# ITS BENEFITS: DATA NEEDS
# 2001 UPDATE

Prepared in Conjunction with the
20 March 2001 ITS BENEFITS DATA NEEDS WORKSHOP

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## Introduction

Since December of 1994, the United States Department of Transportation's (U.S. DOT's) Joint Program Office (JPO) for Intelligent Transportation Systems (ITS) has been actively collecting information regarding the impact of ITS projects on the operation of the surface transportation network. The evaluation of ITS is an ongoing process. Significant knowledge is available for many ITS services, but gaps in knowledge also exist.

To aid the distribution of the information collected, the JPO has sponsored the development of the ITS benefits database on the internet. The database, which summarizes both national and international benefits described in evaluations, conference papers, and other reports, is available by visiting www.benefitcost.its.dot.gov.

This is the second in a series of reports documenting the results of a periodic assessment of the state of knowledge regarding the impacts of various ITS implementations on the surface transportation system. The report presents the results of the 20 March workshop in Washington, DC sponsored by the Benefits, Evaluation and Costs (BEC) committee of ITS America and a corresponding survey distributed to ITS stakeholders across the United States. In contrast to the survey distributed in 2000, the 2001 survey asked participants to rate the importance of continued evaluation of implementations in each of the ITS application areas. In the survey distributed in 2000, participants were only questioned about the need for research in the areas with minimal coverage in the online ITS benefits database. The 2001 survey also requested ratings for applications of ITS for commercial vehicle operations (ITS/CVO) and intermodal freight.

The gaps highlighted by the Data Needs effort are used to show where little data have been collected in a particular measure or ITS service. The lack of benefits data in an ITS service area does not mean the service is not a good one. Rather, it indicates where more evaluation may be needed to understand the full impacts of the service. The data needs effort is intended to assist the JPO and to provide guidance to researchers for establishing which gaps are considered to be the most important and determining where limited evaluation resources may provide the most advantage.

For more information on the types of ITS implementations considered under each application area discussed in this report, and a summary of the information contained in the Benefits Database as of February 2001, refer to the FHWA report:

*Intelligent Transportation Systems Benefits: 2001 Update.* FHWA Report (FHWA-OP-01-024). June 2001. (EDL #13463)

*REPORT ORGANIZATION*

The following sections of this report discuss the results of the workshop and survey. The workshop summary provides an overview of the March 2001 meeting, including discussions held regarding data needs in the areas of metropolitan applications and integration of metropolitan applications as well as rural, ITS/CVO, and intermodal freight applications. The third section of

this report presents and discusses the survey results and written comments received for each of these same areas.

## Workshop Summary

On March 20th, 2001, the Benefits, Evaluation, and Costs (BEC) committee of ITS America sponsored a half-day workshop at the Renaissance Mayflower Hotel in Washington, D.C., to assist in the determination of national ITS benefits data needs. Thirty-two (32) attendees participated in the workshop, representing federal government, regional planning agencies (metropolitan planning organizations and regional councils), local transportation agencies, professional associations, universities, and consultants.

*WELCOME*

Peggy Tadej, National Association of Regional Councils (NARC) Director of Special Projects, opened the meeting with a summary of last year's workshop. She noted that NARC is trying to increase participation of various stakeholders[1]. Greg Hatcher (Mitretek Systems) thanked Peggy and asked everyone to introduce himself or herself and state their area of interest. Interest areas included the following:

- Archive Data User Service (ADUS)
- ARTIMIS system evaluation
- Advanced traveler information systems (ATIS)
- Advanced traffic management systems (ATMS)
- Bus priority
- CVISN impacts
- Data collection and archiving for operational purposes
- Integration earmarks
- Planning impacts
- Red light running
- Reliability of travel
- Rural ITS
- Safety
- Simulation modeling to estimate benefits
- Stretching the transportation dollar

Joe Peters of the ITS Joint Program Office (JPO) acknowledged ITS America's sponsorship and thanked them for their support.

[1] To increase participation, James Pol suggested advertising the event in the Transport Communications Newsletter. Larry Brown suggested that the Survey Announcement be submitted to AASHTO and ITE.

*OVERVIEW OF WORKSHOP BACKGROUND, BENEFITS DATABASE, DATA NEEDS SURVEY AND HANDOUTS*

After Greg discussed the purpose of the workshop (as discussed in the Introduction of this report), Rob Maccubbin (Mitretek Systems) demonstrated the online ITS Benefits database. Rob then reviewed each page of the Data Needs Survey. He reviewed the remaining handouts including the desk reference, Summary of Known Benefits[2], Benefits of Metropolitan Integration, and the Survey Announcement. Appendix A contains each of the workshop handouts, including a sample of the survey.

Regarding the survey, concern was expressed over having to fill out areas of the survey which weren't familiar to the participants. Rob and Greg stated that survey respondents need not fill out the areas they don't feel qualified to address; the only part of the survey which will be factored into the results is the part which is filled in (that is, leaving the cell "blank" is equivalent to a "no-vote" for that area).

In a comment about Taxonomy nomenclature, concern was expressed that those unfamiliar with technical terms would be unable to access useful information. Rob suggested that site visitors view the definitions provided on the help page of the online benefits database.

*DISCUSSION OF METROPOLITAN DATA NEEDS*

Rob led a discussion of data needs in the Metropolitan area. Arterial Management Systems are heavily evaluated. Joe noted that "Study in Progress" designated in the Summary of Known Benefits table includes Integration Program national evaluations but does not include Field Operational Tests which may be in progress.

Someone asked what measures are heavily covered in the Metropolitan area. Rob explained that Travel Time and Delay appear frequently. He also noted that Travel Time Reliability is becoming another good measure. Someone asked what type of data is contained in the database. Rob answered that measured data is the primary data type, supplemented with predicted or estimated data.

Participants expressed that just because the number of records is low in a given area, it is not necessarily a data gap (for example, electronic toll collection didn't have as many records as expected, but the benefits are well understood and no federal evaluation is necessary).

The definition of "Regional Multimodal" was questioned. There was no agreement on whether it means "Regional *or* Multimodal" or "Regional *and* Multimodal", however, it was clear that the category was intended to be inclusive of regional, multimodal, and regional multimodal information systems.

A question about how mode choice was represented in the database was raised. Rob's answer was that the "customer satisfaction" measure is used.

[2] In the table, it was suggested that "no benefits" be replaced with "indirect benefits".

*DISCUSSION OF METROPOLIAN INTEGRATION DATA NEEDS*

One participant expressed their opinion that links 21a and 21b (Emergency Management-to-Incident Management) should be considered a priority link. Paul Pisano (FHWA) mentioned that maintenance management should be included in the bubble chart. Some discussion ensued about the extent to which maintenance should be reflected in the taxonomy.

In the discussion of Metropolitan Integration, Marcia Pincus (ITS America) mentioned the need to provide higher level meta-analysis information to the user. This type of information can help provide answers to questions such as "What is implementing a 511 program going to cost me?" and "What are the benefits of integration?"

*DISCUSSION OF RURAL DATA NEEDS*

A brief discussion of technical issues versus institutional issues prompted Joe Peters to note that the problem is not a lack of data, but poor communication of benefits data to the right people, in the right way. Many jurisdictions desire a tool that helps them assess specific benefits to their area. The ITS Deployment Analysis System (IDAS) is a tool which provides that functionality.

Workshop participants noted three areas of data needs in both metropolitan and rural areas:

- the variability and reliability of travel
- safety in highway and bus operations (localized to time-of-day, not just global measures)
- the effect of maintenance on operations (failure rate of inductive loop detectors is a big problem).

Operating agencies are focusing more on providing "reliable" service than simply offering "capacity". It was suggested that the focus of evaluations should be on what type of data is collected and which evaluation measures are used. For example, capacity might be a useful measure for planning purposes since ITS projects often compete with road improvement projects for operations and maintenance funds.

Someone suggested that rural categories should match those in the metropolitan area. The JPO uses the designation "rural aspect of" specific metropolitan categories. Joe asked if there is a need for rural traffic management and how it was different than metropolitan applications. Paul Pisano noted that evacuations from rural coastal areas significantly impact traffic management. It was recognized that implementation of various systems will be different in rural areas. Joe stated that the metropolitan/rural split in the taxonomy will be further addressed.

*DISCUSSION OF CVO & INTERMODAL DATA NEEDS*

CVISN evaluation data will be released in the next few months. Data needs in the ITS/CVO area include deployment, operations and maintenance benefits and costs for electronic Safety Screening and Credential Checking. In Carrier Operations, data is needed on cargo monitoring and communication links to incident response agencies. Also, fixed versus portable systems should be distinguished in the electronic Weight Screening area.

Amy Polk (NASA – JPL) noted the similarity between ITS/CVO Border Clearance and Intermodal Freight Border Crossing Processes.

*WRAP UP*

Greg Hatcher wrapped the meeting up by thanking the participants for their contributions and reminding them to send in their surveys by the end of the month.

## Survey Results

Survey participants were asked to rate ITS application areas based on their assessment of the importance of conducting further evaluation in that ITS area. The rating occurred on a scale of 0 to 5 with 0 being no importance, and five being high importance. (Appendix A includes a copy of the survey). Tables on the following pages present the results of the survey in each group of ITS application areas: Metroplitan, Metropolitan Integration Links, Rural, ITS/CVO, and Intermodal Freight. Entries in the survey results tables have been sorted by the mean value of the importance rating given by respondents. For each question, the mean was calculated based on the number of responses received.

Forty-four individuals returned surveys. Participants were asked to give their stakeholder perspective when completing the survey; Table 1 contains the number of respondents identifying with each perspective.

| *Stakeholder Perspective* | *Responses* |
|---|---|
| Federal Government | 20 |
| State Government | 9 |
| Local Government | 2 |
| Consultant | 6 |
| ITS Industry/Industry Society | 2 |
| *"Other" Responses* | |
| University | 1 |
| Maritime Trade Organization | 1 |
| MPO | 2 |
| Regional Council | 1 |
| **TOTAL** | **44** |

**Table 1.** *Survey Participants' Stakeholder Perspectives*

*METROPOLITAN APPLICATION AREAS*

Table 2 shows the survey results from the metropolitan ITS application areas. The application areas are sorted by the average rating, with the highest score being at the top of the table. Since not all respondents rated each area, the average rating was calculated by dividing the total score by the applicable number of responses. Respondents rated metropolitan traveler information and enforcement applications high, while several transit management applications and ETC were among the lowest rated.

| | Metropolitan Application Areas | | Number of DB Entries* | # of Responses | Avg. Rating |
|---|---|---|---|---|---|
| Metropolitan | Reg. MM Trav. Info. | En-route Information | 10 | 36 | 3.722 |
| | Reg. MM Trav. Info. | Pre-trip Information | 11 | 36 | 3.569 |
| | Art. Mgmt. | Information Dissemination | 0 | 37 | 3.568 |
| | Art. Mgmt. | Public Safety / Enforcement | 9 | 37 | 3.541 |
| | Inc. Mgmt. | Clearance | 1 | 36 | 3.514 |
| | Free. Mgmt. | Public Safety / Enforcement | 3 | 35 | 3.486 |
| | Metro. Other | Road Weather Management | 2 | 35 | 3.486 |
| | Inc. Mgmt. | Detection | 5 | 38 | 3.395 |
| | Free. Mgmt. | Information Dissemination | 13 | 37 | 3.378 |
| | Transit Mgmt. | Transit Information | 3 | 38 | 3.368 |
| | Inc. Mgmt. | Response (Patrols) | 15 | 36 | 3.333 |
| | Inc. Mgmt. | Surveillance | 3 | 37 | 3.324 |
| | Free. Mgmt. | Traffic Surveillance | 2 | 37 | 3.162 |
| | Emer. Mgmt. | Emergency Vehicle (Route Guidance) | 0 | 34 | 3.162 |
| | Emer. Mgmt. | Emergency Management (AVL, Fleet Mgmt.) | 5 | 32 | 3.156 |
| | Metro. Other | Operations and Maintenance | 1 | 36 | 3.139 |
| | Info. Mgmt. | Data Archiving | 0 | 37 | 3.135 |
| | HRI | Control | 1 | 38 | 3.105 |
| | Art. Mgmt. | Traffic Control Emerg. Veh. Signal Priority | 2 | 35 | 3.086 |
| | HRI | Display - Audio/Visual | 3 | 38 | 3.053 |
| | Art. Mgmt. | Traffic Control Coordinated Signals | 14 | 35 | 3.000 |
| | Free. Mgmt. | Traffic Control Lane Control | 3 | 35 | 2.971 |
| | ETC | Toll Collection | 5 | 34 | 2.971 |
| | Elec. Fare Payment | Administration/Management | 4 | 33 | 2.939 |
| | HRI | Surveillance | 1 | 35 | 2.914 |
| | HRI | Enforcement | 1 | 35 | 2.900 |
| | Metro. Other | Parking Management | 0 | 36 | 2.889 |
| | Art. Mgmt. | Traffic Control Transit Signal Priority | 8 | 38 | 2.842 |
| | Art. Mgmt. | Traffic Control Adaptive Signals | 13 | 34 | 2.824 |
| | Transit Mgmt. | Security | 1 | 34 | 2.794 |
| | Art. Mgmt. | Traffic Surveillance | 2 | 33 | 2.788 |
| | Transit Mgmt. | Transit Mgmt. AVL | 8 | 35 | 2.786 |
| | Elec. Fare Payment | Transit Vehicle | 1 | 33 | 2.712 |
| | Art. Mgmt. | Traffic Control Pedestrian Control | 1 | 34 | 2.706 |
| | Free. Mgmt. | Traffic Control Ramp Metering | 7 | 34 | 2.691 |
| | Metro. Other | Travel and Tourism | 1 | 33 | 2.667 |
| | ETC | Toll Vehicle | 3 | 32 | 2.625 |
| | Transit Mgmt. | Transit Mgmt. Maintenance | 1 | 35 | 2.600 |
| | ETC | Toll Administration | 2 | 31 | 2.468 |
| | Transit Mgmt. | Transit Mgmt. Paratransit (CAD) | 2 | 35 | 2.457 |
| | Transit Mgmt. | Personal Rapid Transit | 1 | 32 | 2.156 |

* Reflects Number of entries in the database as of 15 February 2001.

**Table 2.** S*urvey Results for Metropolitan ITS application areas*

*METROPOLITAN INTEGRATION LINKS*

Table 3 depicts the survey results for evaluation of the integration of ITS components, again sorted by average rating. The links used in the survey help describe the types of integration that occur between various applications. Appendix B provides a more thorough discussion of the types of communication and coordination represented by each link. Respondents' ratings indicate that the integration of Incident Management with other ITS components needs further evaluation. The integration of Arterial Management and Incident Management also appears to be an area in need of further study according to the survey results.

| Metropolitan Integration Links | Number of DB Entries* | # of Responses | Avg. Rating |
|---|---|---|---|
| Link 7: Incident Management to Emergency Management | 3 | 32 | 3.813 |
| Link 6: Incident Management to Regional Multimodal Traveler Information | 11 | 37 | 3.703 |
| Link 8: Incident Management to Freeway Management | 4 | 33 | 3.667 |
| Link 4: Arterial Management to Incident Management | 1 | 35 | 3.629 |
| Link 5: Incident Management to Arterial Management | 2 | 35 | 3.571 |
| Link 14b: Transit Management to Regional Multimodal Traveler Information: | 1 | 35 | 3.514 |
| Link 28: Electronic Toll Collection intra-component | 0 | 34 | 3.471 |
| Link 21a: Emergency Management to Incident Management: Location | 0 | 32 | 3.469 |
| Link 30: Freeway Management intra-component | 0 | 32 | 3.469 |
| Link 21b: Emergency Management to Incident Management: Clearance | 0 | 31 | 3.419 |
| Link 10: Freeway Management to Regional Multimodal Traveler Information | 8 | 34 | 3.412 |
| Link 13: Freeway Management to Incident Management | 5 | 33 | 3.394 |
| Link 27: Electronic Fare Payment intra-component | 1 | 34 | 3.382 |
| Link 2: Arterial Management to Freeway Management | 2 | 35 | 3.371 |
| Link 25: Incident Management intra-component | 0 | 29 | 3.328 |
| Link 23: Highway-rail intersection to Incident Management | 0 | 32 | 3.281 |
| Link 1: Arterial Management to Regional Multimodal Traveler Information | 2 | 36 | 3.278 |
| Link 11: Freeway Management to Arterial Management | 1 | 34 | 3.265 |
| Link 14a: Transit Management to Regional Multimodal Traveler Information: | 6 | 34 | 3.235 |
| Link 22: Emergency Management to Arterial Management | 2 | 29 | 3.172 |
| Link 3: Arterial Management to Transit Management | 1 | 36 | 3.167 |
| Link 9: Incident Management to Transit Management | 0 | 35 | 3.114 |
| Link 24: Highway-rail intersections to Arterial Management | 0 | 30 | 3.067 |
| Link 26: Arterial Management intra-component | 3 | 30 | 3.033 |
| Link 29: Transit Management to Incident Management | 0 | 32 | 3.016 |
| Link 16b: Transit Management to Arterial Management: Transit vehicles as | 1 | 33 | 2.894 |
| Link 12: Freeway Management to Transit Management | 0 | 35 | 2.857 |
| Link 16a: Transit Management to Arterial Management | 8 | 34 | 2.853 |
| Link 17: Electronic Toll Collection to Freeway Management | 0 | 36 | 2.847 |
| Link 15b: Transit Management to Freeway Management: Transit Vehicles | 0 | 32 | 2.797 |
| Link 18: Electronic Toll Collection to Arterial Management | 0 | 35 | 2.786 |
| Link 20: Electronic Fare Payment to Transit Management | 0 | 31 | 2.774 |
| Link 15a: Transit Management to Freeway Management: Ramp Meter | 0 | 33 | 2.727 |
| Link 19: Electronic Toll Collection to Electronic Fare Payment | 0 | 33 | 2.697 |

* Reflects Number of entries in the database as of 15 February 2001.

**Table 3.** S*urvey Results for Metropolitan Integration Links*

The most common theme in respondent comments for the metropolitan application areas and metropolitan integration links was a desire for more information on the impacts of the provision of traveler information. Several respondents indicated the desire for evaluation of how the

various integration links can help provide better traveler information. Suggested research areas included trip itinerary planning within transit information systems and the integration of parking management systems with traveler information.

Other comments included:

- the need for investigating the value to passengers and reduction in emissions due to arterial management information provided to transit management,
- and a request for studies of transit signal priority benefits.

*RURAL APPLICATION AREAS*

Table 4 presents the results for rural application areas. Following the workshop, the survey was modified to request that participants provide ratings for subcategories within the rural areas. Results are presented ordered by the average rating for the major application areas, with the corresponding subcategories for each area listed in order of their average ratings. Respondents ratings indicate a strong interest in additional information on the impacts of Emergency Services and Road Weather Management applications in rural areas. Interest was low in further evaluation of Travel and Tourism as well as Transit and Mobility applications.

| | Rural Application Areas | | Number of DB Entries* | # of Responses | Avg. Rating |
|---|---|---|---|---|---|
| Rural | **Emergency Services** | | 3 | 31 | 3.677 |
| | Em. Serv. | Information Dissemination | 0 | 4 | 3.750 |
| | Em. Serv. | Detection (Call Centers, Surveillance) | 2 | 4 | 3.000 |
| | Em. Serv. | Mobilization & Response | 1 | 4 | 2.750 |
| | **Road Weather Management** | | 9 | 31 | 3.565 |
| | RWM | Information Dissemination | 5 | 7 | 3.857 |
| | RWM | Response and Treatment | 4 | 7 | 3.857 |
| | **Crash Prevention and Security** | | 3 | 21 | 3.048 |
| | **Operations and Maintenance** | | 1 | 33 | 2.970 |
| | O&M | Work Zone Management | 1 | 6 | 3.833 |
| | O&M | Information Dissemination | 0 | 7 | 3.714 |
| | O&M | Infrastructure Managment | 0 | 5 | 3.400 |
| | O&M | Fleet Management | 0 | 5 | 3.000 |
| | **Traffic Management** | | 0 | 30 | 2.900 |
| | Traffic Mgmt. | Information Dissemination | 0 | 7 | 4.143 |
| | Traffic Mgmt. | Traffic Control | 0 | 5 | 3.800 |
| | **Transit and Mobility** | | 3 | 31 | 2.694 |
| | Transit & Mobility | Traveler Information | 0 | 6 | 3.500 |
| | Transit & Mobility | Transit Management | 3 | 5 | 3.000 |
| | Transit & Mobility | Ride Sharing and Matching | 0 | 5 | 3.000 |
| | Transit & Mobility | Electronic Payment | 0 | 5 | 2.800 |
| | **Travel and Tourism** | | 1 | 30 | 2.367 |
| | Trav. and Tour. | Traveler Information | 1 | 6 | 3.500 |
| | Trav. and Tour. | Electronic Fare Payment | 0 | 5 | 2.400 |

* Reflects Number of entries in the database as of 15 February 2001.

**Table 4.** S*urvey Results for Rural Application Areas*

Very few survey respondents entered comments within the rural area. However, these applications were discussed at the workshop, as discussed in the previous section of this report.

*COMMERCIAL VEHICLE APPLICATION AREAS*

Table 5 includes the survey results for ITS commercial vehicle (ITS/CVO) application areas. Responses indicate great interest in safety related ITS/CVO applications including Electronic Screening for Safety and Safety Assurance applications. Carrier Operations applications were rated least favorably, however the generally high ratings for all ITS/CVO categories indicate strong interest in evaluation of these types of systems.

| Commercial Vehicle Application Area | | | Number of DB Entries* | # of Responses | Avg. Rating |
|---|---|---|---|---|---|
| ITS/CVO | E. Screening | Safety Screening | 1 | 32 | 4.109 |
| | Safety Assurance | Safety Information Exchange | 2 | 31 | 3.935 |
| | Safety Assurance | Automated Inspections | 2 | 30 | 3.867 |
| | E. Screening | Weight Screening | 1 | 32 | 3.813 |
| | E. Screening | Credential Checking | 2 | 32 | 3.797 |
| | E. Screening | Border Clearance | 2 | 32 | 3.797 |
| | Carrier Ops. | Electronic Credentialing | 2 | 32 | 3.766 |
| | Credentials Admin. | Administrative Processes | 2 | 30 | 3.633 |
| | Safety Assurance | General | 1 | 27 | 3.481 |
| | Carrier Ops. | Onboard Monitoring | 0 | 32 | 3.469 |
| | E. Screening | General | 1 | 28 | 3.286 |
| | Carrier Ops. | Fleet Management | 6 | 32 | 3.281 |
| | Carrier Ops. | Traveler Information | 1 | 33 | 3.273 |
| | Carrier Ops. | General | 0 | 28 | 3.250 |

* Reflects Number of entries in the database as of 15 February 2001.

**Table 5.** S*urvey Results for Commercial Vehicle Application Areas*

Several respondents commented on the commercial vehicle application areas. One requested a study of the impact of automated inspections on the productivity of field staff, the impact of credentials administration on both industry as well as government, and the infrastructure preservation benefits of weight screening programs. Another indicated little need for information regarding safety information exchange or credentials administration due to the wide acceptance of the programs.

*INTERMODAL FREIGHT APPLICATION AREAS*

Table 6 presents the survey results for intermodal freight application areas. Each of these application areas rated above three, indicating a generally high level of interest in evaluation of the impacts of ITS applications for intermodal freight.

| | Intermodal Freight Application Area | Number of DB Entries* | # of Responses | Avg. Rating |
|---|---|---|---|---|
| Intermodal | Border Crossing Processes | 0 | 29 | 3.862 |
| | Freight Highway Connector Systems | 0 | 29 | 3.621 |
| | Freight Tracking | 0 | 28 | 3.571 |
| | Asset Tracking | 0 | 27 | 3.481 |
| | Drayage Operations | 0 | 27 | 3.444 |
| | Freight Terminal Gate Systems | 0 | 27 | 3.333 |

* Reflects Number of entries in the database as of 15 February 2001.

**Table 6.** S*urvey Results for Intermodal Freight Application Areas*

There were very few comments entered regarding intermodal freight applications.

*BENEFITS MEASURES*

Survey participants were also asked to allocate 100 points to the importance of measuring the impact of ITS implementations on each of the few good measures. Thirty-nine respondents completed this portion of the survey. Table 7 contains the average number of points assigned to each of the measures by these respondents. The most highly rated measures were improving safety, improving mobility, and increasing efficiency.

| Goal Area | Avg. Rating |
|---|---|
| Improve Safety | 29.1 |
| Improve Mobility | 18.4 |
| Increase Efficiency | 17.9 |
| Increase Productivity | 9.3 |
| Conserve Energy | 6.8 |
| Traveler Response | 6.6 |
| Customer Satisfaction | 6.1 |
| Improve Environment | 5.2 |

**Table 7.** S*urvey Results for Benefit Measures*

There were many comments about the various measures used to assess ITS. These comments generally described the virtues of each of the measures, indicating a high level of interest in the impacts in each of the areas. The ratings in the table reflect strong support for the three primary ITS goals of saving lives, time and money, while other comments received with the surveys indicate continued interest in each of the remaining measures presented.

# Appendix A

## Sample Survey and Workshop Handouts

# Appendix A-1

# ITS Benefits Data Needs Workshop Agenda

# ITS Benefits
2001 Data Needs Workshop

## Agenda

| | | |
|---|---|---|
| 8:30 AM | Welcome | Peggy Tadej, NARC |
| | Workshop Background | Greg Hatcher, Mitretek Systems |
| | ITS Benefits Database Demonstration | Rob Maccubbin, Mitretek Systems |
| | Overview of Survey & Handouts | Rob Maccubbin, Mitretek Systems |
| | Discussion of Data Needs by Area<br>• Metropolitan Application Area | Rob Maccubbin, Mitretek Systems |
| | Break | |
| | Discussion of Data Needs by Area<br>• Metropolitan Integration Links<br>• Rural Application Area<br>• CVO & Intermodal Freight Areas | Rob Maccubbin, Mitretek Systems |
| 12:15 PM | Wrap-up | Greg Hatcher, Mitretek Systems |

## Handouts

Introductory Presentation

Benefits Desk Reference, including:
- Benefits by Program Area
- Benefits by Measure

Summary of Known Benefits Table

Benefits of Metropolitan Integration

2001 Data Needs Survey Announcement

# Appendix A-2

# Summary of Metropolitan ITS Benefits

# Metropolitan Benefits By Program Area

| Program Area/Benefit Measure | | Summary |
|---|---|---|
| Arterial Management Systems | Safety Improvements | Automated enforcement of traffic signals has reduced violations 20% to 75% |
| | Delay Savings | Adaptive Signal Control has reduced delay from 14% to 44% |
| | Throughput | |
| | Customer Satisfaction | 72% of surveyed drivers felt "better off" after signal control improvements in Michigan |
| | Cost Savings | Transit Signal Priority on Toronto transit line allowed same service with one less vehicle |
| | Environmental | Improvements to traffic signal control have reduced fuel consumption 2% to 13% |
| | Other | Adaptive Control has reduced stops from 10% to 41% |
| Freeway Management Systems | Safety Improvements | Ramp Metering has shown 15% to 50% reduction in crashes |
| | Delay Savings | 11 to 93.1 vehicle hours reduced due to ramp metering I-494: Minneapolis |
| | Throughput | Systemwide study in Minneapolis - St. Paul found 16.3% increase in throughput |
| | Customer Satisfaction | After Twin Cities shutdown, 69% of surveyed travelers support modified continued operation |
| | Cost Savings | Georgia Navigator $44.6 Million/year in incident delay reduction (integrated system) |
| | Environmental | |
| | Other | Ramp Metering has shown 8% to 60% increases in speed on freeways |
| Transit Management Systems | Safety Improvements | AVL with silent alarm supported 33% reduction in passenger assaults on Denver System |
| | Delay Savings | Reported improvements in on-time performance from 9% to 23% with CAD/AVL |
| | Throughput | |
| | Customer Satisfaction | Customer complaints decreased 26% after Denver installed CAD/AVL |
| | Cost Savings | AVL reduced San Jose paratransit expenses from $4.88 to $3.72 per passenger |
| | Environmental | |
| | Other | Reductions in fleet size from 4% to 9% due to more efficient bus utilization |
| Incident Management Systems | Safety Improvements | San Antonio, TX reports reduced accident rate of 41% |
| | Delay Savings | Reductions range from 95 thousand to 2 million hours per year |
| | Throughput | |
| | Customer Satisfaction | Customers very satisfied with service patrols (hundreds of letters) |
| | Cost Savings | Cost Savings from $1 to $45 million per year, varying with extent of system |
| | Environmental | TransGuide reduced fuel consumption up to 2600 gal/major incident |
| | Other | |
| Emergency Management Systems | Safety Improvements | |
| | Delay Savings | |
| | Throughput | |
| | Customer Satisfaction | 95% of drivers equipped with PushMe Mayday system felt more secure. |
| | Cost Savings | |
| | Environmental | |
| | Other | |
| Electronic Toll Collection | Safety Improvements | Carquinez Bridge, CA: Increase in accidents (27 to 30) and Injuries between 1996 and 1997* |
| | Delay Savings | Carquinez Bridge, CA: person time savings of 79,919 hours (per year) or about $1.07 million |
| | Throughput | Tappan Zee Bridge: Manual lane 400-450 vph, ETC lane 1000 vph |
| | Customer Satisfaction | |
| | Cost Savings | Roadway Maintenance can be reduced 14% |
| | Environmental | Florida: Reduced CO 7.3%, HC 7.2%, Increased NOx 34% with 40% ETC usage |
| | Other | Value pricing using ETC in Florida resulted in 20% of travelers adjusting departure time |
| Electronic Fare Payment | Safety Improvements | |
| | Delay Savings | |
| | Throughput | |
| | Customer Satisfaction | In Europe, 71% to 87% user acceptance of coordinated smart cards for transit/city services |
| | Cost Savings | New Jersey Transit estimates $2.7 million cash handling reduction annually |
| | Environmental | |
| | Other | |
| Highway Rail Intersections | Safety Improvements | 92% of train engineers felt safety equal or greater with automated horn warning system |
| | Delay Savings | |
| | Throughput | |
| | Customer Satisfaction | School bus drivers felt in-vehicle warning devices enhanced awareness of crossings |
| | Cost Savings | |
| | Environmental | Automated horn warning system reduced noise impact area by 97% |
| | Other | |
| Regional Multimodal Traveler Information | Safety Improvements | Crash rate for drivers using web traveler information in San Antonio reduced 0.5% |
| | Delay Savings | San Antonio modeling results indicate a 5.4% reduction in delay for web site users |
| | Throughput | |
| | Customer Satisfaction | 38% of TravTek Users found in-vehicle navigation useful in unfamiliar areas |
| | Cost Savings | ROUTES (London): estimated 1.3 million pounds sterling due to increased transit ridership |
| | Environmental | SmartTraveler Boston: estimated reductions NOx 1.5%, CO 33% |
| | Other | |

Source: http://www.benefitcost.its.dot.gov *Database also includes negative impacts of ITS. Date: 3/14/2001

# Metropolitan Benefits By Measure

| Benefit Measure/Program Area | | Summary |
|---|---|---|
| Safety Improvements | Arterial Management | Automated enforcement of traffic signals has reduced violations 20% to 75% |
| | Freeway Management | Ramp Metering has shown 15% to 50% reduction in crashes |
| | Transit Management | AVL with silent alarm supported 33% reduction in passenger assaults on Denver System |
| | Incident Management | San Antonio, TX reports reduced accident rate of 41% |
| | Emergency Management | |
| | Electronic Toll Collection | Carquinez Bridge, CA: Increase in accidents (27 to 30) and Injuries between 1996 and 1997* |
| | Electronic Fare Payment | |
| | Highway Rail Intersection | 92% of train engineers felt safety equal or greater with automated horn warning system |
| | Regional Traveler Info. | Crash rate for drivers using web traveler information in San Antonio reduced 0.5% |
| Delay Savings | Arterial Management | Adaptive Signal Control has reduced delay from 14% to 44% |
| | Freeway Management | 11 to 93.1 vehicle hours reduced due to ramp metering I-494: Minneapolis |
| | Transit Management | Reported improvements in on-time performance from 9% to 23% with CAD/AVL |
| | Incident Management | Reductions range from 95 thousand to 2 million hours per year |
| | Emergency Management | |
| | Electronic Toll Collection | Carquinez Bridge, CA: person time savings of 79,919 hours (per year) or about $1.07 million |
| | Electronic Fare Payment | |
| | Highway Rail Intersection | |
| | Regional Traveler Info. | San Antonio modeling results indicate a 5.4% reduction in delay for web site users |
| Throughput | Arterial Management | |
| | Freeway Management | Systemwide study in Minneapolis - St. Paul found 16.3% increase in throughput |
| | Transit Management | |
| | Incident Management | |
| | Emergency Management | |
| | Electronic Toll Collection | Tappan Zee Bridge: Manual lane 400-450 vph, ETC lane 1000 vph |
| | Electronic Fare Payment | |
| | Highway Rail Intersection | |
| | Regional Traveler Info. | |
| Customer Satisfaction | Arterial Management | 72% of surveyed drivers felt "better off" after signal control improvements in Michigan |
| | Freeway Management | After Twin Cities shutdown, 69% of surveyed travelers support modified continued operation |
| | Transit Management | Customer complaints decreased 26% after Denver installed CAD/AVL |
| | Incident Management | Customers very satisfied with service patrols (hundreds of letters) |
| | Emergency Management | 95% of drivers equipped with PushMe Mayday system felt more secure. |
| | Electronic Toll Collection | |
| | Electronic Fare Payment | In Europe, 71% to 87% user acceptance of coordinated smart cards for transit/city services |
| | Highway Rail Intersection | School bus drivers felt in-vehicle warning devices enhanced awareness of crossings |
| | Regional Traveler Info. | 38% of TravTek Users found in-vehicle navigation useful in unfamiliar areas |
| Cost Savings | Arterial Management | Transit Signal Priority on Toronto transit line allowed same service with one less vehicle |
| | Freeway Management | Georgia Navigator $44.6 Million/year in incident delay reduction (integrated system) |
| | Transit Management | AVL reduced San Jose paratransit expenses from $4.88 to $3.72 per passenger |
| | Incident Management | Cost Savings from $1 to $45 million per year, varying with extent of system |
| | Emergency Management | |
| | Electronic Toll Collection | Roadway Maintenance can be reduced 14% |
| | Electronic Fare Payment | New Jersey Transit estimates $2.7 million cash handling reduction annually |
| | Highway Rail Intersection | |
| | Regional Traveler Info. | ROUTES (London): estimated 1.3 million pounds sterling due to increased transit ridership |
| Environmental | Arterial Management | Improvements to traffic signal control have reduced fuel consumption 2% to 13% |
| | Freeway Management | |
| | Transit Management | |
| | Incident Management | TransGuide reduced fuel consumption up to 2600 gal/major incident |
| | Emergency Management | |
| | Electronic Toll Collection | Florida: Reduced CO 7.3%, HC 7.2%, Increased NOx 34% with 40% ETC usage |
| | Electronic Fare Payment | |
| | Highway Rail Intersection | Automated horn warning system reduced noise impact area by 97% |
| | Regional Traveler Info. | SmartTraveler Boston: estimated reductions NOx 1.5%, CO 33% |
| Other | Arterial Management | Adaptive Control has reduced stops from 10% to 41% |
| | Freeway Management | Ramp Metering has shown 8% to 60% increases in speed on freeways |
| | Transit Management | Reductions in fleet size from 4% to 9% due to more efficient bus utilization |
| | Incident Management | |
| | Emergency Management | |
| | Electronic Toll Collection | Value pricing using ETC in Florida resulted in 20% of travelers adjusting departure time |
| | Electronic Fare Payment | |
| | Highway Rail Intersection | |
| | Regional Traveler Info. | |

Source: http://www.benefitcost.its.dot.gov *Database also includes negative impacts of ITS. Date: 3/14/2001

# Appendix A-3

# Summary Listing of Known Benefits by Application Area

# ITS Benefits

**2001 Data Needs Workshop**

**Summary of Known Benefits**

| | Metropolitan Application Area | Number of Entries* | Study in Progress | Summary of Known Benefits |
|---|---|---|---|---|
| **Metropolitan** | Arterial Management Systems | **49** | **Yes** | |
| | Traffic Surveillance | 2 | Yes | Supporting role, no direct benefits |
| | Traffic Control | 38 | Yes | |
| | Adaptive Signals | 13 | No | Reduced delay 14-44%, fuel consumption 2-13% |
| | Coordinated Signals | 14 | No | Travel time, fuel consumption |
| | Transit Signal Priority | 8 | Yes | Delay savings, improved operational control |
| | Emergency Vehicle Signal Priority | 2 | No | Faster response, impact on other traffic |
| | Pedestrian Control | 1 | No | Reduced pedestrian/vehicle conflicts |
| | Information Dissemination | 0 | No | |
| | Public Safety / Enforcement | 9 | No | Reduced violations 20-75% |
| | Freeway Management Systems | **29** | **No** | |
| | Traffic Surveillance | 3 | No | Supporting role, no direct benefits |
| | Traffic Control | 10 | No | |
| | Lane Control (Speed Limits, Lane Use) | 3 | No | Capacity improvements, accident reduction |
| | Ramp Metering | 7 | No | 15%-50% crash reduction, increased freeway speeds |
| | Information Dissemination | 13 | No | Accident reduction, delay savings |
| | Public Safety / Enforcement | 3 | No | Customer satisfaction, Safety |
| | Transit Management Systems | **16** | **Yes** | |
| | Personal Rapid Transit | 1 | No | Travel time, emission reductions |
| | Transit Management & Operations | 11 | Yes | |
| | Maintenance | 1 | No | Time savings for maintenance tasks |
| | AVL | 8 | Yes | Delay/Travel Time improvements, cost savings |
| | Paratransit (CAD) | 2 | No | Efficiency, cost savings, customer satisfaction |
| | Security | 1 | No | Customer satisfaction |
| | Transit Information | 3 | No | Customer satisfaction, faster information retrieval |
| | Incident Management Systems | **25** | **No** | |
| | Surveillance | 3 | No | Supporting role, no direct benefits |
| | Detection | 5 | No | Time savings in incident detection |
| | Response (Patrols) | 15 | No | Customer satisfaction, delay savings, safety |
| | Clearance | 1 | No | Time savings, cost savings |

| | Metropolitan Application Area | Number of Entries* | Study in Progress | Summary of Known Benefits |
|---|---|---|---|---|
| **Metropolitan** | Emergency Management | **5** | **No** | |
| | Emergency Management (AVL, Fleet Mgmt.) | 5 | No | Anecdotal evidence of response time savings |
| | Emergency Vehicle (Route Guidance) | 0 | No | |
| | Electronic Toll Collection | **10** | **No** | |
| | Toll Administration | 2 | No | Cost savings, B/C ratio |
| | Toll Collection | 5 | No | Time savings, capacity, anecdotal safety concern |
| | Toll Vehicle | 3 | No | Reduced emissions |
| | Electronic Fare Payment | **5** | **No** | |
| | Administration/Management | 4 | No | Cost savings |
| | Transit Vehicle | 1 | No | Customer satisfaction |
| | Highway Rail Intersection | **6** | **No** | |
| | Surveillance | 1 | No | Supporting role, no direct benefits |
| | Control | 1 | No | Supporting role, no direct benefits |
| | Display - Audio/Visual | 3 | No | Customer satisfaction; crash and delay savings in simulation |
| | Enforcement | 1 | No | 92% reduction in violations in LA |
| | Regional Multimodal information | **21** | **Yes** | |
| | Pre-trip Information | 11 | Yes | Customer satisfaction |
| | En-route Information | 10 | Yes | Customer satisfaction |
| | Information Management | **0** | **No** | |
| | Data Archiving | 0 | No | |
| | Other Metropolitan Systems | **4** | **No** | |
| | Travel and Tourism | 1 | No | Customer satisfaction, combined with traveler info. |
| | Road Weather Management | 2 | No | Slight impact of weather information during events, safety |
| | Operations and Maintenance | 1 | No | Customer satisfaction |
| | Parking Management | | No | |

* Reflects Number of entries in the database as of 15 February 2001.

| | Rural Application Area | Number of Entries* | Study in Progress | Summary of Known Benefits |
|---|---|---|---|---|
| Rural | Crash Prevention and Security | 7 | No | Info. Dissemination: Safety, Customer Satisfaction |
| | Emergency Services | 3 | Yes | Mobilization & Response: Clearance Time, Cost Savings |
| | Travel and Tourism | 1 | No | Traveler Information: Customer Satisfaction |
| | Traffic Management | 0 | No | |
| | Transit and Mobility | 3 | No | Transit Management: Cost Savings |
| | Operations and Maintenance | 1 | No | Work Zone Management: customer satisfaction |
| | Road Weather Management | **9** | **Yes** | |
| | Information Dissemination | 5 | Yes | Safety, Delay/Time savings, Cost Savings |
| | Response and Treatment | 4 | Yes | Cost Savings, Safety, Delay/Time savings |
| | Surveillance and Monitoring | 6 | Yes | Supporting role, no direct benefits |

* Reflects Number of entries in the database as of 15 February 2001.

| | Commercial Vehicle Application Area | Number of Entries* | Study in Progress | Summary of Known Benefits |
|---|---|---|---|---|
| CVO | Safety Assurance | **5** | **No** | |
| | Safety Information Exchange | 2 | No | B/C ratios, Customer Satisfaction |
| | Automated Inspections | 2 | No | B/C ratios, Customer Satisfaction |
| | General | 1 | No | B/C of automated enforcement in Australia 2.5 to 1 |
| | Credentials Administration | **2** | **No** | |
| | Administrative Processes | 2 | No | Cost Savings |
| | Electronic Screening | **7** | **No** | |
| | Safety Screening | 1 | No | Benefit Cost Ratios |
| | Credential Checking | 2 | No | Cost Savings, Customer Satisfaction |
| | Border Clearance | 2 | No | Delay reductions |
| | Weight Screening | 1 | No | Anecdotal benefits in cost savings, efficiency, safety |
| | General | 1 | No | Anecdotal benefits in cost savings, efficiency, safety |
| | Carrier Operations | **9** | **No** | |
| | Fleet Management | 6 | No | Cost savings, Delay/Time savings |
| | Traveler Information | 1 | No | Customer Satisfaction |
| | Onboard Monitoring | 0 | No | |
| | Electronic Credentialing | 2 | No | B/C Ratios, and Customer Satisfaction in Maryland |
| | General | 0 | No | |

* Reflects Number of entries in the database as of 15 February 2001.

| | Intermodal Freight Application Area | Number of Entries* | Study in Progress | Summary of Known Benefits |
|---|---|---|---|---|
| Intermodal | Drayage Operations | 0 | No | |
| | Freight Tracking | 0 | No | |
| | Asset Tracking | 0 | Yes | |
| | Freight Terminal Gate Systems | 0 | No | |
| | Border Crossing Processes | 0 | No | |
| | Freight Highway Connector Systems | 0 | No | |
| | | | | |

* Reflects Number of entries in the database as of 15 February 2001.

# Appendix A-4

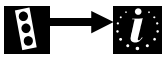
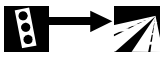
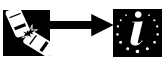
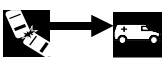
# Benefits of Metropolitan Integration Handout

# ITS Benefits
## 2001 Data Needs Workshop

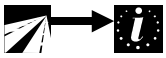
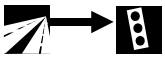
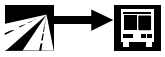
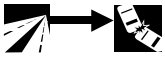
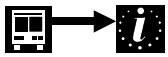
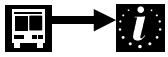
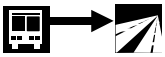
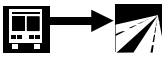
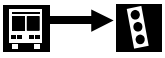
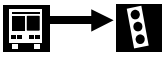
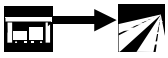
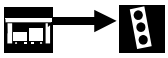
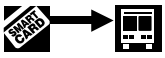
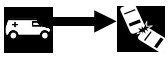
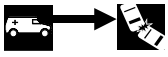
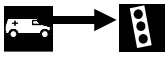
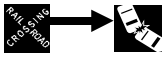
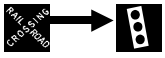
## Benefits of Metropolitan Integration

Few studies have evaluated the impacts of integration in comparison to the impacts of stand-alone ITS implementations. However, many evaluated the overall impact of ITS implementations that included integration between components. The table below presents the number studies represented in the ITS Benefits database that involve integration of applications from different user services. In the table, the following icons represent ITS application areas:

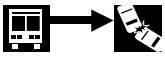

Arterial Management Systems
Freeway Management Systems
Transit Management Systems
Emergency Management Systems
Incident Management Systems
Electronic Toll Collection
Electronic Fare Payment
Highway-Rail Intersections
Regional Multimodal Traveler Information

| Link No. | Integration Link | Link Purpose | Data Available | Study in Progress? |
|---|---|---|---|---|
| 1 |  | Affect Travel Decisions | 2 | No |
| 2 |  | Arterial Conditions | 2 | Yes |
| 3 |  | Adjust Schedules or Routes | 1 | No |
| 4 |  | Adjust Ramp Signals or Inform Drivers | 1 | Yes |
| 5 |  | Affect Traffic Control Strategy | 2 | No |
| 6 |  | Affect Travel Decisions | 11 | No |
| 7 |  | Adjust Emergency Response | 3 | No |
| 8 |  | Affect Control Strategy | 4 | Yes |
| 9 |  | Adjust Schedules/Routes | 0 | No |

# ITS Benefits
## 2001 Data Needs Workshop

| Link No. | Integration Link | Link Purpose | Data Available | Study in Progress? |
|---|---|---|---|---|
| 10 |  | Affect Travel Decisions | 8 | No |
| 11 |  | Adjust Arterial Signals | 1 | No |
| 12 |  | Adjust Routes/Schedules | 0 | Yes |
| 13 |  | Detect Incidents and Adjust Response | 5 | Yes |
| 14a |  | Static Route/Schedule Information | 6 | No |
| 14b |  | Real-Time Route/Schedule Information | 1 | No |
| 15a |  | Signal Priority | 0 | No |
| 15b |  | Probe Information | 0 | Yes |
| 16a |  | Signal Priority | 8 | No |
| 16b |  | Probe Information | 1 | No |
| 17 |  | Probe Vehicle Information to Affect Control Strategy | 0 | No |
| 18 |  | Probe Vehicle Times Affect Timing | 0 | No |
| 19 |  | Share Common Fare Media | 0 | No |
| 20 |  | Transit Service Planning | 0 | No |
| 21a |  | Information on Incident Severity, Location and Type | 0 | Yes |
| 21b |  | Information on Incident Clearance | 0 | No |
| 22 |  | Signal Priority | 2 | No |
| 23 |  | Signal Coordination | 0 | No |
| 24 |  | Alert | 0 | No |
| 25 |  | Agencies Participating | 0 | Yes |

# ITS Benefits
## 2001 Data Needs Workshop

| Link No. | Integration Link | Link Purpose | Data Available | Study in Progress? |
|---|---|---|---|---|
| 26 |  | Coordinate Timing Across Jurisdictions | 3 | No |
| 27 |   | Transit Operators with Common Fare Media | 1 | No |
| 28 |  | Toll Operators with Common Tags | 0 | No |
| 29 |  | Information on Incident Severity, Location and Type | 0 | Yes |
| 30 |  | Agencies Share Freeway Condition Information | 0 | No |

# Appendix A-5

# Sample Data Needs Survey

# ITS Benefits

**2001 Data Needs Survey**

**Survey Deadline:**
**30 March 2001**

*Background Information*

Name: _____

Organization: _____

Please forward your completed survey as an e-mail attachment to:

Rob Maccubbin (robert.maccubbin@mitretek.org)
or FAX 202-863-2988.

Please be sure to forward your responses by Friday, 30 March 2001.
For inclusion in the summary to be discussed at the 20 March workshop, please forward responses by Tuesday, 13 March.
You can submit revisions to your responses after the workshop, until the 30 March deadline.

Please mark the box next to the stakeholder perspective which best represents your viewpoint while filling out this survey.

- ☐ Local Government
- ☐ State Government
- ☐ Federal Government
- ☐ Consultant
- ☐ ITS Industry/Industry Society
- ☐ Other (Please define: _____)

Please rate the following categories using the scale provided in the box below. Base your ratings on where you feel additional data would help fill gaps in the knowledge base and provide the greatest benefit to decision makers, local government agencies, researchers, etc. Please add any additional categories you feel are important in the spaces provided. Space is also provided for any comments you wish to add about your entries. If you feel you cannot make an assessment of the need for research in a particular area, you may leave it blank.

| *Evaluation Scale* |
|---|
| 0 - No Importance |
| 1 - Minimal Importance |
| 2 |
| 3 - Moderate Importance |
| 4 |
| 5 - High Importance |

Throughout the survey, some application areas are divided into more specific subcategories. In these instances rate the subcategories only. Application areas not requiring rating are identified by a shaded box (example at right.).

Two columns in the survey tables provide an indication of the level of understanding of benefits in each application area. The first indicates the number of entries in the USDOT's ITS Benefits database containing information on each application. For more information on the impacts described in each record, refer to the online database at http://www.its.dot.gov/eval/itsbenefits.htm.

The "Study in Progress" column indicates whether or not federally funded evaluations of ITS Integration Program projects are expected to assess the impacts of each application area. Field Operational Tests, State, and local evaluations may also be assessing impacts of various ITS implementations, these evaluations are not represented in this table. As reports from these evaluations become available, they are included in the online database.

| | Metropolitan Application Area | Number of Entries* | Study in Progress | Importance Rating (0-5) | Notes/Comments |
|---|---|---|---|---|---|
| | Arterial Management Systems | **49** | **Yes** | | <-- Please do not rate shaded boxes |
| | Traffic Surveillance | 2 | Yes | | |
| | Traffic Control | 38 | Yes | | |
| | Adaptive Signals | 13 | No | | |
| | Coordinated Signals | 14 | No | | |
| | Transit Signal Priority | 8 | Yes | | |
| | Emergency Vehicle Signal Priority | 2 | No | | |
| | Pedestrian Control | 1 | No | | |
| | Information Dissemination | 0 | No | | |
| | Public Safety / Enforcement | 9 | No | | |
| | Freeway Management Systems | **29** | **No** | | |
| | Traffic Surveillance | 3 | No | | |
| | Traffic Control | 10 | No | | |
| | Lane Control (Speed Limits, Lane Use) | 3 | No | | |
| | Ramp Metering | 7 | No | | |
| | Information Dissemination | 13 | No | | |
| | Public Safety / Enforcement | 3 | No | | |
| | Transit Management Systems | **16** | **Yes** | | |
| | Personal Rapid Transit | 1 | No | | |
| | Transit Management & Operations | 11 | Yes | | |
| | Maintenance | 1 | No | | |
| | AVL | 8 | Yes | | |
| | Paratransit (CAD) | 2 | No | | |
| | Security | 1 | No | | |
| | Transit Information | 3 | No | | |
| | Incident Management Systems | **25** | **No** | | |
| | Surveillance | 3 | No | | |
| | Detection | 5 | No | | |
| | Response (Patrols) | 15 | No | | |
| | Clearance | 1 | No | | |

| Metro | | | | | |
|---|---|---|---|---|---|
| | Emergency Management | **5** | **No** | | |
| | Emergency Management (AVL, Fleet Mgmt.) | 5 | No | | |
| | Emergency Vehicle (Route Guidance) | 0 | No | | |
| | Electronic Toll Collection | **10** | **No** | | |
| | Toll Administration | 2 | No | | |
| | Toll Collection | 5 | No | | |
| | Toll Vehicle | 3 | No | | |
| | Electronic Fare Payment | **5** | **No** | | |
| | Administration/Management | 4 | No | | |
| | Transit Vehicle | 1 | No | | |
| | Highway Rail Intersection | **6** | **No** | | |
| | Surveillance | 1 | No | | |
| | Control | 1 | No | | |
| | Display - Audio/Visual | 3 | No | | |
| | Enforcement | 1 | No | | |
| | Regional Multimodal information | **21** | **Yes** | | |
| | Pre-trip Information | 11 | Yes | | |
| | En-route Information | 10 | Yes | | |
| | Information Management | **0** | **No** | | |
| | Data Archiving | 0 | No | | |
| | Other Metropolitan Systems | **4** | **No** | | |
| | Travel and Tourism | 1 | No | | |
| | Road Weather Management | 2 | No | | |
| | Operations and Maintenance | 1 | No | | |
| | Parking Management | | No | | |
| | **Additional Suggestions:** | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

* Reflects Number of entries in the database as of 15 February 2001.

| Metropolitan Integration Links | Number of Entries* | Study in Progress | Importance Rating (0-5) | Notes/Comments |
|---|---|---|---|---|
| Link 1: Arterial Management to Regional Multimodal Traveler Information: Arterial travel time, speed and condition information are displayed by Regional Multimodal Traveler Information media. | 2 | No | | |
| Link 2: Arterial Management to Freeway Management: Freeway Management Center monitors arterial travel times, speeds, and conditions using data provided from Arterial Management to adjust ramp meter timing, lane control or HAR in response to changes in rea | 2 | Yes | | |
| Link 3: Arterial Management to Transit Management: Transit Management adjusts transit routes and schedules in response to arterial travel times, speeds, and conditions information collected as art of Arterial Management. | 1 | No | | |
| Link 4: Arterial Management to Incident Management: Incident Management monitors real-time arterial travel times, speeds, and conditions using data provided from Arterial Management to detect arterial incidents and manage incident response activities. | 1 | Yes | | |
| Link 5: Incident Management to Arterial Management: Arterial Management monitors incident severity, location, and type information collected by Incident Management to adjust traffic signal timing or provide information to travelers in response to incident | 2 | No | | |
| Link 6: Incident Management to Regional Multimodal Traveler Information: Incident location, severity and type information are displayed by Regional Multimodal Traveler Information media. | 11 | No | | |
| Link 7: Incident Management to Emergency Management: Incident severity, location and type data collected as part of Incident Management are used to notify Emergency Management for incident response. | 3 | No | | |

| | | | | |
|---|---|---|---|---|
| Link 8: Incident Management to Freeway Management: Incident Severity, location, and type data collected by Incident Management are monitored by Freeway Management for the purpose of adjusting ramp meter timing, lane control or HAR messages in response to | 4 | Yes | | |
| Link 9: Incident Management to Transit Management: Transit Management adjusts transit routes and schedules in response to incident severity, location, and type data collected as part of Incident Management. | 0 | No | | |
| Link 10: Freeway Management to Regional Multimodal Traveler Information: Freeway travel time, speed and condition information are displayed by Regional Multimodal Traveler Information. | 8 | No | | |
| Link 11: Freeway Management to Arterial Management: Freeway travel time, speeds, and conditions data collected by Freeway Management are used by Arterial Management to adjust arterial traffic signal timing or arterial VMS messages in response to changing | 1 | No | | |
| Link 12: Freeway Management to Transit Management: Transit Management adjusts transit routes and schedules in response to freeway travel times, speeds, and conditions information collected as part of Freeway Management. | 0 | Yes | | |
| Link 13: Freeway Management to Incident Management: Incident Management monitors freeway travel time, speed, and condition data collected by Freeway Management to detect incidents or manage incident response. | 5 | Yes | | |
| Link 14a: Transit Management to Regional Multimodal Traveler Information: Transit routes, schedules, and fare information are displayed on Regional Multimodal Traveler Information media. | 6 | No | | |
| Link 14b: Transit Management to Regional Multimodal Traveler Information: Transit schedule adherence information is displayed on Regional Multimodal Traveler Information media. | 1 | No | | |

| | | | | |
|---|---|---|---|---|
| Link 15a: Transit Management to Freeway Management: Freeway ramp meters are adjusted in response to receipt of transit vehicle priority signal. | 0 | No | | |
| Link 15b: Transit Management to Freeway Management: Transit Vehicles equipped as probes are monitored by Freeway Management to determine freeway travel speeds or travel times. | 0 | Yes | | |
| Link 16a: Transit Management to Arterial Management: Traffic signals are adjusted in response to receipt of transit vehicle priority signal. | 8 | No | | |
| Link 16b: Transit Management to Arterial Management: Transit vehicles equipped as probes are monitored by Arterial Management to determine arterial speeds or travel times. | 1 | No | | |
| Link 17: Electronic Toll Collection to Freeway Management: Vehicle equipped with electronic toll collection tags are used as probes and monitored by Freeway Management to determine freeway travel speeds or travel times. | 0 | No | | |
| Link 18: Electronic Toll Collection to Arterial Management: Vehicle equipped with electronic toll collection tags are used as probes and monitored by Arterial Management to determine arterial travel speeds or travel times. | 0 | No | | |
| Link 19: Electronic Toll Collection to Electronic Fare Payment: Transit operators accept ETC issued tags to pay for transit fares. | 0 | No | | |
| Link 20: Electronic Fare Payment to Transit Management: Ridership details collected as part of Electronic Fare Payment are used in transit service planning by Transit Management. | 0 | No | | |
| Link 21a: Emergency Management to Incident Management: Incident Management is notified of incident location, severity and type by Emergency Management to identify incidents on freeways or arterials. | 0 | Yes | | |

| | | | | |
|---|---|---|---|---|
| Link 21b: Emergency Management to Incident Management: Incident Management is notified of incident clearance activities by Emergency Management to manage incident response on freeways or arterials. | 0 | No | | |
| Link 22: Emergency Management to Arterial Management: Emergency Management vehicles are equipped with traffic signal priority capability. | 2 | No | | |
| Link 23: Highway-rail intersection to Incident Management: Incident Management is notified of crossing blockages by Highway-rail intersection to manage incident response. | 0 | No | | |
| Link 24: Highway-rail intersections to Arterial Management: Highway-rail intersection and Arterial Management are interconnected for the purpose of adjusting traffic signal timing in response to train crossing. | 0 | No | | |
| Link 25: Incident Management intra-component: Agencies participating in formal working agreements or incident management plans coordinate incident detection, verification and response. | 0 | Yes | | |
| Link 26: Arterial Management intra-component: Agencies operating traffic signals along common corridors sharing information and possible control of traffic signals to maintain progression on arterial routes. | 3 | No | | |
| Link 27: Electronic Fare Payment intra-component: Operators of different public transit services share common electronic fare payment media. | 1 | No | | |
| Link 28: Electronic Toll Collection intra-component: Electronic Toll Collection agencies share a common toll tag for the purpose of facilitating “seamless” toll transactions. | 0 | No | | |
| Link 29: Transit Management to Incident Management: Transit agencies notify Incident Management agencies of incident locations, severity and type. | 0 | Yes | | |
| Link 30: Freeway Management intra-component: Agencies operating freeways within the same region share freeway travel time, speeds and condition data. | 0 | No | | |

Based on discussion at the workshop held March 20th. Additional detail has been added to the rural component areas. For consistency with results received from the first version of the survey, please rate the need for research in the primary application areas (**bold**). If you wish to indicate which subareas are most important within the primary headings, also complete ratings for the subareas (shaded boxes).

| | Rural Application Area | Number of Entries* | Study in Progress | Importance Rating (0-5) | Notes/Comments |
|---|---|---|---|---|---|
| Rural | **Crash Prevention and Security** | **3** | **No** | | |
| | **Emergency Services** | **3** | **Yes** | | |
| | Detection (Call Centers, Surveillance) | 2 | No | | |
| | Mobilization & Response | 1 | No | | |
| | Information Dissemination | 0 | Yes | | |
| | **Travel and Tourism** | **1** | **No** | | |
| | Traveler Information | 1 | No | | |
| | Electronic Fare Payment | 0 | No | | |
| | **Traffic Management** | **0** | **No** | | |
| | Traffic Control (Lane Control, Work Zones, Signals) | 0 | No | | |
| | Information Dissemination | 0 | No | | |
| | **Transit and Mobility** | **3** | **No** | | |
| | Transit Management | 3 | No | | |
| | Traveler Information | 0 | No | | |
| | Electronic Payment | 0 | No | | |
| | Ride Sharing and Matching | 0 | No | | |
| | **Operations and Maintenance** | **1** | **No** | | |
| | Fleet Management | 0 | No | | |
| | Infrastructure Managmeent | 0 | No | | |
| | Work Zone Management | 1 | No | | |
| | Information Dissemination | 0 | No | | |
| | **Road Weather Management** | **9** | **Yes** | | |
| | Information Dissemination | 5 | Yes | | |
| | Response and Treatment | 4 | Yes | | |
| | **Additional Suggestions:** | | | | |
| | | | | | |
| | | | | | |

* Reflects Number of entries in the database as of 15 February 2001.

| | Commercial Vehicle Application Area | Number of Entries* | Study in Progress | Importance Rating (0-5) | Notes/Comments |
|---|---|---|---|---|---|
| CVO | Safety Assurance | **5** | **No** | | |
| | Safety Information Exchange | 2 | No | | |
| | Automated Inspections | 2 | No | | |
| | General | 1 | No | | |
| | Credentials Administration | **2** | **No** | | |
| | Administrative Processes | 2 | No | | |
| | Electronic Screening | **7** | **No** | | |
| | Safety Screening | 1 | No | | |
| | Credential Checking | 2 | No | | |
| | Border Clearance | 2 | No | | |
| | Weight Screening | 1 | No | | |
| | General | 1 | No | | |
| | Carrier Operations | **9** | **No** | | |
| | Fleet Management | 6 | No | | |
| | Traveler Information | 1 | No | | |
| | Onboard Monitoring | 0 | No | | |
| | Electronic Credentialing | 2 | No | | |
| | General | 0 | No | | |
| | **Additional Suggestions:** | | | | |
| | | | | | |
| | | | | | |

* Reflects Number of entries in the database as of 15 February 2001.

| | Intermodal Freight Application Area | Number of Entries* | Study in Progress | Importance Rating (0-5) | Notes/Comments |
|---|---|---|---|---|---|
| Intermodal Freight | Drayage Operations | 0 | No | | |
| | Freight Tracking | 0 | No | | |
| | Asset Tracking | 0 | Yes | | |
| | Freight Terminal Gate Systems | 0 | No | | |
| | Border Crossing Processes | 0 | No | | |
| | Freight Highway Connector Systems | 0 | No | | |
| | | | | | |
| | **Additional Suggestions:** | | | | |
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* Reflects Number of entries in the database as of 15 February 2001.

**Allocate 100 points to the importance of sponsoring further research in each of these goal areas.**

| Goal Area | Measures | Points | Notes/Comments |
|---|---|---|---|
| Improve Safety | Crashes<br>Fatalities | | |
| Increase Efficiency | Throughput<br>Effective Capacity | | |
| Improve Mobility | Travel Time<br>Delay<br>Reliability | | |
| Increase Productivity | Costs | | |
| Conserve Energy | Fuel Consumption | | |
| Improve Environment | Emissions | | |
| Customer Satisfaction | Self Reports/ Ratings | | |
| Traveler Response | Behavior Changes | | |
| **Additional Measures:** | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | Total Points | **100** | |

*Your Comments*

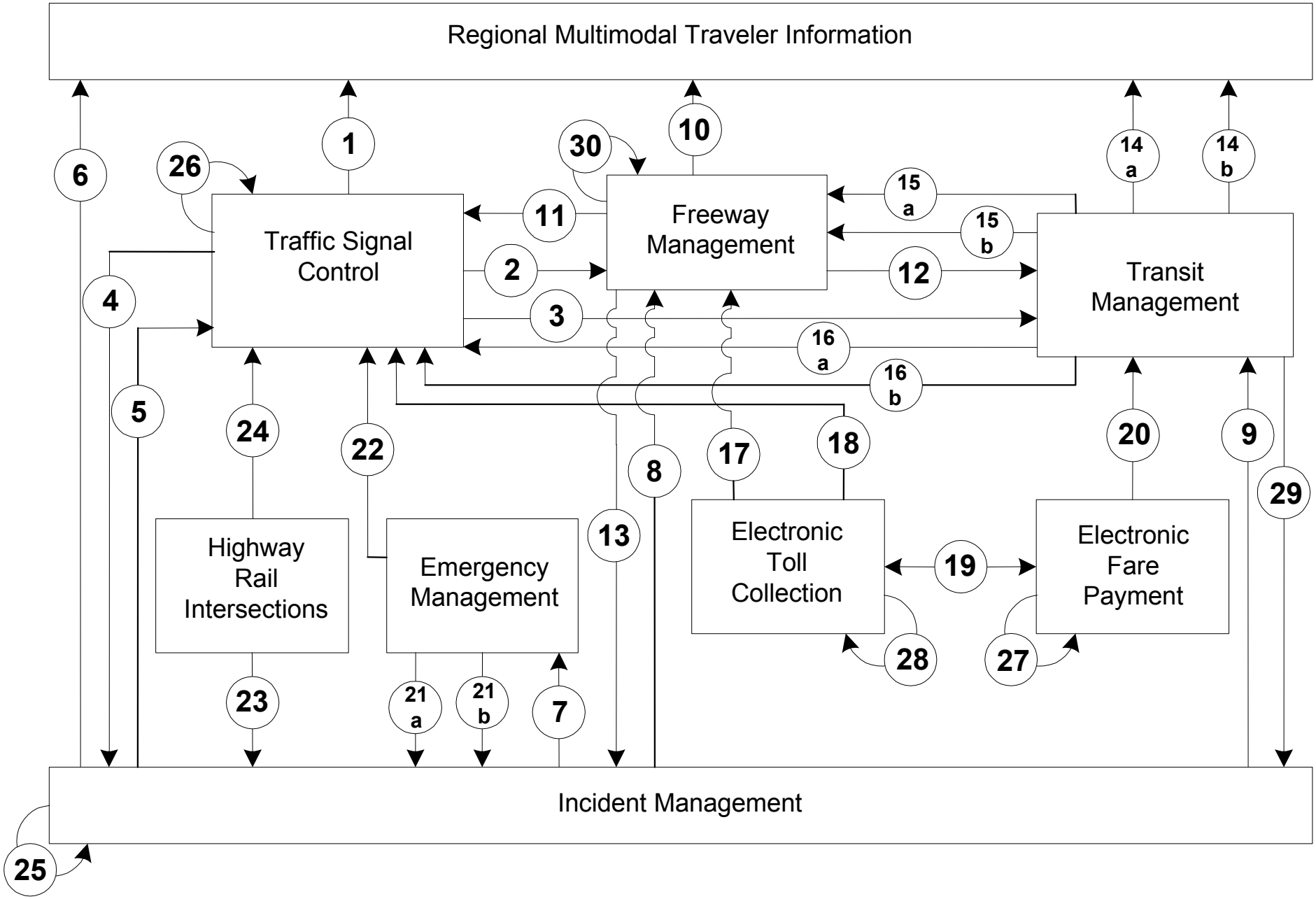
Please provide name and contact information (email, phone #) for others who may be interested in participating in this survey:

Please provide us with any other comments or suggestions you have:

THANK YOU FOR PARTICIPATING!!

# Appendix B

# Definitions for Metropolitan Integration Links


Regional Multimodal Traveler Information
Traffic Signal Control
Freeway Management
Transit Management
Highway Rail Intersections
Emergency Management
Electronic Toll Collection
Electronic Fare Payment
Incident Management
1
2
3
4
5
6
7
8
9
10
11
12
13
14 a
14 b
15 a
15 b
16 a
16 b
17
18
19
20
21 a
21 b
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Link 1: Arterial Management to Regional Multimodal Traveler Information: Arterial travel time, speed and condition information are displayed by Regional Multimodal Traveler Information media.

Link 2: Arterial Management to Freeway Management: Freeway Management Center monitors arterial travel times, speeds, and conditions using data provided from Arterial Management to adjust ramp meter timing, lane control or HAR in response to changes in real-time conditions on a parallel arterial.

Link 3: Arterial Management to Transit Management: Transit Management adjusts transit routes and schedules in response to arterial travel times, speeds, and conditions information collected as art of Arterial Management.

Link 4: Arterial Management to Incident Management: Incident Management monitors real-time arterial travel times, speeds, and conditions using data provided from Arterial Management to detect arterial incidents and manage incident response activities.

Link 5: Incident Management to Arterial Management: Arterial Management monitors incident severity, location, and type information collected by Incident Management to adjust traffic signal timing or provide information to travelers in response to incident management activities.

Link 6: Incident Management to Regional Multimodal Traveler Information: Incident location, severity and type information are displayed by Regional Multimodal Traveler Information media.

Link 7: Incident Management to Emergency Management: Incident severity, location and type data collected as part of Incident Management are used to notify Emergency Management for incident response.

Link 8: Incident Management to Freeway Management: Incident Severity, location, and type data collected by Incident Management are monitored by Freeway Management for the purpose of adjusting ramp meter timing, lane control or HAR messages in response to freeway or arterial incidents.

Link 9: Incident Management to Transit Management: Transit Management adjusts transit routes and schedules in response to incident severity, location, and type data collected as part of Incident Management.

Link 10: Freeway Management to Regional Multimodal Traveler Information: Freeway travel time, speed and condition information are displayed by Regional Multimodal Traveler Information.

Link 11: Freeway Management to Arterial Management: Freeway travel time, speeds, and conditions data collected by Freeway Management are used by Arterial Management to adjust arterial traffic signal timing or arterial VMS messages in response to changing freeway conditions.

Link 12: Freeway Management to Transit Management: Transit Management adjusts transit routes and schedules in response to freeway travel times, speeds, and conditions information collected as part of Freeway Management.

Link 13: Freeway Management to Incident Management: Incident Management monitors freeway travel time, speed, and condition data collected by Freeway Management to detect incidents or manage incident response.

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Link 14b: Transit Management to Regional Multimodal Traveler Information: Transit schedule adherence information is displayed on Regional Multimodal Traveler Information media.

Link 15a: Transit Management to Freeway Management: Freeway ramp meters are adjusted in response to receipt of transit vehicle priority signal.

Link 15b: Transit Management to Freeway Management: Transit Vehicles equipped as probes are monitored by Freeway Management to determine freeway travel speeds or travel times.

Link 16a: Transit Management to Arterial Management: Traffic signals are adjusted in response to receipt of transit vehicle priority signal.

Link 16b: Transit Management to Arterial Management: Transit vehicles equipped as probes are monitored by Arterial Management to determine arterial speeds or travel times.

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Link 18: Electronic Toll Collection to Arterial Management: Vehicle equipped with electronic toll collection tags are used as probes and monitored by Arterial Management to determine arterial travel speeds or travel times.

Link 19: Electronic Toll Collection to Electronic Fare Payment: Transit operators accept ETC issued tags to pay for transit fares.

Link 20: Electronic Fare Payment to Transit Management: Rider ship details collected as part of Electronic Fare Payment are used in transit service planning by Transit Management.

Link 21a: Emergency Management to Incident Management: Incident Management is notified of incident location, severity and type by Emergency Management to identify incidents on freeways or arterials.

Link 21b: Emergency Management to Incident Management: Incident Management is notified of incident clearance activities by Emergency Management to manage incident response on freeways or arterials.

Link 22: Emergency Management to Arterial Management: Emergency Management vehicles are equipped with traffic signal priority capability.

Link 23: Highway-rail intersection to Incident Management: Incident Management is notified of crossing blockages by Highway-rail intersection to manage incident response.

Link 24: Highway-rail intersections to Arterial Management: Highway-rail intersection and Arterial Management are interconnected for the purpose of adjusting traffic signal timing in response to train crossing.

Link 25: Incident Management intra-component: Agencies participating in formal working agreements or incident management plans coordinate incident detection, verification and response.

Link 26: Arterial Management intra-component: Agencies operating traffic signals along common corridors sharing information and possible control of traffic signals to maintain progression on arterial routes.

Link 27: Electronic Fare Payment intra-component: Operators of different public transit services share common electronic fare payment media.

Link 28: Electronic Toll Collection intra-component: Electronic Toll Collection agencies share a common toll tag for the purpose of facilitating “seam less” toll transactions.

Link 29: Transit Management to Incident Management: Transit agencies notify Incident Management agencies of incident locations, severity and type.

Link 30: Freeway Management intra-component: Agencies operating freeways within the same region share freeway travel time, speeds and condition data.