit Service."

Program Theme. When asked about their reaction to the theme of the proposed ITS programs for environment, the participants' responses were favorable, but suggestions were offered for strengthening the message. Suggestions included a more proactive approach to changing travel behavior, promoting the environmental aspects of ITS in planning and operations, and expanding the scope to include commercial vehicles and freight transportation.

The emphasis on travel behavior change was raised in several forms. Drivers need to make conscious decisions to be greener, and policy-driven incentives for green-based actions can spur change. Currently people think of time and cost and not their carbon footprint when planning travel. Getting people to think more broadly about their travel decisions is key. In addition, tolling is one strategy that can directly affect emissions, because, in response to price signals, drivers will change behaviors in ways that can reduce carbon emissions. Without broader application of tolling, the environmental community may view ITS-based congestion pricing as simply a means to reduce congestion and not an environmentally focused approach. Reducing travel is a key component of the overall carbon-reduction model, whether measured by vehicle miles traveled (VMT), vehicle hours traveled (VHT) or hours of delay.

> **Highlights of Stakeholder Input on Program Theme**
>
> - USDOT theme of enabling environmentally beneficial choices is correct but a more proactive approach is needed.
>
> - ITS-generated data can improve the environmental outcomes of transportation planning and operations.
>
> - The potential impact of environmentally beneficial technology choices made by commercial vehicle operators should not be overlooked.

The discussion of incorporating the environmental aspects of ITS in agencies' planning and operations included a number of points. First, better demonstration of ITS-based environmental benefits is needed. For example, preventing crashes and reducing incident clearance times reduce emissions. These benefits need to be promoted and included in the planning process. ITS-generated environmental data from sensors can be used to enhance the planning process. These data also have immediate operational benefits. Further, road weather information systems provide data to operators for use in more efficient chemical applications for snow and ice, which can reduce water quality problems from runoff. Real-time

traffic information can more clearly identify air quality problem areas, help refine air quality modeling, and improve targeting ozone status alerts to the public.

Suggestions were made to broaden the proposed program theme to commercial vehicle operators, as well as private vehicle drivers. It was noted that fleet operators have the highest economic interest to operate efficiently. Decisions about technology are made for an entire fleet and can have a greater and more immediate impact that trying to effect change by separate individuals. Commercial fleets are already improving fuel efficiency by showing drivers how to perform in "sweet spots" that correspond with low-emission operations. The research focus should be on incentives for eco-friendly behavior on the part of drivers, truckers, carriers, and others, and less on punitive measures.

Who Will Do What? The discussion identified a variety of stakeholders and the roles they would play in the research program. Table 4-3 lists the identified stakeholders.

Table 4-3. Environment Research Program Stakeholders

• The traveling public • Federal agencies: Department of Transportation, Environmental Protection Agency, Department of Energy, Department of Defense • Metropolitan Planning Organizations • State agencies: departments of transportation and air quality and environmental agencies • Transit agencies • Climate action groups (e.g. California Climate Action Reserve) • Public interest and environmental groups (e.g. Sierra Club) • Trade associations • Healthcare community	• International groups: European Union, Organization for Economic Cooperation and Development (OECD), European Conference of Ministers of Transport (ECMT), European ITS organizations, international standards organizations • Vehicle manufacturers • ITS manufacturers and operators • Developers of environmental sensor technologies • Land developers • Terminal operators • Energy companies/oil companies • Research community (e.g. Transportation Research Board)

Possible roles and actions for some, but not all, of these stakeholders were identified by participants. These roles were related directly to the ITS research program and to the more general nature of the transportation/environment relationship.

- Among Federal agencies linkages and cooperation is needed. DOT should be coordinating with EPA and DOE in their programs and research.
  - o In transportation research programs, DOT should lead but do so in conjunction with the other agencies to help plan research projects, resulting in positive interaction with practical results.
  - o Federal agencies need to build long range strategic transportation planning related to climate change into their own facilities. Department of Defense was cited as having been previously resistant, but it is now shifting to a more proactive position.

- Federal agencies should be linked to the <u>state and local governments</u>, in a cascading effect for research programs.

- <u>Regional and metropolitan transportation organizations</u>, such as MPOs, port authorities, and transit operators, can play a key role in research given their regional viewpoint. MPOs, for example, have air quality oversight responsibility and can also incorporate environmental elements in the regional ITS architecture.

- <u>Owners and operators of infrastructure</u>, such as rail terminal operators, port authorities, transit agencies, and utilities, have the potential for regional cooperation in the form of shared facilities. Identifying infrastructure needs for the future is also important. For example, where will charging stations for electric vehicles be located, and how will they be funded?

- <u>Public interest groups and associations</u> can help build support for the ITS research program that provide environmental benefits. Voicing concerns to the DOT is also important, rather than getting blindsided by press releases.

- Much can be learned from the experience of the <u>international community</u>. Learning from international standards organizations and trade organizations that deal with carbon credits on how to properly account for and document emissions so that they can be sold represents one of these areas. It was observed that the European Union has done work on the "eco-driving" concept and the U.S. should take advantage of their findings.

- At the individual level of the <u>traveling public,</u> education and outreach should be an important part of the overall program. Building a shared understanding related to the mobility-environment relationship that already exists represents a good approach. The overall public benefit and the proportion of those who benefit from this approach is greater than those who lose.

Technologies. Stakeholders were asked what technologies, either current or emerging, will play a key role in the ITS program on the environment and offered a variety of responses:

- Tolling technology can be used to extend the concept of congestion pricing to emissions or energy pricing. Real-time data on a vehicle's emissions and/or fuel consumption or a pre-established profile based on make and model of the vehicle could be the basis for emission pricing. Emissions based on the make and model may be too simplistic, however, because other factors, such as elevation, have an impact on fuel efficiency.

- It was noted that in the aviation industry, the systems exist to track a plane's speed, fuel usage, and other information in the air traffic stream. A similar system would be possible for the surface transportation system for identifying real-time commercial vehicles that exceed some emissions threshold. The institutional framework is not in place at this time to facilitate the approach, however. However, a recent project in Oregon was cited that is aimed at collecting data along those lines.

- Better trip planning and routing technologies are needed that are explicitly environment-based or have environmental benefits as a by-product. Google Maps' trip planner with an environmentally-friendly travel option was cited as an example. There is a need to add real-time information into the mix of factors considered in trip planning. That is the case for routing trucks or other vehicles so they can take the most fuel- and time-efficient route while avoiding congested roads that lower fuel efficiency.

- Better sensors are needed both in and outside the vehicle for collecting environmentally-relevant data.

- As managed lanes become more widespread, technology for measuring vehicle occupancy in high occupancy tolling (HOT) and high occupancy vehicle (HOV) lanes is needed and is a potential focus for DOT's research program.

- *Clarus*, the DOT's road weather information management system initiative, was cited as an example of a data collection model that might be applied to environmental data more broadly.

- With all the potential data recommended for collection in the ITS environment program, software development of applications will be needed for managing the data.

- Looking internationally might help identify new technology ideas. A scan of European examples for modeling and monitoring was noted. Policy options might also be identified, such as Japan's policy for buses to turn off their engines at red lights. While potentially beneficial for fuel efficiency, it was also noted that such a policy may not benefit air quality.

Defining Success. Stakeholders offered the following ideas on what would constitute success for the ITS research program on the environment. They included:

- Increased awareness by the public, decision makers, and agencies of ITS contributions to addressing GHG. Providing information is needed to start this process, which would then move toward policy development. Based on the relative contribution to be made by ITS technologies, decision makers can start selecting among the various techniques to be implemented.

- An integrated view of how safety and mobility and environment all work together in terms of data, benefits, and funding was noted as a key measure of success. Decisions should not be made without taking into account environmental effects.

- A much more fully integrated transportation system with consolidated multimodal traveler information is needed. For example, a system is needed to tell people that their Amtrak train was canceled and at the same time present them with other options from which to choose.

- Reasonable metrics need to be established to identify the impact of ITS on environmental changes by determining the baseline, what the problem is today, and what is achievable given population growth and other factors. Can a verifiable 20 percent reduction in GHG emissions across all modes be achieved by 2020?

- Many unanswered questions remain before success can be defined. Will the system work? Can we create a system that will, over time, reduce GHG emissions? Will it be commercial? Will it be utilized? Will there be incentives for people to use it? Will the environmental benefits estimated actually be realized?

- Improved cooperation among DOT, EPA, and DOE, with procedures enacted to share research programs related to transportation and the environment was suggested as a measure of success.

- Demonstration of a situation-aware vehicle with x percent less fuel use. For example, demonstrate an electric vehicle that knows a traffic light is going to change (because of an ITS safety application), and can therefore use battery power efficiently.
- Improved transit services will be needed to enable mode shift on days with bad air quality.

Linkages with Other Programs. As noted previously in this section, stakeholders felt strongly that the environment should be a part of programs in other goal areas. The programs should be designed in such a way that the benefits derived from ITS in safety and mobility programs are benefits to the environment as well.

5.0 MAJOR THEMES AND SUMMARY OF APPARENT STAKEHOLDER PROGRAM RECOMMENDATIONS

This chapter synthesizes and summarizes the stakeholder input described in Chapter 4.0. Major themes are identified, including cross-cutting issues, and stakeholder recommendations in specific goal areas and programs are summarized.

5.1 Major Themes

This section identifies a number of major themes—those issues and observations that surfaced repeatedly in multiple breakout sessions and/or in plenary discussion.

5.1.1 Value of Continuing Stakeholder Involvement

The value of a proactive, inclusive approach to involving a wide range of stakeholders in the U.S. DOT ITS Strategic Plan development was apparent. First, the excellent attendance and general energy level was a powerful demonstration of stakeholder interest. The attendance was all the more remarkable considering the workshop came at the end of a three-day conference that many stakeholders had attended. Especially telling was the lack of any significant drop off in attendance through the afternoon.

Comments made in the individual breakout sessions also made clear the importance of continuing, vigorous stakeholder involvement. In essentially all of the program discussions, participants underscored the importance of involving a diverse range of stakeholders over the duration of the program, often citing stakeholder understanding and support as an important definition of program success. Many of the proposed programs focus on systems that impact and should be shaped by a large set of stakeholders. For example, in the breakout discussion of the proposed Mileage-based User Fee Program (part of the Mobility (Payment) area), within just a few minutes stakeholders brainstormed a list of 41 stakeholder groups who should be involved.

Several breakout discussions emphasized the importance of involving stakeholders and seeking lessons learned in both the United States and abroad; in the private and public sectors; at all levels of government; and through coordination with existing stakeholder organizations.

5.1.2 Key Milestones and Check Points

Stakeholders in several breakout groups validated the importance of structuring the research programs around key milestones at which point progress and direction can be reassessed and mid-course corrections made if necessary. Most of the proposed programs are large, complex and will span over many years. It is not possible to forecast over a 3 to 5 year period all of the many changes that could impact Federal ITS research, including the findings of the early stages of the programs.

5.1.3 Relationships among Programs

Stakeholder input reinforced the intuitive conclusions that there are strong relationships between programs within a goal area. For example, there are obvious relationships and a need to closely coordination activities among the various IntelliDrive^{SM} research areas within the Safety area

and between the Mileage-based User Fee and Integrated Payment programs in the Mobility (Payment) area.

Additionally, a number of linkages were identified between programs in different goal areas, including:

- The Mobility (Data) program is related to research in all of the other areas. In most cases, the relationship is as a "supplier" in which applications in the other research areas, such as Mobility (Payment) or Mobility (Applications) may utilize data collected through systems developed in the Mobility (Data) area. In the case of the Safety area where IntelliDrive^{SM} represents a key potential source of data, the Mobility (Data) program may relate as a "consumer."

- Stakeholders agreed that there is a strong linkage between the Mobility (Data) and Mobility (Applications) research. In the Mobility (Applications) breakout sessions there was a lot of discussion of data needs and data development. In those sessions there was also recognition (as there was in the Mobility (Data) sessions as well) that data availability drives application development and that applications push data development.

- Mobility (Payment) breakout participants focused a great deal on potential non-finance related objectives of MBUF including congestion pricing and encouragement of fuel efficient vehicles. To the extent that such objectives are considered in MBUF research, coordination with Mobility (Applications) and the Environment areas would be appropriate.

- Environment breakout participants believe that environmental considerations (potential environmental benefits and applications) should be considered in all of the programs with mobility, safety and environmental benefits promoted as a package.

5.1.4 Systems Engineering, Architecture and Standards

The need and value of using a structured systems engineering process to plan and carry out research and the importance of system architectures and standards in defining program success came through in several breakout sessions. Support for systems engineering emerged in a variety of specific stakeholder comments relating to the need to define requirements before exploring technologies, development of concepts of operations and use cases, and testing alternative solutions against requirements and clearly defined performance criteria.

Structured systems engineering approaches are a necessity given the complexity of many of the proposed programs. Stakeholders emphasized the importance of a structured, stepwise approach starting with needs and objectives as way to avoid letting technology solutions dictate objectives and policy. System architectures and standards were identified as critical tools in the U.S. DOT effort to stimulate stakeholders to carry forward with deployment and operation, including private sector entrepreneurship. At several points during the workshop and in several breakout sessions, the Apple iPhone was identified as a model for empowering innovators by providing a central platform.

5.1.5 Addressing Policy Issues

In the morning presentations that preceded the breakout sessions, U.S. DOT presented proposed research programs corresponding to five of the six draft ITS goal areas. U.S. DOT explained

that considerations related to the sixth goal (addressing policy issues) cut across and would be addressed in research programs associated with each of the other five goal areas (Safety, Mobility (Data), Mobility (Applications), Mobility (Payment), and Environment). Input from stakeholders during the breakout sessions supported the need to address policy integrally as part of each research program. One of the clearest examples came from the Mobility (Payment) discussions where, initially, a number of stakeholders felt that it would be impossible to appropriately consider technology solutions without resolving policy issues. Ultimately, most of the stakeholders came to understand and agree with the approach proposed by U.S. DOT in which the research would acknowledge and be guided by the policy considerations but not make the policy decisions (i.e., the range of policy options would be identified and then the technology options and issues corresponding to each would be researched).

5.1.6 Federal Role

With the exception of the Mobility (Data) breakout sessions where there was some debate, stakeholders generally supported the Federal role that was identified in most of the proposed programs. In most cases stakeholders agreed that the role of the Federal research program should not be to deploy systems but rather stimulate deployment by others by:

- Resolving technical issues and providing policy makers the information they need to make decisions.
- Acting as a market catalyst by empowering private sector entrepreneurship and state and local governmental creativity by:
  - Resolving key issues (that would not necessarily be addressed by any private entity because of the size of the challenge or lack of clear ownership), and
  - Creating a flexible framework or platform (via system architecture and standards) within which deployers and innovators can build.

In the Mobility (Data) breakout sessions, there was greater consideration of the possibility that the Federal role could extend to collecting and disseminating data. One of the justifications for such a role is that even with a guiding architecture, requirements and standards, there might be portions of the country with insufficient profit opportunities to spur private sector investment in data collection systems.

5.1.7 Leverage Private Sector Innovation

The importance of leveraging private sector innovation was noted in many of the breakout sessions. It was also noted in numerous contexts, including discussions of the need to involve a wide range of stakeholders, the value in learning from relevant existing and developing industries in the United States and abroad (e.g., electronic toll collection and cell phones), and the role of Federal ITS research as a market catalyst—stimulating private stakeholder entrepreneurship such as through the "iPhone model."

5.1.8 Do Not "Lead with Technology"

Stakeholders in most of the breakout sessions emphasized the importance of starting with needs and objectives, then developing requirements, and only then considering potential technologies to satisfy the requirements. That is, they cautioned strongly against research that starts with the technologies and seeks to determine what uses can be made of them.

5.2   Key Apparent Stakeholder Program Recommendations

The most detailed and comprehensive apparent stakeholder recommendations associated with each program and goal area are described in chapter 4.0. This section summarizes the most significant recommendations in each goal area.

5.2.1   Safety

Major, apparent stakeholder recommendations related to research in this area consisted of the following:

- Program themes need to be "problem based" rather than based on communication mode and revised to include crash scenarios. The highest priority should be given to the most significant causes of crashes.

- It should be expected that vehicle technologies and infrastructure systems will be deployed on related, but different time lines and USDOT should not identify single milestones where equal levels of vehicle systems and infrastructure will be deployed. Infrastructure systems may take more time to deploy than vehicle systems.

- Liability is a crucial issue throughout this research area but especially important for the Vehicle Control Assistance for Safer Travel program. Resolution of major liability issues, possibly in part through defining requirements and then certifying systems as satisfying requirements, is necessary to ensure public acceptance and should be a key definition of USDOT research success.

- USDOT should establish specific, quantitative performance standards (or definitions of success) as goals or targets, e.g., to decrease crashes of a specific type by X%. Such clearly defined goals or performance standards will provide system developers, including private industry, a focus for their efforts.

- Given the rapid advance of technologies, the concept of milestones and check points to reassess progress and direction is especially important in this area of research.

- In the IntelliDrive^{SM} Vehicle–to-Infrastructure program, stakeholders noted that there are a wide range of relevant technologies (Wi-Fi, RFID, cellular, satellite, DSRC) but research is needed to make wide spread deployment of these technologies affordable.

- The IntelliDrive^{SM} Vehicle-to-Vehicle program needs to be closely coordinated with the Vehicle-to-Infrastructure program and with the NHTSA New Car Assessment Program. Key activities should include development of an objective testing protocol to analyze and measure the performance of safety applications; development of human factors guidelines; and resolution of DSRC range, reliability and interoperability issues.

- The need for the Harmonization of International Standards and Architecture program needs to be stated more clearly, e.g., harmonization will lead to more efficient utilization of resources, avoid duplication of effort between USDOT and various Standard Development Organizations, and promote economies of scale. Coordination with European Union stakeholders will be very important as well as an emphasis on testing and certifying systems/applications against defined standards.

- The definition of "proactive/partial control" needs to be refined in the Vehicle Control Assistance program to clarify the extent to which infrastructure and traffic management components are involved. Success will entail completion of benefit-cost analyses of

crash scenarios and applications and a strategy for resolving liability issues, including identification of required legislation and legal rulings and a certification program.

- The theme of the Human Factors for IntelliDrive^{SM} program needs to emphasize the positive, e.g., focusing on driver assistance rather than distraction. This program needs to focus on driver arbitration of messages/stimuli or "driver workload," that is, how drivers input, process and respond to a multitude of inputs.

5.2.2 Mobility (Data)

Major, apparent stakeholder recommendations related to research in this area consisted of the following:

- The proposed scope of the program—"all roads and all modes"—might be too broad and may not be consistent with JPO Director Shelley Row's emphasis on "few, focused" initiatives. It would be appropriate to prioritize data needs and applications, which could include close coordination with the other research programs that may rely on data (such as the Mobility (Applications) program) or provide data (such as the IntelliDrive^{SM} portions of the Safety area).

- The research program should be driven by clearly defined needs and requirements, which in turn stem from the applications being considered across the other research programs.

- One of the most critical needs, and an appropriate focus of the Federal research, is to develop a variety of standards and guidelines addressing interoperability/data exchange, data quality, and metadata and for those standards to be adopted by public and private sector stakeholders.

- Much can be learned from various existing models for data collection and sharing, including those used by the National Weather Service and the cellular telephone industry.

- There should be an early effort to identify how much of the prioritized, needed data can be assembled from existing sources, both public and private. There is considerable public data that is not currently shared well among agencies. Much of the U.S. DOT role in promoting interoperability and data exchange will focus on existing systems and data.

- Data for rural areas and arterial roadways are of particular importance because there is currently little data being collected and/or because these areas (namely, rural areas) may have special needs and issues.

- Data archive and data mining will be important areas of research because getting the right data to the right organizations and applications goes beyond data collection.

- Success can be defined from at least three perspectives:
  - Data collection and management (e.g., amount of data collected and availability of accepted standards);
  - Data usage (e.g., establishment of data sharing infrastructure and usage of data by various stakeholders in various applications); and
  - Institutional successes (e.g., completion of cooperative agreements for data sharing and establishment of a viable business model that addresses public and private interests).

5.2.3 Mobility (Applications)

Major, apparent stakeholder recommendations related to research in this area consisted of the following:

- The proposed program theme needs to be broadened to include:
    - o Explicit reference to real-time control applications;
    - o Development of adaptive learning systems; and
    - o Mobility as defined by more than travel time, such as accessibility and environmental considerations.
- Research needs to focus on clarifying public and private roles.
- The "iPhone model" is a good one: U.S. DOT should focus on defining standard data models and platforms and then the marketplace will apply its ingenuity and expertise to develop useful applications that fulfill users' needs.
- Prioritization will be important and one strategy would be to focus first and/or most on applications that address multiple needs and on core, enabling technologies needed to support multiple applications.
- Key stakeholder engagement strategies could include competitions for innovative uses of data, funding and training programs for state and local agencies to promote adoption of innovative applications, and pooled-fund programs to encourage open source application development.
- In addition to various performance targets such as the rate of adoption or deployment of specific applications, research program success should be defined by the completion of a 10-15 year roadmap (the research program cannot be completed within the 3-5 year planning horizon for this strategic plan), completion of a return-on-investment model, and implementation of a proof-of-concept program to evaluate results.

5.2.4 Mobility (Payment)

Major, apparent stakeholder recommendations related to research in this area consisted of the following:

- The Mileage-based User Fee research should investigate both highway-finance related objectives as well as other potential objectives related to mobility and environment. The objectives of an MBUF will drive all of the more specific research into requirements, architecture, technologies and standards, and, therefore, it is essential to define the range of MBUF objectives for consideration at the outset.
- The Mileage-based User Fee and Integrated Payment Systems programs are related and research should be coordinated closely between the two programs.
- While policy decisions are beyond the scope of the research program, it is still imperative that the MBUF research be structured according to policy options and questions; technology options and recommendations should flow from policy options rather than the reverse.
- There are many and diverse stakeholders that need to be involved in both research programs; these programs cut across many different stakeholders and existing systems and processes.

- There are many lessons that can be learned from existing industries both in the United States and abroad, and there has been considerable research and experimentation in the area of MBUF and IP as well. An appropriate early research activity would be to conduct a scan of existing systems and research, both to establish state-of-the-practice, identify gaps, and identify stakeholders.

- Research should be highly structured and follow a systems engineering process. Development of requirements, system architecture and standards should be a key focus. These products are crucial in stimulating state and local government to deployment and stimulating private sector entrepreneurship and catalyzing business markets.

- In addition to stimulating deployers and entrepreneurs, a major objective of the research should be in articulating "day-in-the-life" scenarios or use cases and using them, and other research results, to educate the public and other stakeholders and generate awareness and interest—"buzz."

- One or more major field demonstrations—potentially multiple demonstrations with each including thousands of participants—should be conducted.

5.2.5 Environment

Major, apparent stakeholder recommendations related to research in this area consisted of the following:

- Environment should be part of all the goal areas. There should be coordination among all of the goal areas related to examining potential environmental benefits and applications. Promoting environmental benefits and applications along with safety and mobility as a package strengthens the message.

- The logical initial environmental focus should be on air quality, greenhouse gases and climate change.

- Government participation at all levels is needed for progress on environmentally sustainable transportation. At the Federal level, U.S. DOT should be the lead but the Environmental Protection Agency and Department of Energy should also be involved. State and local agencies that should be involved include state departments of transportation, state and regional environmental and air quality agencies, metropolitan planning organizations, and transit agencies.

- Outreach for gaining good research ideas and support should be as broad as possible and should include coordination with international groups to learn from what other countries have and are doing in this area. There are also opportunities and benefits associated with private sector stakeholder involvement, including shippers/carriers, ITS industries, and energy companies.

- Raising awareness about "eco-transportation" among the public, policy makers and other groups is needed. Eco-transportation should encompass the full range of environmental issues associated with travel, which go well beyond the issues associated with just driving.

- Behavioral change should be a fundamental focus. Proactive steps are needed to encourage travelers, policy makers and transportation planners and operators to consider environmental issues as seriously as they consider efficiency (e.g., travel time), safety and costs.

- Research should focus on improving the understanding of the environmental benefits of ITS and ensuring that transportation planning and programming processes reflect that improved understanding.