Data Requirements in Transportation Reauthorization Legislation

Operations & Security

1. Introduction

This conference will identify and refine the *data* issues associated with the programs stipulated in the **Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETY-LU).** The conference is designed for federal, state and local officials and practitioners who manage data systems or who must assure the availability of high-quality data for their programs. Discussions will focus on the new and expanded requirements, including the new responsibilities that the data communities in state and local organizations are likely to face. The data requirements across programs will be examined and suggestions will be offered to develop more efficient data program strategies across all transportation organizations.

Specifically, the conference is to: (1) identify the challenges of new data requirements as well as challenges for existing data programs, (2) articulate impacts of these new requirements on data providers and analysts, and (3) develop strategic directions for new data paradigms through collaboration, innovation, and coordination.

2. Objectives

This paper has two objectives. First, it provides conference attendees with information on:

- Relevant legislative provisions,
- Data implications,
- Existing data needs and status under new legislation,
- New data needs,
- Data program options,
- Changing roles of partners, including the private sector, and
- Performance expectations.

By providing this information, a context is set to hopefully stimulate additional discussion and dialogue at the conference. Therefore, it is not the intention of this paper to be conclusive or all-inclusive. This paper addresses data provisions directly or indirectly related to transportation *operations* and *security* in SAFETEA-LU.

3. Legislative Provisions

There are many data provisions in SAFETEA-LU that directly or indirectly relate to transportation operations and/or transportation security. Among them are:

- Section 1201. Real-Time System Management Information Program,
- Section 1303. Coordinated Border Infrastructure Program,
- Section 5502. Surface Transportation Congestion Relief Solutions Research Initiative, and
- Title VII: Hazardous Materials Transportation Safety and Security Reauthorization Act of 2005.

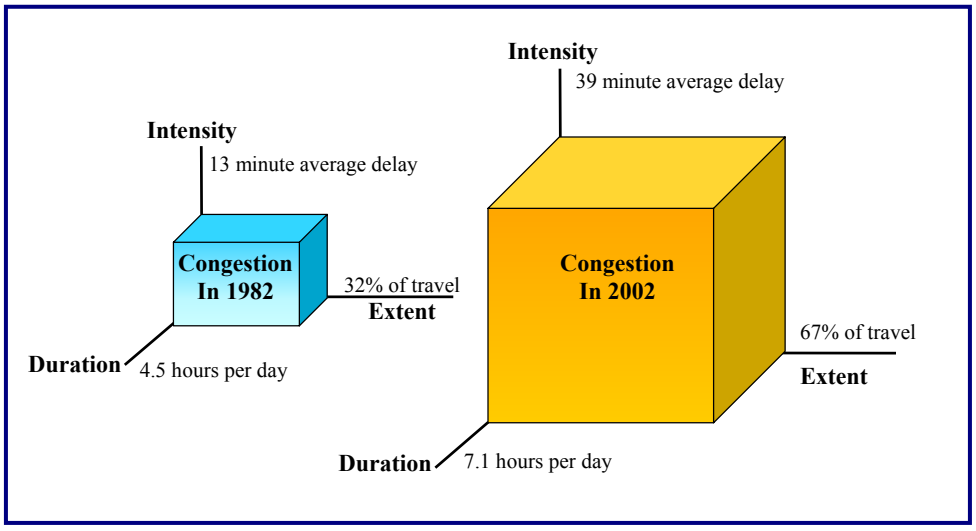
For the purpose of this conference, discussions will predominantly focus on congestion mitigation (Sections [1201], [5502], and others) and, to a lesser extent, border operations, planning and security (Section [1303]). A preliminary analysis of hazardous materials transportation (Title VII) identified few data implications and requirements in the legislation. Thus, discussion on HazMat would be limited in the conference at this time.

Congestion Mitigation

Since congestion mitigation provisions are stipulated in a number of sections (e.g., [1121], [1201], [5502], and [5210]), it makes sense to focus attention on identifying data needs, gaps and challenges specifically related to congestion mitigation and the effectiveness of congestion relief solutions.

Traffic congestion trends from 1982 to 2002 are illustrated in Figure 1 with respect to their duration, intensity, and extent. According to statistics reported by the Federal Highway Administration, the duration of individual traffic delay, on average, has increased from 13 minutes in 1982 to 39 minutes in 2002[1]. While traffic congestion impacted 32% of the travel in 1982, this percentage has increased to 67% in 2002. Traffic congestion costs Americans $63.1 billion a year and is getting worse[2]. Factoring in today's fuel prices, congestion-related costs add another $1.7 billion per year[2]. The Congestion Relief Program considers a number of congestion relief strategies such as building more road and public transportation capacity, innovative pricing, designated truck lanes, and more efficient use and operating of highway capacity.

Figure 1. Traffic Congestion Trends, 1982-2002



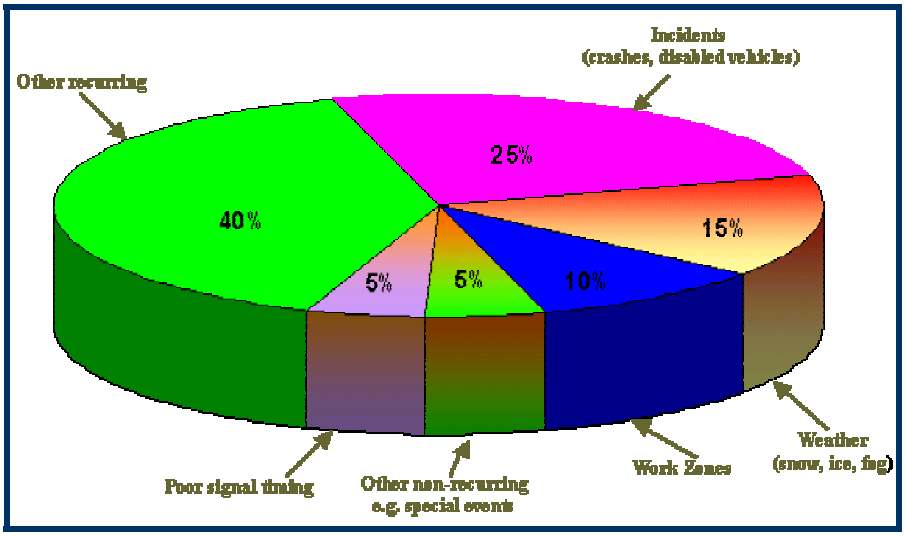
Source: "*SAFETEA-LU System Management and Operations Provisions*." J. Lindley. FHWA. September 2005.

[1] "*SAFETEA-LU System Management and Operations Provisions*." Presentation by Jeff Lindley, Office of Transportation Management, Office of Operations. Federal Highway Administration. U.S. Department of Transportation. September, 2005.

[2] "2005 Urban Mobility Report." Tim Lomax. Texas Transportation Institute. College Station, Texas.

It is estimated that roughly half of the traffic congestion is recurrent, caused by recurring demands (such as commuting) where road use exceeds the existing capacity (Figure 2). These recurrent demands typically remain relatively constant from one day to the next[3]. The other half of the traffic congestion is non-recurrent, caused by traffic incidents (ranging from disabled vehicles to major crashes), work zones, weather, and special events.

Figure 2. Contributing Factors to Traffic Congestion



Source: http://www.fhwa.dot.gov/congestion/congest2.htm. FHWA Office of Operations.

Traffic incidents are attributable to an estimated one-quarter of the congestion. Traffic incident management programs have been developed and implemented in major urban areas to reduce the time to detect, respond to, and clear incidents. The intention of the Real-Time System Management Information Program (Section [1201]) is to assist states with the capability to monitor, in real time, the traffic and travel conditions of the major highways in the U.S. and to share that information among the stakeholders to improve the security of surface transportation, to address congestion problems, to support improved response to weather events and incidents, and to facilitate regional highway traveler information (i.e., 511).

To encourage wider deployment of congestion mitigation solutions, Section 5502 stipulates that research be conducted so that the effectiveness of congestion management systems is estimated, and so that the lessons learned and best practices in locally designed congestion mitigation solutions are identified, documented, and disseminated. The legislation further requires that analytical techniques be developed to assist states and local agencies in assessing the size and the nature of their congestion problems and to aid

[3] http://www.fhwa.dot.gov/congestion/congest2.htm. FHWA Office of Operations.

their decision-making process in designing locale-specific and proactive congestion relief solutions.

4. Data Requirements and Implications on Congestion Mitigation

"Fact sheets" developed by USDOT for key relevant parts of the legislation are included here to give an overview of its intent and help identify data requirements and challenges and the roles of different stakeholders in carrying out the legislative requirements.

SEC. 1201. REAL-TIME SYSTEM MANAGEMENT INFORMATION PROGRAM.

Program Purpose

To provide the capability to monitor, in **real-time**, the **traffic and travel conditions** of the major highways of the United States and to share that information to improve surface transportation system security, address congestion, improve response to weather events and surface transportation incidents, and to facilitate national and regional highway traveler information.

Funding

No separate funds are authorized for this program. States may use their National Highway System, Congestion Mitigation and Air Quality Improvement program, and Surface Transportation program apportionments for activities related to the planning and deployment of real-time monitoring elements that advance the goals of the program to the extent that such activities are eligible for funding under the source program.

Program Features

The purposes of the program are to:

- establish, in all States, a system of basic real-time information for managing and operation the surface transportation system,
- identify longer range real-time highway and transit monitoring needs and develop plans and strategies for meeting the needs, and
- provide the capability and means to share the data with State and local governments and the traveling public.

Within 2 years of the date of enactment of SAFETEA-LU, the Secretary of Transportation is to establish **data exchange formats** to ensure that the data provided by highway and transit monitoring systems, including statewide incident reporting systems, can be readily exchanged to facilitate nationwide availability of information.

As States and local governments develop or update regional intelligent transportation system architectures (as described in 23 CFR 940.9), they shall explicitly address real-time highway and transit information needs and the systems needed to meet those needs. States shall also incorporate the data exchange formats established by the Secretary.

"Statewide incident reporting system" is defined as a statewide system for facilitating the real-time electronic reporting of surface transportation incidents to a central location for use in monitoring the event, providing accurate traveler information, and responding to the incident as appropriate.

SEC. 5502. SURFACT TRANSPORTATION CONGESTION RELIEF SOLUTIONS RESEARCH INITIATIVE

Program Purpose

To establish a surface transportation congestion solutions research initiative consisting of 2 independent research programs to assist State transportation departments and metropolitan planning organizations measure and address surface transportation congestion problems.

Funding

$9,000,000 for each of fiscal years 2006 through 2009 will be available to carry out the Surface Transportation Congestion Solutions Research Program stipulated in subsections (a) and (b). $750,000 for each of fiscal years 2006 through 2009 will be available to provide technical assistance and training (subsection (c)).

Program Features

The purposes of this program are to:

- Improve surface transportation congestion management system measures by: (1) examining the *effectiveness* of different congestion relief measures deployed since the enactment of ISTEA in 1991, (2) identifying best case examples of monitoring, measuring, and reporting congestion information, and (3) incorporating the identified best cases in the development of national models and methods to monitoring, measure, and report congestion information;
- Develop analytical techniques to analyze the effectiveness of procedures used by States and MPOs to assess congestion problems and to assess the nature and the size of their congestion problems; and
- Develop a technical and training program to disseminate the results of the aforementioned research initiative.

The congestion mitigation-related sections are summarized below.

4.1 Data implications/challenges

All States should establish a system to monitor, in real-time, the traffic and travel conditions of the major highways of the United States to improve surface transportation security…

Does this statement suggest that each state should develop a **single**, real-time, traffic and incident monitoring system? Traffic monitoring has being done through the Highway Performance Monitoring System (HPMS). How should the "real-time" system interact with this legacy system? Real-time traffic monitoring is also being done in many parts of the country through loop detectors and closed circuit televisions. Could a national system of travel information be possible if not all of the states

choose to fulfill this legislative requirement? What is to entice a complete compliance from all states?

What does "real-time" mean? Is a 15-minute interval adequately "real-time" to meet the objectives of the monitoring? Should there be different time requirements depending on what needs to be monitored? For example, in emergency operations, should a 15-minute interval be reduced to 5 minutes? What assets and procedures should agencies mobilize to switch to emergency mode? Is it cost effective to maintain emergency mode at all times?

Developing a **single real-time** system requires integration of different data elements (e.g., traffic, incident, roadway conditions, weather, and transit). These data are highly likely to be collected by different stakeholders with different procedures. The development of such a system faces challenges on:

- Interoperability of data elements. For example, are data elements collected by different stakeholders consistent in their definition? Are there standard geospatial references? Is metadata a widespread practice? How adaptable and feasible are the existing standards? A number of standards exist today such as the standardized Traffic Management Data Directory[4] (TMDD), those by the Alliance for Telecommunications Industry Solutions (ATIS), and the NTCIP Center-to-Center standards that addresses the communications protocols between two centers (e.g., two traffic management centers).
- Interoperability of data acquisition devices (e.g., sensors). For example, can data collected from port tags be integrated with and/or communicate with data collected from toll tags?
- Data and system ownership. Who is responsible and pays for the operation and maintenance of this data system?

Providing *up-to-date* and *accurate* information on the performance and conditions of transportation systems on a real-time basis faces challenges of:

- Near real-time information collection and processing
- Near real-time information dissemination and access
- Tailoring information for specific users (traveler vs. TMC)

What metrics should this system monitor in order to improve surface transportation security? Does this stipulation apply to emergency transportation operations (e.g., emergency evacuation)?

To share that information with state and local government and the traveling public…

[4] http://www.ite.org/tmdd/.

Who should have access to the real-time data? Should data accessibility be limited to emergency responders and other stakeholders during emergency situations?

What is the nature of the communications problem among various stakeholders (e.g., state vs. local; highway vs. transit; TMC vs. law enforcement vs. emergency responders)?

How to coordinate standards development activities such as those undertaken by the National Traffic Incident Management Coalition (NTIMC) and other organizations?

To address congestion, improve responses to incidents…

What other data should be collected in order to better understand the propensity and causes of congestion? In order to improve response to incidents, information on timelines is crucial for example, the time when an incident occurs, the time when the incident is reported, the time when the incident is verified, the time when the responders are notified, the time when the responders arrive, the time when the incident is clear and the time when traffic resumes to normal. Can these data be collected and transmitted electronically? In fatal crashes, this timeline information is carefully recorded. What happens in non-fatal crashes, and in disabled-vehicle incidents? If it is overly cumbersome to collect these data for every non-fatal incident, would a sample of representative incidents suffice? How would one select a representative sample of incidents?

To facility national and regional highway traveler information (i.e., 511)…

Individual state systems could be the building blocks for national and regional systems. What framework should be developed and encouraged at the state and regional levels that allows real-time data to be "rolled up" from the local level to the state and regional levels, and finally to the national level? Would the current architecture and/or standards provide that support? If not, what are the barriers and how should they be overcome? Are there alternatives that could circumvent the legacy systems?

How should these data be archived, if at all? How can these operations data be used to improve operations? For example, archived data can be used to develop thresholds and patterns for near real-time data quality checks. How can these operations data be used for planning? What are other innovative applications of these archived data?

To examine the effectiveness of different congestion relief measures deployed since the enactment of ISTEA in 1991…

Are there adequate amounts of data collected since the enactment of ISTEA for a "before and after" study? If not, are there alternative analytical and/or modeling approaches to examine this effectiveness? How would the assessment control for the impacts of external factors?

4.2 Existing data needs and status under new legislation

The data necessary to meet the legislative objectives on congestion mitigation include:

- Traffic and travel conditions on the major highways
  - Location
  - Travel time
  - Traffic speeds
  - Congestion
- Road conditions and weather events
  - Air and roadway surface temperature
  - Visibility
  - Precipitation
- Incidents and crashes
  - event description, traffic problems, and their severity
  - location, the area, highway segment or point location affected
  - time taken to clear the incident/problem
  - direction and extent, identifying adjacent segments or point locations affected, and the direction of traffic affected
  - diversion advice, whether drivers are advised to find an alternative route

4.3 New data needs are:

- Integration of transit monitoring and highway monitoring
- Performance measures of congestion relief solutions since the enactment of ISTEA in 1991

4.4 Data program options (Are there options to meet data requirements other than developing/maintaining a data program?)

Cell phones have been used to monitor traffic and travel conditions. Although promising, the reliability, accuracy, coverage and the privacy issues persist. In addition, there are a number of emerging technologies or technology-related initiatives that could provide opportunities to meet data requirements for congestion mitigation. They are:

- Vehicle Infrastructure Integration (VII) - integration of on-board vehicle sensors and computing with roadside communication devices.

        - Who is to collect?
        - Who owns the data?
        - How to archive/harvest?
        - How and who to process?
        - How to check/validate data quality?
        - How to integrate?
        - How to disseminate?
        - Privacy vs. accessibility?
    - Leveraged resources from private traffic information providers.
    - Archived ITS data, statistical approaches, and modeling, e.g., MicroSoft's JamBayes

4.5 Roles to carry out the legislative requirements on congestion mitigation

- Federal DOT is responsible for the development of the data exchange format for sharing information. What data standards (if any) are states and local agencies using? Are data being exchanged with other stakeholders? If so, what data with which stakeholders? What are the current mechanisms for data sharing? Are there alternatives?
- Federal DOT is to provide States and MPOs with capabilities to monitor traffic and travel conditions in a real-time basis.
- States may use CMAQ and other apportionments for activities related to the planning and deployment of real-time monitoring systems. SAFETEA-LU requires that States and MPOs give priority to projects and programs to enable cost-effective congestion mitigation activities that provide **air quality** benefits.
- Partnerships with the automobile and communications industries are crucial in Vehicle Infrastructure Integration (VII) where congestion could be mitigated through vehicle-to-vehicle and vehicle-to-roadside communications.

4.6 Performance expectations

SEATEA-LU stipulates that:

- Data exchange formats should be established two years after the enactment of SAFETEA-LU
- Information needs to be "real-time." A consensus on the definition of "real-time" should be reached among stakeholders (e.g., data providers, system developers and operators, and decision-makers).
- Information needs to be accurate.
    - How accurate is accurate?
    - Do different users require different levels of accuracy?
    - Who bears the cost of improving information accuracy?
- Activities embarked on by states and MPOs must demonstrate air quality benefits.

5. Data Requirements and Implications for Border Operations, Planning and Security

To improve the economic efficiency of the U.S. transportation system, one of the Federal Highway Administration's strategies is to reduce the hours of delay for commercial motor vehicles passing through the northern and southern ports-of-entry with Canada and Mexico. An FHWA review[5] of seven ports-of-entry found that (1) inbound clearances took longer than outbound clearances, and (2) southern border delay times exceeded northern border delay times. This review estimated that the average inbound travel time was 26.8 minutes, while the average outbound travel time was 14.2 minutes. For the four northern ports in the review, the average inbound travel time was 24.1 minutes; the average outbound was 12.6 minutes. For the three southern ports, the average inbound travel time was 33.8 minutes; the average outbound, 17.2 minutes. FHWA also pointed out that borer crossing delays were less predictable than those observed on urban roadways, thus significantly more challenging to manage and plan[6].

Given heightened terrorist concerns and increased travel and trade between the United States and its neighbors, operations and planning at overland border crossings are a growing challenge. In 2003, 13.3 million trucks crossed at the U.S.-Canada border while 4.2 million trucks crossed from Mexico into the United States[7]. According to the Bureau of Transportation Statistics' TranStats[8], almost 31 million passenger vehicles crossed the northern border in 2004 while three times as many passenger vehicles (91 million) crossed the overland ports at the southern border.

Activities related to border operations, planning and security are stipulated primarily in Section 1303: Coordinated Border Infrastructure Program.

5.1 Data Implications/Challenges

The Coordinated Border Infrastructure Program ([1303]) requires that

the Secretary is to establish a formula distribution program for border States…based on

(1) incoming commercial trucks crossing at the overland borders,
(2) incoming passenger vehicles and buses crossing at the overland borders,
(3) total weight of incoming cargos, and
(4) the number of ports-of-entry.

The Bureau of Transportation Statistics compiles annual border crossing and entry statistics for vehicles, containers, passengers and pedestrians based on data provided by the Department of Homeland Security's Customer and Border Protection. Annual summary statistics cover eighty-seven overland ports at the

[5] "International Border Crossing Truck Travel Time for 2001." Texas Transportation Institute and Battelle Memorial Institute. April 17, 2002
[6] "Border Wizard." Federal Highway Administration. http://www.fhwa.dot.gov/rnt4u/ti/pdfs/border_wizard.pdf.
[7] Hochman, J. L., "Border Planning for the 21st Century." *Public Roads.* January/February 2005.
[8] http://www.transtats.bts.gov/bordercrossing.aspx.

northern border and twenty-six ports at the southern border, across fifteen border States.

SECTION 1303. COORDINATED BORDER INFRASTRUCTURE PROGRAM

Program Purpose

The Secretary is to establish a formula distribution program for border States to improve the safe movement of motor vehicles at or across the land border between the U.S. and Canada and the land border between the U.S. and Mexico. Program funds may be used to construct transportation and supporting infrastructure, make operational improvements, modify regulatory procedures, and coordinate international planning and operations at the northern and southern borders.

Funding/Formula

Funds are to be apportioned among border States based on factors related to the movement of people and goods through the land border ports of entry within the boundaries of the State as follows:

- 20% based on the ratio of incoming commercial truck crossings in a state to the total incoming commercial truck crossings in all border states;
- 30% based on the ratio of incoming personal vehicle and bus crossings into a state to the total incoming personal vehicle and bus crossings in all border states;
- 25% based on the ratio of total weight of incoming cargo in a state to the total weight of incoming cargo in all border states; and
- 25% based on the ratio of the total number of ports-of-entry in a state to the total number of ports-of-entry of all border states.

The funding level is at $833 million for the next 5 years (2005-2009).

Eligible Use of Funds

States may use funds in a border region, defined as any portion of a border State within 100 miles of an international land border with Canada or Mexico, for the following types of improvements to facilitate/expedite cross border motor vehicle and cargo movements:

- Improvements to existing transportation and supporting infrastructure
- Construction of highways and related safety and safety enforcement facilities related to international trade
- Operational improvements, including those related to electronic data interchange and use of telecommunications
- Modifications to regulatory procedures
- International coordination of transportation planning, programming, and border operation with Canada and Mexico.

States may use funds for improvements that facilitate/expedite cross border motor vehicle and cargo movements. The type of improvements includes:

- ***Improvements to existing transportation and supporting infrastructure…***

  The need to balance security and the efficient movement of passengers and goods through border crossing sites requires not only detailed data on both passenger and cargo movements but also their characterization by time of day and day of the week.

  The number of inspection/processing booths open at each port at any given time has a significant influence on travel times. To facilitate decisions with regard to how many lanes and/or booths should be open at any given time, FHWA, General Services Administration, Customs and Border Protection, and Immigration and Customs Enforcement jointly developed a tool called *Border Wizard*. The purpose of this tool is to simulate cross-border movements of automobiles, buses, trucks, and pedestrians. The simulation takes into account all Federal inspection activities, including customs, immigration, motor carrier, and security procedures. This tool is being tested for effectiveness.

  Since inspections take longer for special cargos such as hazardous materials or radioactive shipments, *Border Wizard* would be more effective if the simulation takes into account the typical temporal patterns of commodity movement at a specific port.

- ***Operational improvements, including those related to electronic data interchange and use of telecommunications…***

  Many different groups own, operate and maintain international crossing ports-of-entry. Electronic data interchange and information sharing among this diverse group of stakeholders would require coordination, cooperation, and a standard data exchange format. The data exchange format stipulated in Section 1201 could be drawn upon.

  As Canadian and Mexican versions of the *Border Wizard* are developed, those models need to be integrated with the U.S. model. Not only should the models be integrated, input data necessary to run the model(s) also need to be interoperable and exchangeable.

- ***Modifications to regulatory procedures…***

  To identify which components of the regulatory procedures could be improved, it is important to first understand the *causes* and the *extent* of the delays and congestion at border crossings. Therefore, it is necessary to collect operational and land use data such as:
    - cargo manifests by origin and destination,

- special cargo movements (e.g., hazardous materials) by time of day and day of week,
- time delays by time of day and day of week,
- vehicle counts by vehicle type and by time of day and day of week,
- Vehicle occupancy and passenger counts by time of day, day of week, and season of the year (this is particular important for ports where tourists cross), and
- Land use and environmental features surrounding a border crossing.

Impacts of modified regulatory procedures can be assessed only if data on the direct and indirect costs and benefits are available.

5.2 Data Opportunities (Are there options to meet data requirements other than developing/maintaining a data program?)

The Department of Homeland Security (DHS) plans to implement the U.S. Visitor Immigrant Status Indicator Technology (US VISIT) program at all land ports-of-entry by December 31, 2005. The US VISIT program is to track all entries and exits to and from the United States. Although this program focuses primarily on determining the legal status of foreign nationals entering the U.S., data collected by this program can be used to improve transportation operations and planning at border crossings.

5.3 Partnerships On Border Planning And Operations

Border planning and operations involve not only domestic stakeholders, both in and outside the transportation community, but also international counterparts. Many different groups own, operate and maintain international crossing ports-of-entry. Difficulties in coordinating and sharing information are amplified because of the diverse group of domestic and international stakeholders. With its counterparts in Mexico and Canada, FHWA created two joint working groups: the Joint Working Committee (JWC) along the U.S.-Mexico border; and the U.S.-Canada Transportation Border Working Group (TBWG). In addition to the coalitions among various jurisdictions, interoperability in communications technologies and data sharing protocols are instrumental to coordination and cooperation.

6. Cross-cutting Requirements and Opportunities

There are many opportunities where data, standards, and information systems can be shared, and lessons can be learned across programs. For example, the Real-Time System Management Information Program (Section 1201) is to monitor traffic conditions on a near real-time basis, share that information with stakeholders to quickly detect incidents, and improve the response time to clear an incident and relieve congestion. Data requirements for this real-time system would undoubtedly fulfill part of the data needs in Section 5502 (Congestion Relief Solutions). Furthermore, data collected for the

real-time system could supplement and/or augment data collected from the sample highway sections under the HPMS. Also, the real-time system can be scaled and/or re-tooled for border crossing applications (Section 1303).

Should the data exchange formats be established and implemented as stipulated in Section 1201, then these formats presumably could be used as a starting point by other applications such as data sharing with international counterparts at border crossings, or data sharing among emergency response stakeholders during emergency evacuation.

Other legislative provisions relevant to operations and security spill over into other sections. Specific examples are freight provisions and transportation planning provisions. Discussions of the data implementation and challenges in operations and security are not complete without discussion of freight data and personal travel information.