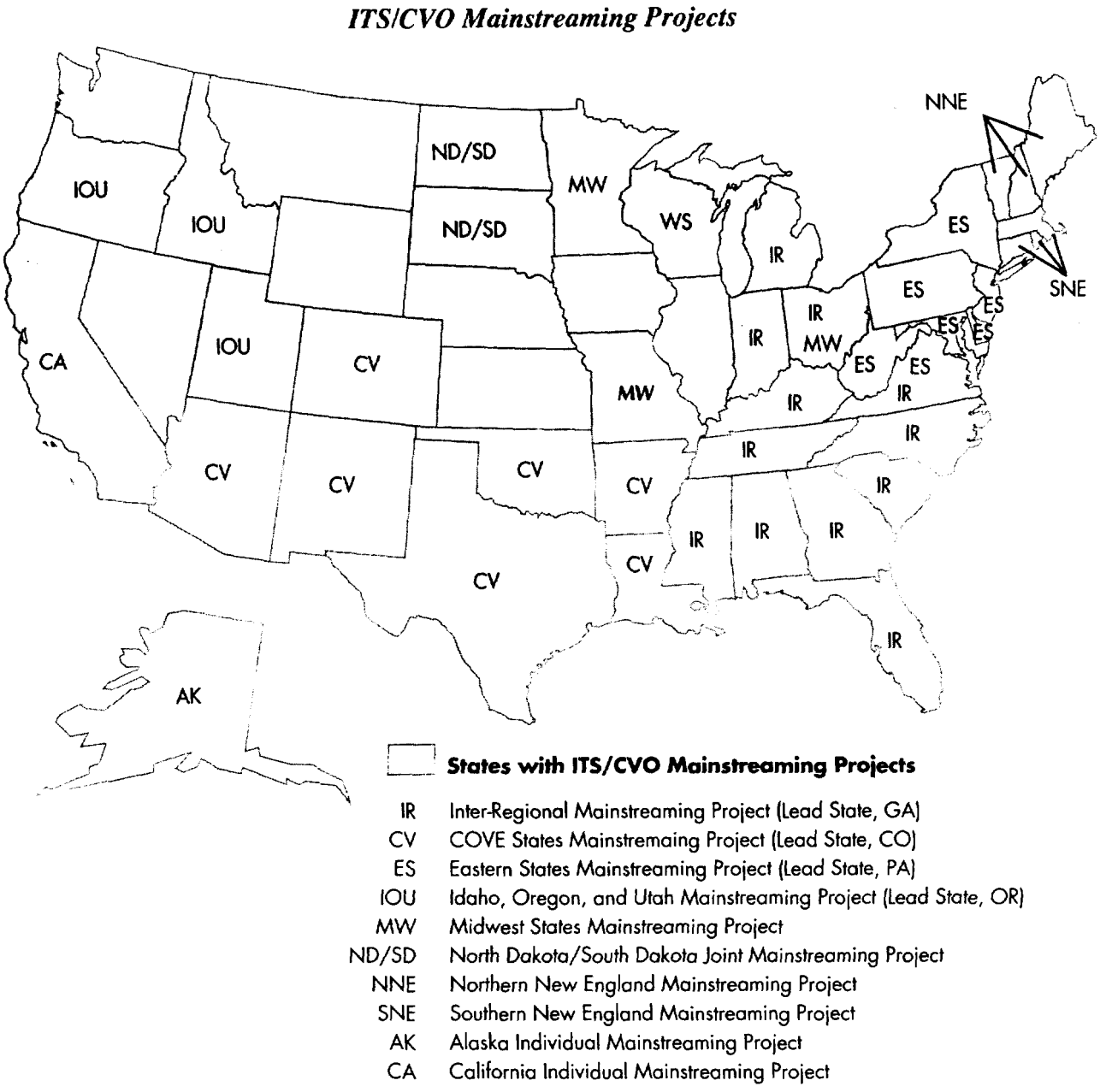

Exhibit 6. ITS/CVO Mainstreaming Projects

Currently, 39 states are participants in ITS/CVO mainstreaming projects.

To date, 18 Phase I plans (which identify institutional problems and key interfaces) have been completed; by 1996, 5 Phase II plans, which will lay out deployment strategies for these groups of allied states, will be complete.

ITS early deployment planning to support travel management is underway at both the metropolitan and corridor levels. We anticipate that, by 1996, 75 of those plans will be initiated or in place (see Exhibit 7 for a map).

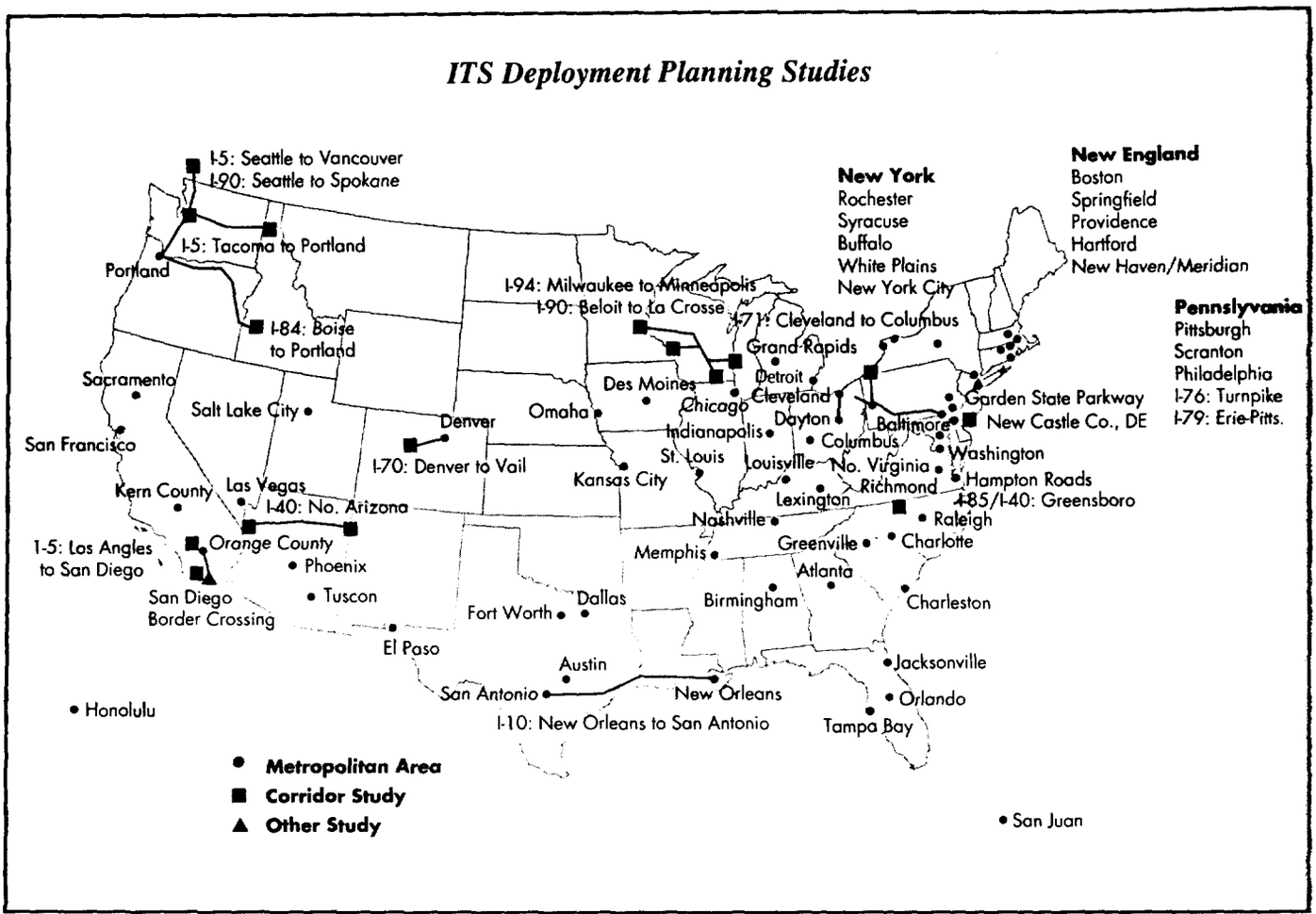

Exhibit 7. ITS Deployment Planning Studies

Current ITS Deployment Planning Studies include metropolitan areas, priority corridor studies, as well as other studies.

In addition, the ITS Priority Corridors are completing their strategic and business planning processes and are expected to move immediately into implementation.

6. Identified a Set of "Core" Public ITS Infrastructure to Launch National Deployment of ITS Travel Management and Commercial Vehicle S .rvices —

Early results of field testing and implementation, early deployment planning, and the architecture analysis all indicated the need to identify a set of core ITS infrastructure to provide the early safety, security, passenger convenience and congestion relief benefits of ITS technologies, and to serve as a platform for the evolution of more sophisticated services. These building blocks—technologies such as passenger information services, traffic control signals, ramp meters, weigh-in-motion (WIM), computer-aided dispatch, vehicle-tracking systems, etc.—are being deployed every day in states, cities and counties across the Nation.

Unfortunately, many independent deployments thus far lack a common view to forming a unified technology platform for the evolution of even more powerful future services. Continued unfocused deployment presents the risk that incompatibilities or other discontinuities among systems will either preclude integration and evolution or make it very expensive, thereby impeding domestic ITS market development and reducing U.S. industry's ability to compete in the international marketplace.

The Department has identified a critical next step in the ITS program as the *model deployment of an integrated system* of these individual technologies—to showcase the value of such integration and to test many of the key interfaces that will be identified for standards development in the architecture.

C. Where Do We Go From Here?

An R&D program is inherently one of discovery and course correction. Thus, there is always uncertainty in plotting a future course; however, the information currently available to the Department suggests the following "themes" will characterize the ITS program over the next several years:

1. Model Deployment

Several factors make model deployment of core CVO and Travel Management infrastructure a critical next step in this program:

- The need to **test and demonstrate the architecture** that emerges from the National Consensus Architecture Program; the need to validate standards requirements at key interfaces by testing them in operational environments is particularly important.

- The need to **test on a wide scale the National Commercial Vehicle Information Network.**

- The need to **demonstrate the benefit of *integrating into a system*** the various individual core ITS infrastructure elements technologies in a way that mayors, county officials and state transportation officials can "touch and see." They will be the key decision-makers and architects in deploying the first wave of integrated ITS infrastructure across America.

- The need to **intervene by example** to preclude current haphazard (or "stovepiped") ITS deployment.

- The need to test and **demonstrate the institutional arrangements** necessary to bring together numerous public and private institutions tightly enough to allow exchange of, and real-time access to, multi-layered transportation-related information. This level of coordination and information sharing, based on carefully built trust relationships, can enable services such as real-time passenger information services, truck safety inspection, automated licensing and permitting, emergency response, transit fleet management and traffic management.

- The need to **test the private market for the value of information.** Although all our models indicate private-sector delivery of various travel information services, few working examples exist. The private sector believes these services cannot be provided until a "critical mass" of real-time information is available. We believe a fully-integrated core travel management infrastructure would provide that critical mass of information.

We propose to identify, by competitive solicitation, travel management and commercial vehicle model deployment sites. The Federal program will assist in sufficient development of both the institutional and technical infrastructure to provide a national demonstration of a fully-functioning ITS deployment.

2. Mainstreaming

To prepare for national deployment, we have recognized the need to move the program from the laboratories and testbeds to the mainstream of FHWA and FTA practice. Thus, our program will reflect an emphasis on "mainstreaming" ITS deployment in three critical areas:

- **Champions** — Local "champions" can address local institutional issues. Our early institutional studies showed that, in many instances, ITS is the technical underpinning of a *re-engineered process or approach to dealing with a problem.* That "problem" could be the streamlining of truck regulation or the management of traffic congestion. The nontechnical barriers to implementation identified early in the ITS program are often merely the challenges inherent in changing the paradigm, process, or approach to dealing with an issue. Our studies identified the following actions that must be addressed for successful ITS deployment:

  - re-engineer truck regulatory processes,
  - streamline procurement practices,
  - establish new communication channels,
  - develop new engineering and system integration skills,
  - create methods to protect individual privacy,
  - change institutional and corporate culture.

  We can overcome these barriers, but not with "one-size-fits-all" national policies. In many cases, local champions have solved these "problems" by bringing together people and institutions that did not traditionally communicate to find ways of changing paradigms, processes or approaches to solving problems.

  Experience has shown that many institutional issues are best resolved by supporting local champions or conveners.

- **Training** — Unlike the last generation of transportation infrastructure, which was structural in nature and involved a relatively well-defined set of decisions and decision makers, ITS will be implemented through independent decisions by individuals at different government levels, in multiple agencies and in the private sector, and in thousands of regions across the United States These individuals should become comfortable with the technical specifications of the communications and information infrastructure required to support this new generation of transportation. Achieving the ITS vision requires as aggressive a national commitment to training as was made in the development of the technology itself. The Department is currently working with ITS America to develop a comprehensive strategic approach for this area.

- **Guidance** — Many agencies are purchasing elements of core ITS infrastructure, though relatively unaware that it is or could be part of a larger, area wide system. The ITS architecture will be complete in 1996 and we plan a major effort to provide guidance to FTA and FHWA field representatives and our state and local partners on making acquisitions consistent with that national architecture, and thus capable of evolving and interoperating with future systems.

3. Operational Tests

In the past, the ITS program has sponsored a variety of operational tests of new technology or innovative applications of existing technology. We now have over 77 of these tests underway or completed; over the next several years, they will provide a rich stream of evaluation information. We are now beginning of a new phase of our operational test program: fewer tests are being proposed, and these have emerged from the longer term ITS research program, now mature enough to require field testing. Specifically, we propose:

- **Field Tests of Crash Avoidance and Other Safety Systems.** To validate safety specifications under real operating conditions, and to help facilitate the development of marketable systems, NHTSA will conduct operational tests and in-service evaluations of refined prototypes in the highway environment. In cooperation with industry, test vehicles will be outfitted with the system and subjected to a carefully designed field trial to assess performance, reliability, maintainability, failure modes/consequences, and costs. NHTSA is currently implementing operational tests of intelligent cruise control (ICC) and automatic collision notification systems. Candidates for the next phase of field testing (FY 1997-99) might include systems for night vision enhancement, driver-impairment warning, smart cruise control, rear-end collision warning, or other concepts already under development by industry.

- **Field Tests of Adaptive Traffic Signal Control and Traffic Management Coordination.** The FHWA research program in Real-Time Traffic Adaptive Control (RT-TRACS) has developed a number of technical approaches to the problem of real-time optimized control of the roadway network, and is currently evaluating these approaches in a laboratory simulation and research test environment. Operational field tests of RT-TRACS systems will evaluate one or more algorithms in a larger, real-world application. Application of RT-TRACS is expected to form the technological foundation to improved efficiency in roadway network control for the future, eventually allowing multiple jurisdictions to proactively manage roadway service levels to meet anticipated demands.

RT-TRACS and other ITS solutions require the ability to exchange data easily among jurisdictions. This capability is especially important for coordinating operations on roadways that cross jurisdictional boundaries, which means that systems must "speak the same language" when exchanging location-specific (i.e., roadway, intersection, High-Occupancy Vehicle (HOV) lane, etc.) data. Work on location-referencing systems and spatial database transfer standards will provide the means to link various jurisdictions into a regional system with the capability to optimize efficiency of freeway and arterial traffic movement.

4. The Automated Highway System (AHS)

The AHS development program is structured in three phases. The Analysis Phase, which is near completion, established the empirical foundation for the System Definition Phase. The National Automated Highway System Consortium (NAHSC) is now conducting the Systems Definition Phase; milestones are the establishment of performance and design objectives, a 1997 proof of technical feasibility demonstration, identification and description of multiple feasible AHS concepts, selection of the preferred AHS system configuration, completion of prototype testing, and completion of system conceptual development and supporting documentation. The Operational Test and Evaluation Phase begins in 2002, following the System Definition Phase. It will include:

(1) integrating the proffered AHS system configuration into the existing institutional technological and regulatory environment;
(2) evaluating this configuration in a number of operational settings; and
(3) establishing guidelines by which U.S. DOT will support AHS deployment.

5. Standards Development

Although standards development has been initiated in several areas, we anticipate that the completion of the national architecture by July 1996 will have launched additional standards development efforts. When a public interest must be advanced quickly, the Department will support the requirements development process through ITS America and the standard-drafting process through the appropriate Standards Developing Organizations (SDOs) by providing technical expertise and financial assistance to help advance the process of building support for these key standards.

6. Evaluation and Tracking

Early focus was on launching a variety of operational tests; in the next two years, we will incorporate goals of the Government Performance and Results Act of 1993 (P.L. 103-62) into the ITS Program by increasing front-end emphasis on the importance of evaluating program results through measurement of project results, service quality, and customer satisfaction. We will adjust our current course and, more importantly, identify research requirements for the rest of the decade based on the insight obtained from a growing set of data provided by ITS operational tests. We anticipate the resulting larger database will allow a more rigorous assessment of ITS benefits. We will also track deployment levels of the travel management and CVO core infrastructure across the Nation.

D. Emerging Issues

We anticipate several issues to promote national dialogue over the next few years and, ultimately, determine the extent and shape of ITS deployment. These include:

1. National Deployment Strategy.

Launching the first wave of ITS deployment presents two important questions.

(1) What is the best catalyst for sustained ITS deployment? What is the most appropriate role for U.S. DOT in fostering nationwide deployment?

(2) How can we ensure the evolution of reasonably common national standards, to assure common product markets and inter-operability, without precluding local choice?

One obvious catalyst for deployment is the ability to use regular Federal-aid and state transportation funds for ITS. However, many ITS travel management functions substitute network management and operations for capital expenditure to achieve more capacity; and, historically, Operations and Maintenance (O&M) funds have been among the scarcest and least predictable resources in transportation agencies. Some transit and highway agencies receive funding from existing Federal (and often state) programs for ITS technology deployment; however, similar programs to support CVO core technology deployment do not exist.

2. Wireline Communications Infrastructure Policy.

Current information suggests that a fully operational ITS infrastructure would consume considerable bandwidth. A number of states and local governments have established public-private partnerships to obtain this communications capacity, these arrangements often involve the public sector giving telecommunications providers access to highway rights-of-way (for laying fiber optic lines) in exchange for long term use of some of the new capacity for ITS applications. Other jurisdictions have built, or are planning to build, the needed infrastructure themselves. Still others lease communications capacity from existing networks. Some communications companies are concerned about Government agencies building and owning communications infrastructure and, to a lesser degree, the emerging public-private partnerships. They fear transportation agencies may build and/or own excess capacity and sell it in competition with private telecommunications companies. No current, comprehensive analysis on the economics of owning versus leasing communications capacity exists; however, DOT is conducting such an analysis. Preliminary findings indicate that leasing may be less expensive than investing in communications infrastructure, if telecommunications companies are competitive and creative in their pricing. Bartering right of way for long term use of communications infrastructure also has proven to be very cost competitive.

3. Wireless Spectrum Requirements.

Many crash avoidance technologies depend on vehicle-to-roadside communication, as do all vehicle identification and transaction technologies and some in-vehicle travel information services. Specific spectrum requirements will depend on technology development and thus will not be defined for several years. As the United States makes more spectrum available, however, staking an early claim becomes critical to protect an emerging ITS industry. Moreover, serious concerns have risen over the effect on the industry of spectrum auctioning, particularly the spectrum used for emergency response, crash avoidance and other safety services.

4. Maintenance of Software, Architecture and Standards.

In the past, certain Department research programs have sponsored production of software products to assist transportation systems analysts and developers. Likewise, several developing ITS arenas will result in widespread use of software and databases that may benefit from long term maintenance, upgrading, and "version control." The same may be true for the Department-supported national system architecture and standards development efforts. Although we expect that the existing mechanisms for maintaining standards within national and international Standards Organizations to serve the ITS industry well, it may be necessary to maintain a special interest in standards and architecture in order to preserve national ITS compatibility, as chartered by ISTEA. The Department does not wish to be in the business of software or standards maintenance, but needs to understand how to best support the ISTEA goals of national compatibility. We intend to explore precedents, alternative future scenarios, and potential DOT roles in this area.

II. PROGRAM PROGRESS

ITS applies to several broad transportation areas, which correspond to various offices and programs within U.S. DOT, that are responsible for delivering each component of the program.

- **Advanced Travel Management** encompasses a wide range of ITS services that address traffic management, traveler information, transit management and electronic fare/toll payment.

- **Advanced Commercial Vehicle Systems** apply advanced technologies and information networks to increase productivity and efficiency for both fleet operators and state motor carrier regulators.

- **Advanced Crash Avoidance Systems** comprise a program area that explores the use of ITS to improve driver safety through enhanced vehicle control, automated collision notification (ACN) and other technologies.

- **Automated Highway System (AHS)** comprises a program area that is defining system requirements for the fully automated highways of the future; a demonstration of feasibility will presented in 1997.

- **Rural Applications of ITS** use innovative and advanced technologies to address numerous safety problems associated with rural transportation.

- **System Architecture and Standards** lay the foundation for national interoperability among all ITS components.

In the following sections, we present the status and principal accomplishments of each of these individual program areas.

A. Advanced Travel Management

The long term vision for advanced travel management is an integrated multimodal web of information infrastructure, products and services that:

- uses **public and private monitoring sources to "sense" traffic conditions** on freeways and arterials, and dynamically adjust traffic control devices to: maximize throughput, decrease response times to emergencies and grant priority to transit vehicles;

- uses **real-time location information** from transit and emergency response vehicles to achieve: more productive routing and dispatch, quicker response to emergencies, increased passenger security, and enhanced law enforcement;

- provides **dynamic traffic and transit routing information, vehicle location and arrival information** (and a variety of other convenience information) to travelers at home, in vehicle, at work, and in other public places—and supports personal and public-agency efforts to reduce travel demand and increase vehicle occupancy;

- supports intermodal **"smart card"** fare payment (for transit, tolls, parking, etc.) as well as various policy-driven pricing strategies; and

- supports long term metropolitan transportation planning.

It is widely recognized that a fully integrated, metropolitan-area information infrastructure will spawn multiple spin-off applications, services and products—much as the desktop computer introduction spurred the software application explosion.

Achieving this vision will require successful completion of several key **R&D** efforts, continued field testing of some technologies, and continued **support for widespread deployment** of what the Department has identified as a core ITS travel management infrastructure in metropolitan regions across the United States. Key objectives in each of these areas are outlined below:

1. Research and Development

There are several primary research frontiers aimed at achieving the long term vision for Advanced Travel Management:

a. The development of an open architecture, area-wide, **dynamically adaptive traffic control system.** Today, most cities function with static or pre-programmed traffic control. A few cities have adaptive control at key intersections. U.S. DOT is evaluating larger-area proprietary signal systems as part of the FAST-TRAC (Oakland County, MI) and SCOOT Adaptive Control System (Anaheim, CA) operational tests. The goal is to develop a next-generation system available to all vendors that will provide capability to link freeway and arterial control. Key accomplishments include:

   - the development of a **Traffic Management Laboratory** and a prototype **Traffic Control Center.** The former will be used to simulate metropolitan traffic conditions and test various control strategies, their support systems and hardware and software. The latter is a prototype training center,

   - launched the development and evaluation of **five dynamic traffic assignment algorithms** which will be critical in developing optimal region-wide adaptive control; which will, in turn, enable the forecasting capabilities necessary to supply efficient routing solutions,

   - launched the development of a version of TRAF-NETSIM **software to evaluate traffic flow** that will interface with the real-time traffic adaptive signal prototypes. This software will allow laboratory testing of the prototypes prior to field testing and deployment, and provide greater capabilities to the more than 800 registered users of the off-line versions.

b. Gaining an understanding of the **human factors** associated with the design and, ultimately, the operation of traffic control centers as well as those associated with delivering traffic information to users in vehicles or through other media. Key accomplishments have been the establishment of a **human factors laboratory** at the Georgia Institute of Technology and the development of a set of preliminary **human factors guidelines** to be considered in the design of transportation control centers.

c. Development, refinement or adoption of key **enabling technologies** including Global Positioning System (GPS), wireless communications, and geographic location referencing for digital maps. Key accomplishments in this area include:

- the completion of a **detailed analysis of spatial data requirements** for ITS. This study evaluated the complex institutional, legal, economic and technical factors related to achieving a common means of referencing locations in various ITS databases and applications, and is considered a critical step in facilitating widespread ITS deployment. All significant existing methods of location referencing were reviewed and evaluated against real-world databases using a specially developed computer model. The project recommended development of an interoperability framework for ITS spatial data to support ITS infrastructure deployment,

- the 1996 completion of **guidelines for a nationwide GPS augmentation infrastructure** to support ITS needs,

- the 1996 completion of a **comparison of alternative communications technologies** against requirements established by the national architecture.

d. Development and testing of the use of **automated fare and toll payment technology.** Although tag/transponder technology is more widely used for toll collection and other forms of vehicle tracking, and several transit agencies are experimenting with electronic fare payment, the base technologies are different. Moreover, both parallel the rapidly evolving debit/bank card industry which could, conceivably, eventually encompass all transportation electronic payment forms. Last year we completed a study on the development of a conceptual design for an **automated card** that could support fare and toll payment applications. The study presents separate card design characteristics for both person-based and vehicle-based applications for the end card system.

2. Operational Tests

To date, we have launched a total of 41 operational tests in the Travel Management area. Test areas include evaluations of: the capability of individual technologies—personal digital assistants (PDA), pagers, etc.—to deliver travel information; the concept of "vehicles as probes" as a less infrastructure-intensive means of obtaining network information; the use of GPS satellites for transit fleet tracking; complex technical and institutional systems, such as the integrated traffic control/surveillance system in the FAST-TRAC project in Oakland County, Michigan, or the synthesis of traffic information for private sector dissemination in the TRAVINFO project in San Francisco. Summary and key update information on these tests follows:

a. **Traffic Management** — We have launched 14 operational tests[3] focusing primarily on ITS traffic management services and technology. Several of these tests are nearing final development stages, and all are expected to be up and running by the end of 1995. Testing includes the full range of system components and technologies used in traffic management systems: surveillance, communications, data analysis and response algorithms, and control mechanisms.

[3] The 14 tests are San Antonio, FAST-TRAC, Integrated Ramp Metering/Adaptive Signal Control, Mobile Communications System, Satellite Communications System, Seattle Wide-Area Information for Travelers (SWIFT), SCOOT, Smart Call Box, Smart Corridor, Spread Spectrum, TRANSMIT, CAPITAL, CT Freeway ATMS, & Multi-Agency Aerial Surveillance.

Early findings have shown the following:

- **Innovative traffic flow monitoring technologies show real promise.** Operational test project contributions include radar testing in Connecticut; "electronic toll tag" reading in New York/New Jersey and Houston, Texas; flow measurement via cellular phone transmissions in Virginia/Maryland; and aerial surveillance in Maryland/Virginia.

- **Advanced video analysis** (i.e., machine vision techniques), though still in development, **will provide valuable monitoring tools** for use by state and local agencies.

- **Multiple jurisdictions working together to share information** and cooperatively respond to accidents and other incidents in congested corridors **has proven valuable.** Coordinated action plans for specific situations can maximize freeway and arterial capacity, thus minimizing disruption and delay. The Smart Corridor project in Southern California was in its infancy when successfully used after the January 1994 Northridge earthquake to provide traveler information on transit and HOV use, and to facilitate rerouting of traffic from the damaged Santa Monica Freeway onto the arterial street system.

- **A strong set of incident management policies and response procedures can greatly improve response and clearance time,** improving service to the traveling public by reducing congestion-induced delays (facilitated through expanded inter-jurisdictional coordination). The National Incident Management Coalition's success has led to the implementation of numerous incident management projects within metropolitan areas.

b. **Transit Management** — Six tests of **GPS-based vehicle tracking** technology were launched to improve fleet management, schedule performance, safety and travel information disseminated to the public. Signpost technology for vehicle location has also shown results are extremely encouraging: Kansas City reduced the number of buses required to serve its customers at the same level of service. For a $2.3 million investment, the city has saved $400,000 per year in operating expenses and $1.5 million in capital expenditures for replacement buses, and has amortized its investment in under 2 years. Baltimore and Milwaukee saw 23 and 28 percent respective improvements in on-time performance; Denver and others have recorded major reductions in emergency response time to bus incidents by pinpointing bus locations and dispatching aid (police, medical, etc.). To date, some 25 transit agencies have or are deploying this technology.

Also in testing, **"bus priority"** technology allows traffic signals to adapt to the presence of transit vehicles. A bus approaching a signalized intersection notifies the signal, which either extends the "green" time or shortens the "red" time as appropriate. The test objective is to shorten bus drive times, and thus increase throughput by moving more people faster.

Two operational tests are using different approaches to this technique. In Portland, a limited test of four intersections along a major artery showed up to an 8 percent reduction in bus travel times. The potential need for fewer buses on major routes makes this technology a cost-effective tool for transit agencies—and the added benefits of convenience and speed for passengers.

c. **Electronic Fare Payment** — Two electronic transit fare payment tests were launched: the Washington Metropolitan Area Transit Authority (WMATA) in Washington, D.C., is testing a single card for bus, rail and parking fees; and the State Department of Transportation in Wilmington, Delaware, is working with the banking community to test a bus fare collection system that also facilitates an employer-subsidized transit incentive program. A number of cities are testing these technologies in pilot projects; most have just begun operations, including New York; New Jersey; Delaware; Ventura, California; Washington, D.C; and the Puget Sound area.

Some projected benefits of this technology follow:

- New Jersey estimates a saving of $2.7 million per year in reduced labor costs; Central Puget Sound estimates $8.5 million savings in reduced maintenance.

- Ventura County, California, estimates a $9.5 million per year savings on reduced fare evasion; New York estimates savings up to $2.5 million per year.

- New York estimates increased ridership producing annual revenue of $4.9 million from improved convenience and marketing opportunities.

d. ***Traveler Information*** — Seventeen tests of ITS traveler information services and technology have been launched. In addition, many transit properties are routinely testing approaches to delivering real-time transit information including cable TV, video text data which can be accessed on personal computers, and automated telephone information centers. Three key operational tests have been completed (INFORM, TravTek and Boston SmarTraveler), and at least three others will be actively collecting data by the end of 1995[4]. The remaining projects are in various phases of design, integration, and engineering.

These efforts have produced an important development: the provision of combined traffic and transit information kiosks. This technology has been placed in the form of interactive devices in the workplace, shopping malls, and major transportation centers to test public acceptance. A key demonstration of combined transit and traffic information will appear at the 1996 Summer Olympics in Atlanta.

Early Traveler Information test findings show:

- The INFORM project in Long Island, New York, demonstrated that drivers will divert to less congested routes if presented with reliable and credible traffic congestion information. The project showed that 5 to 10 percent of freeway traffic can be diverted to appropriate off-ramps when necessary, saving an estimated 300,000 vehicle-hours of travel; the ramp metering system has increased morning peak-period speeds by 3 to 8 percent.

---

[4] The 17 tests are INFORM, Trilogy, TravLink, TravInfo, ADAS, Atlanta Kiosks, Boston SmarTraveler, Denver PIDS, Detroit Transit Info., DIRECT, Genesis, Herald, Houston Smart Commuter, TransCal, ADVANCE, Travel-Aid, & TravTek. ADVANCE, and DIRECT will be actively collecting data by the end of 1995.

- The hugely successful TravTek project, fully operational for one year ending March 1993 in Orlando, Florida, showed that drivers were receptive to (and enthusiastic about) in-vehicle, dynamic route guidance devices. System use analysis showed that drivers using route suggestions provided by the system shortened travel times by up to 20 percent. Many users reported an easy transition to (and eventual reliance on) finding destinations electronically, without using paper maps. The TravTek experience has influenced private-sector development decisions, including marketing of in-vehicle devices now available as both new-car sales options and after-market installations.

- The Boston SmarTraveler project evaluated public acceptance and potential traffic impacts of a telephone-based audiotext traffic information system. Public response and system use have been excellent, with over 3 million calls received from the system launch in January, 1993, to October 1995. The SmarTraveler Operations Center has expanded its role as a regional incident management provider by transmitting an average of 300 roadway incident first notifications per month. SmartRoute Systems (the project's private-sector partner) is continuing the project in cooperation with the State of Massachusetts.

- In Los Angeles, the use of first generation travel information kiosks received extremely positive response. Additional deployment and expansion of informational services is being considered by additional agencies.

- Collecting and "fusing" data from multiple sources using dissimilar databases and protocol is a challenging effort, as the TravInfo project in San Francisco has shown. This effort is moving toward an openly-available database of region-wide traffic and transit performance information for use by both public sector operating agencies and private sector "value-added" services. Linking geographic databases from various sources, and reaching consensus among public and private sector entities on technical aspects of the system, have proven challenging and educational. These experiences will guide further efforts to develop location referencing standards, spatial database transfer standards, and metropolitan-wide information sharing systems.

- DOT is also learning more about the dynamics and flexibility necessary to forge effective public/private partnerships. In some cases, we have established preliminary partnerships which have stalled due to changes in corporate priorities. This is an "every-day occurrence" for most private firms as they continually re-evaluate the market potential for specific services and/or technologies, but these changes can disrupt ITS program plans and schedules. DOT is learning to work within the private sector environment, and to quickly adjust to dynamic situations, which is necessary to maintain and evolve the public-private relationships essential to the success of the overall ITS Program.

e. **Dynamic Route Guidance** — We have launched two significant tests of the use of real-time traffic information to assist the in-vehicle selection of routes:

- The TravTek field trial in Orlando, Florida, was successfully completed in 1993 and the evaluation summary published in 1995.

- The ADVANCE project in the Chicago Metropolitan area was designed to build upon the TravTek experience. ADVANCE originally planned to field a much larger fleet of vehicles than did TravTek; this would have greatly improved the extent of the "probe" data on roadway flow speeds reported by the vehicles to the control center. System development issues led the Partnership to reduce the scope of the project and focus on a targeted deployment of less than 100 vehicles. The project will still achieve many of the original test objectives at a much reduced cost. In addition, the Mid-West ITS Priority Corridor, which includes portions of three states and the Gary-Chicago-Milwaukee metropolitan areas will use many of the resources and products created for the ADVANCE project.

3. Deployment Support

Perhaps the most critical accomplishment of 1995 was the Department's and ITS America's joint identification of a **core set of ITS infrastructure** that would share a common national architecture to allow consistent market evolution of ITS technologies. Each "core infrastructure" component, illustrated below in Exhibit 8a and outlined in Exhibit 8b, delivers its own particular set of safety, congestion reduction, security and/or productivity benefits [see Appendix IV for a detailed discussion].

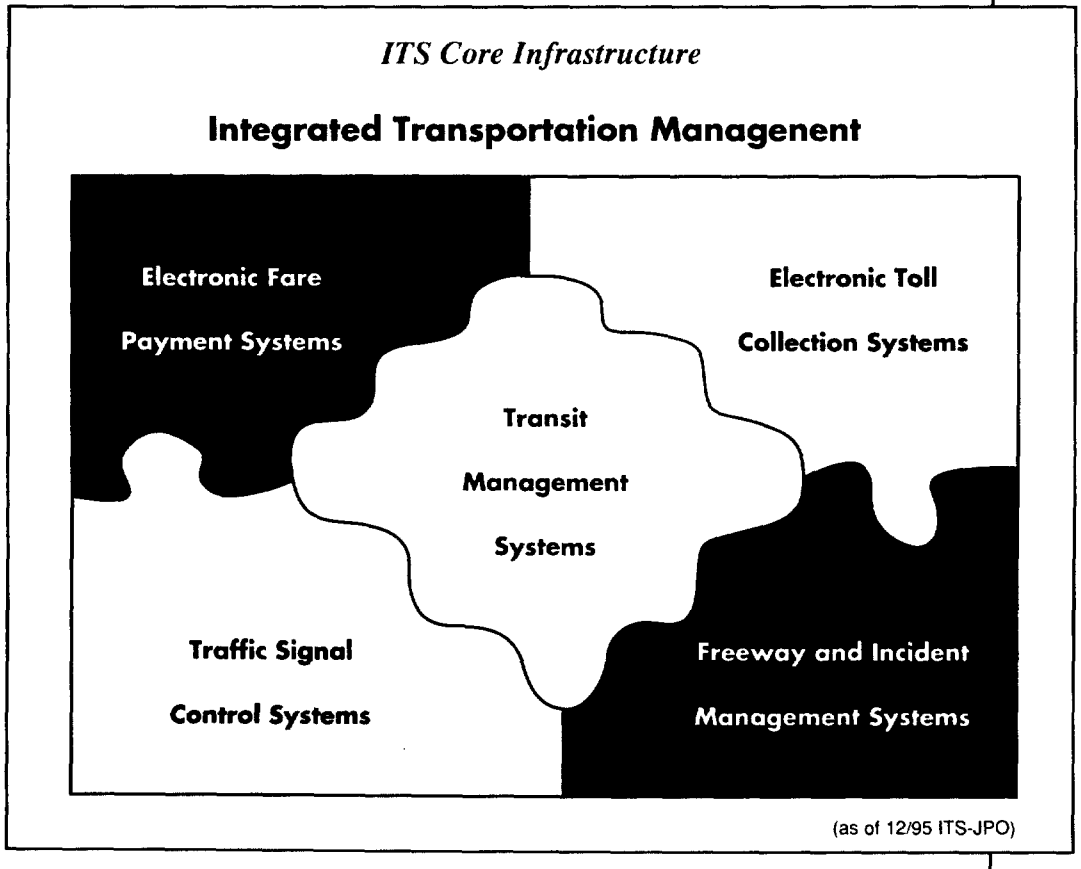

Exhibit 8a. ITS Core Infrastructure

ITS Core Infrastructure can be broken down into seven component systems that, when integrated, work together as smoothly as the pieces of a puzzle.

Exhibit 8b. ITS Core Infrastructure Elements

1. Traffic Signal Control Systems. Optimizes traffic flow by adjusting signal timing and patterns in response to real-time traffic data. Coordinated, computerized traffic signals in Lexington, KY, reduced "stop and go" traffic delays by about 40 percent and reduced accidents by 31 percent.

2. Freeway Management Systems. A formal program for improving traffic flow on high-volume roadway segments via adjustments to ramp metering rates, changeable message signs and highway advisory radio messages based on real-time traffic surveillance. Ramp metering in Minneapolis, MN, increased freeway speeds by 35 percent and freeway capacity by 22 percent, and reduced accident rates by 25 percent.

3. Transit Management Systems. A program for managing bus operations based on real-time bus location information. Using AVL data to optimize bus routes and reduce run times allowed Kansas City, MO, to eliminate seven buses from its fleet of 200. The savings paid for the system in two years.

4. Incident Management Programs. A program to identify and respond to vehicle accidents or breakdowns with appropriate emergency services; restore roadway to full service. The Incident Management Program in Chicago, IL, has reduced incident clearance time by 50 percent.

5. Electronic Fare Payment Systems. A system to consolidate all transit and parking transactions onto one card to add convenience for users and provide centralized information to transit agency managers. In Los Angeles, CA, the benefits of Smart Cards were shown to exceed the costs by more than double.

6. Electronic Toll Collection Systems. A system to allow non-stop toll payment. The Oklahoma Turnpike's ETC system minimizes driver delays and has cut the State's operational cost per lane for toll collection by 91 percent.

7. Regional Multi-modal Traveler Information Centers. Collect, analyze and distribute accurate, reliable and timely travel information to travelers and commercial carriers when and where they want it. Montgomery County, MD, broadcasts traffic conditions on major roadways to 180,000 homes via cable television.

The elements of Core Infrastructure have, through implementation, already proven positive results.

The collective benefits of these individual components are considerably enhanced when they are integrated to allow easy information access and sharing among components and across agency-agency and agency-private partner boundaries. This integration creates an enhanced set of ITS services—several of which have revenue potential—that can be provided by a variety of public and/or private mechanisms. This core integrated infrastructure, deployed in each metropolitan region, becomes a solid platform for evolution of the ultimate ITS vision.

The Department has pledged to facilitate implementation of an appropriate level of this Core Travel Management Infrastructure in all U.S. major metropolitan areas over the next 10 years. Future deployment support activity will focus on that goal.

Five key accomplishments will facilitate this deployment support.

1. the **completion, by 1997, of 75 Early Deployment Plans** for the major U.S. metropolitan areas (see Appendix V for a funding breakdown);

2. the completion of **business plans and key early deployments** by the four ISTEA-designated Priority Corridors (see Appendix VI for detailed funding and accomplishment breakdowns);

3. the completion of **key sets of institutional analyses and consensus development** including:

   - analysis of privacy issues and development of ITS privacy principles,

   - analysis of financial, legal, and institutional issues involved in the contractual arrangements for installing communications systems,

   - development of ITS contracting models for use by states and localities,

   - development of case studies evaluating ITS environmental issues,

   - development of case studies evaluating lessons learned from select operational tests,

   - analysis of the learning gained from focus groups and formal surveys designed to test understanding and acceptance of ITS technology among local elected officials and state and local transportation professionals;

4. the mid-1996 completion of a **strategic plan for training** DOT field personnel and key partners slated for involvement in the deployment effort;

5. the 1996 **completion of a National ITS Architecture** which provides the technical underpinnings for the deployment of ITS core infrastructure.

Key next steps in deployment support will focus on:

1. **Model Deployment** of the integrated core infrastructure, and the institutional arrangements necessary to deliver multi-modal travel information in metropolitan areas through public/private partnerships. Our proposal to Congress outlined the competitive selection of one to three sites currently operating most of the elements of the core infrastructure. Selection criteria would include demonstrating long term funding and a long term relationship with the private sector for delivering multi-modal travel information. The Department would support the integration of infrastructure elements consistent with the national architecture to demonstrate both the national architecture and the enabling value of such an integration.

2. **Technical Guidance** — The Department has developed a body of information on solving technical and institutional barriers, and the architecture development program will provide additional information within the year. The key next step is to develop guidance consistent with the National Architecture for local agencies acquiring core infrastructure components.

3. **Training** — The Department must devote significant resources to training field staff and local partners in the procurement, design, specification, and legal issues associated with developing the integrated core infrastructure. Such training has been designated as an agency-wide goal in the FHWA strategic plan.

4. **Champions** — Our institutional issues analyses indicate that the identified initial "barriers" are not "show stoppers;" each has proved surmountable through changes in local legislation, organizational cultural habits and communication channels, and business partners and procedures. The most successful changes were enacted by respected local champions who convened local players to collectively solve problems and develop commitments to integrate applications. The Department is refocusing its support to local "champions" and peer-to-peer problem solving exchanges rather than national-level institutional analyses.

B. Advanced Commercial Vehicle Systems

The CVO program's long term vision is free and safe movement of trucks and buses throughout North America. It envisions electronic vehicle and driver identification and screening with the help of a nationwide, real-time data and information system. Such a system would allow roadside inspectors to target high-risk carriers, commercial motor vehicles and drivers, and let low-risk vehicles proceed at highway speed without stopping for weight, credential, or safety checks (except on a random basis). States could streamline regulatory operations (one-stop shopping), carriers could reduce drive time and record keeping, and the public would enjoy a new level of commercial vehicle safety on the nation's highways.

To achieve this vision, we must:

- complete **development of a Commercial Vehicle Information System Network (CVISN)** to allow information on carriers and drivers to flow easily across state boundaries, and to bring databases to as near real-time currency as possible,

- continue R&D on **automatic brake inspection technologies and on-board safety monitoring technologies,**

- develop **standards for vehicle to roadside communication and electronic data interchange,**

- **field test** the above technologies and **deploy pilot models of the integrated set of core CVO infrastructure** necessary to achieve the vision. Continued field testing will also help determine appropriate technical and institutional models for exchanging information across international boundaries,

- support **the institutional coordination, training, and high-level commitment** required for widespread deployment of core CVO infrastructure in every state.

Key accomplishments over the past two years in each of these areas are outlined below:

1. Research and Development

There is currently emphasis on two general areas of commercial vehicle ITS R&D:

a. **Development of the CVISN.** Today's motor carrier industry evolved from small, local operations, so most motor carrier regulations are state-based. In many states, several agencies create and enforce regulations, which means multiple transactions per state per carrier—multiplied by the number of states in which each carrier does business. An expensive bureaucracy has evolved within the states with multiple staffs maintaining different databases. U.S. DOT is developing a national information systems network (CVISN) to streamline this cumbersome system. CVISN will facilitate the exchange and processing of data among agencies and states in much the same way as universities share research information through the Internet—by linking existing information systems and databases to provide vehicle and driver safety and credential information. Two national databases will form the core of this system:

   1. **SAFER** (Safety and Fitness Electronic Records System) — safety data on inter- and intrastate carriers and (ultimately) individual vehicles,

   2. **CDLIS** (Commercial Driver's License Information System) — licensing data system for all drivers with commercial drivers licenses.

CVISN will also link existing state-level databases used for electronic clearance, credential purchases, registration, fuel tracking and permitting. A preliminary report on the operational concept and architecture of CVISN has been completed. We intend to field test the concept and move into model deployment of the system in FY 1996 and FY 1997.

b. **Automated Brake Inspection Technology Research and Development.** Detecting inoperative, ineffective or poorly adjusted brakes remains a challenge to roadside inspectors, and brake defects account for the highest number of out-of-service violations. Routine inspections identify obvious brake defects (e.g., out of adjustment air brakes or inoperative brakes), but pinpointing others requires closer inspection. In an effort to improve the quality and efficiency of roadside inspections, the Department is working with several states to evaluate and test devices that measure performance. A draft report of first-round tests will be completed by the end of 1995; a final report will be completed by the end of 1996.

2. Operational Tests

U.S. DOT has launched 31 ITS technology field trials related to CVO, in a variety of promising areas:

a. **Roadside Electronic Clearance.** Three tests focus on electronic clearance of transponder-equipped, safe, legal vehicles. Two tests are significant multi-state trials involving the integration of several core CVO infrastructure elements; one is statewide. Both will become important platforms for evolutionary deployment of the full core infrastructure, including the capability to check vehicles electronically at the roadside without transponders, and "one stop electronic" shopping.

- **The HELP** (Heavy Vehicle Electronic License Plate Program)/ Crescent operational test was a multi-state (CA, NM, OR, TX, WA) effort testing an integrated heavy vehicle monitoring system using automatic vehicle identification (AVI), automatic vehicle classification (AVC) and weigh in motion (WIM) technology, and a private-sector approach to handling the electronic clearance functions. HELP has demonstrated the functionality of the technologies and has now moved to deployment by a private, non-profit operation. HELP, Inc., offers a "pre pass" service to enrolled carriers, charging each time a vehicle passes.

- **Advantage I-75** is testing pre-clearance technologies under a public sector institutional model. By the end of 1995, over 30 sites from Florida through Ontario will be brought on-line to allow prequalified carriers to drive non-stop along this international corridor. States will monitor carriers via tag/transponder technology at weigh and inspection sites along the corridor and via random inspections.

- **Operation "Greenlight"** in Oregon is just getting underway. This comprehensive statewide implementation of automated fixed and mobile sites will identify and screen transponder-equipped commercial vehicles.

b. **Border Crossings.** ITS technologies will play a key role in realizing the North American Free Trade Agreement (NAFTA) goal of moving goods across "transparent borders." In support of those goals, the U.S. DOT ITS program is sponsoring field tests applying ITS technologies to border crossings at Nogales, Arizona; Otay Mesa, California; Detroit, Michigan; Buffalo, New York, and Santa Teresa, New Mexico. These projects will develop systems that meet the multiple requirements of transportation, customs, immigration and toll agencies, as well as for intermodal operation.

c. **Tests of Individual Technology Applications.** Individual technology applications are currently being tested in 24 of the 31 CVO operational tests; 22 are now operational. These applications range from automated speed/weight monitoring and warnings to out-of-service verification, hazardous material emergency response and one-stop shopping for credentials.

d. **Enhancement of Motor Carrier Safety Assistance Program (MCSAP) Sites.** Congress has mandated upgrading 200 MCSAP sites to provide roadside access to available national motor carrier safety rating information. Inspectors have been equipped with a pen-based computer system that improves inspection speed and national database accuracy. Inspectors can use prior carrier safety data to pinpoint vehicles and drivers for inspection, electronically check driver's license status and input inspection data. FHWA estimates a potential savings to the states of a cumulative 125 staff years annually by using this system. One hundred sites will be equipped with the system by the end of 1995; 200 sites will be equipped by the end of 1997.

3. Deployment Support

A set of core CVO infrastructure must be in place at the national and state levels to move commercial vehicles across state and international boundaries freely and safely. That infrastructure (see Exhibit 9 below and Appendix IV) involves the national information communication infrastructure of CVISN, as well as roadside technology for vehicle identification (tag/transponders and/or video imaging) and inspection (pen-based computers, WIM and, ultimately, advanced brake testing).

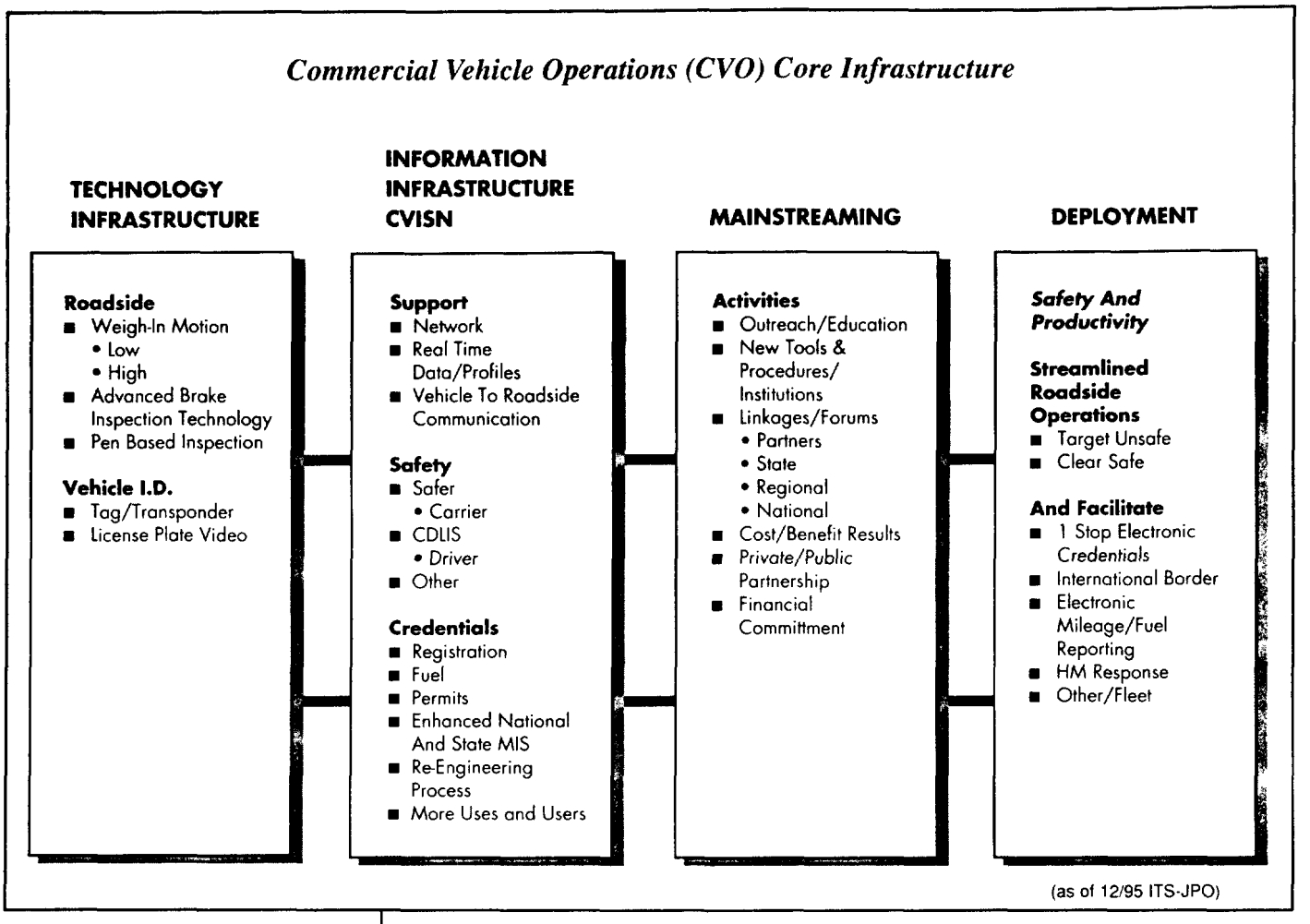

Exhibit 9. Commercial Vehicle Operations (CVO) Core Infrastructure

A specific set of core infrastructure has evolved for Commercial Vehicle Operations (CVO).

Implementation of this infrastructure will require coordinated decisions by numerous regulatory "players" at the state level—from the police, public service commissions, and departments of taxation and motor vehicles to departments of transportation. It will also depend more on institutional coordination and reengineering of process than on the functionality of the technology; therefore, we have supported a series of planning grants to groups of states to identify issues and barriers for coordinated multi-state CVO operations. ITS/CVO institutional grants were provided to states/regions to initiate conversations among agency representatives. Fifty states participated in 7 multi-state groups; 38 of those planning efforts are completed. Phase II efforts will involve 29 states (in 4 multi-state groups), and the Department expects most to be completed in late 1996.

All of the above efforts have resulted in three critical next steps:

a. **State and regional "convening" support.** Unlike the highway and transit communities, CVO has few (if any) forums that regularly pull together CVO regulators. As part of its effort to engineer effective use of the power of available technology, U.S. DOT has committed to support several state and multi-state-level forums focused on these issues and CVO deployment.

b. **Model Deployment.** The most effective argument to encourage state actors to participate in the CVISN and implement roadside technology is a fully-functioning ITS model that demonstrates the benefits to both states and carriers. We believe ITS offers a powerful solution to the mounting pressures on state organizations to do more with less, and a fully implemented example of the core infrastructure linked to the CVISN will drive that point home. We therefore propose to move directly into full model deployment at the successful conclusion of CVISN testing.

c. **Training.** As with the metropolitan regional travel program, significant resources must be devoted to training state and local regulators in using the CVISN, procurement, roadside technology and other CVO systems, e.g., hazardous material response.

C. Advanced Crash Avoidance Systems

Highway crashes remain one of the leading causes of death among adults despite strides made in seat belt usage and air bag prevalence. Analysis suggests that crash protection improvements will show diminishing returns in reducing the highway death toll compared to the significant gains possible with crash avoidance. Human error is the leading cause of accidents, so we have focused on sensing, data processing, and driver-vehicle interface technologies to warn drivers of crash-eminent situations, and automatic vehicle control to potentially enhance vehicle performance. Based on the potential of these opportunities, the Department has articulated a threefold program mission:

1. Demonstrate that advanced technology can improve safety by enhancing vehicle crash-avoidance performance.

2. Ensure that ITS in-vehicle systems do not compromise safety.

3. Facilitate safety-effective commercialization of these technologies.

The Department will accomplish this mission through the following:

- developing a knowledge base and basic research tools, and applying these tools and knowledge bases to obtain better understanding of the driver's performance in crash situations;

- defining crash-avoidance opportunities based on detailed analysis of accidents and "near-miss" incidents;

- developing performance specifications for effective collision avoidance systems, demonstrating the application of technology to these opportunities in field trials, and working with industry to facilitate commercial development of these technologies;

- evaluating the safety features of other in-vehicle systems along with other ITS industry members.

Exhibit 10 describes the relationship of these program elements.

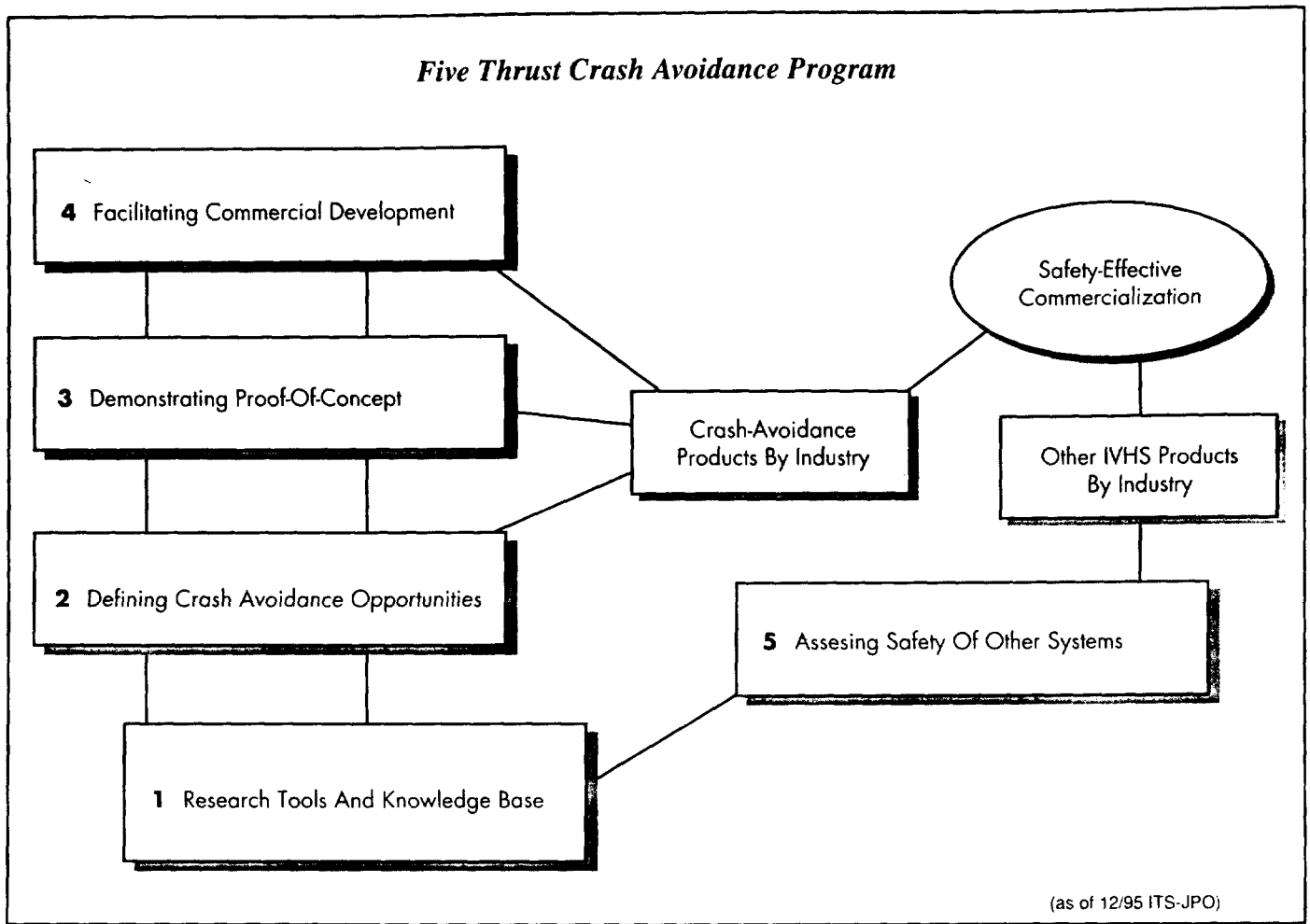

Exhibit 10. Five Thrust Crash Avoidance Program

The Crash Avoidance Program addresses concept development via five thrusts.

Unlike those of Advanced Travel management or Advanced Commercial Vehicle Operations, many of the technology applications associated with crash avoidance are still in the R&D stage. Exhibit 11 illustrates the research and testing program architecture the Department is pursuing.

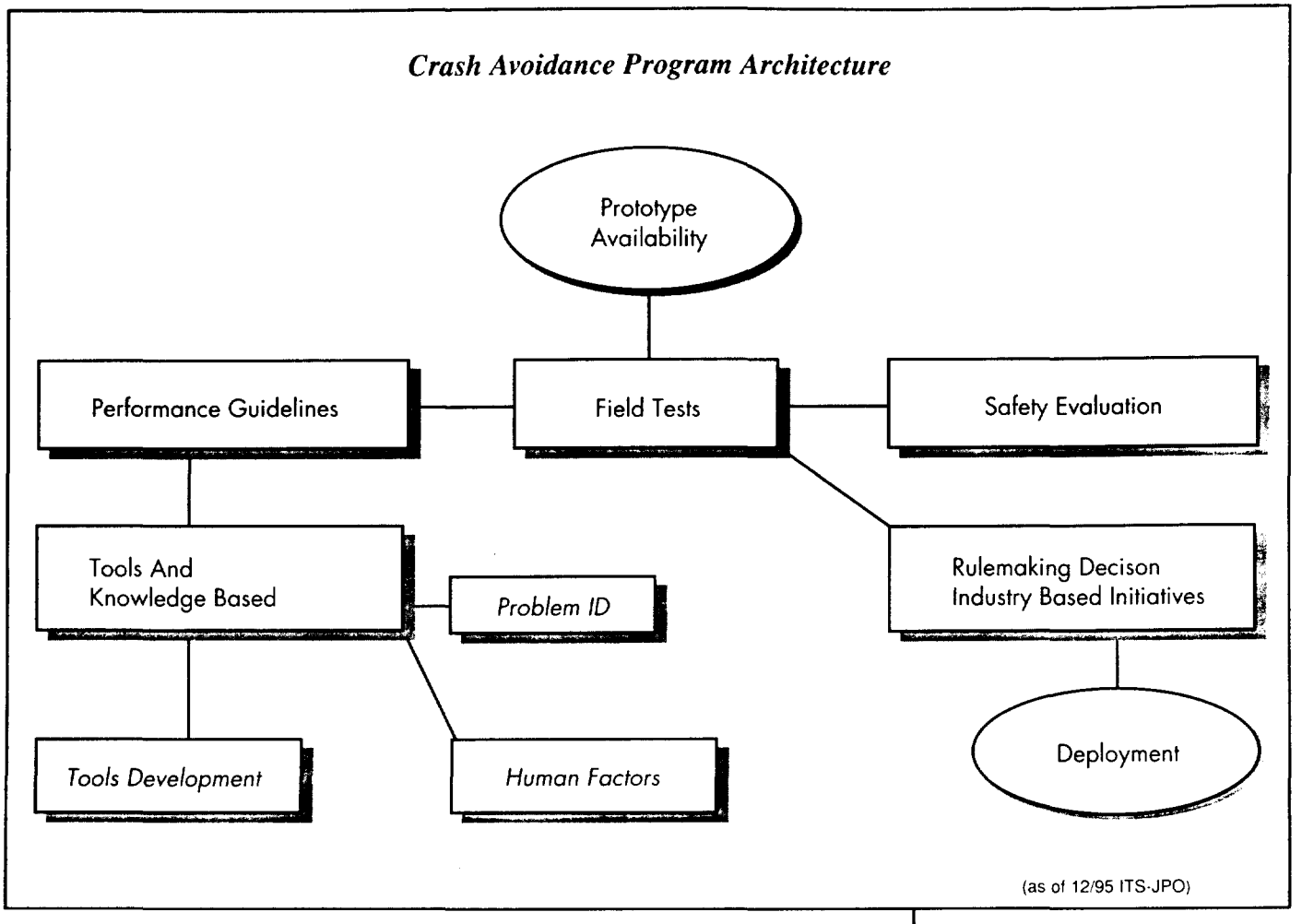

Exhibit 11. Crash Avoidance Program Architecture

The Crash Avoidance Program Architecture outlines the various stages of R&D of the program.

Several fundamental research projects will identify accident causes and aspects of driver behavior under various circumstances. These results will help define preliminary specifications for system performance to help avoid particular kinds of accidents. The specifications will guide both automotive industry product developers and field test criteria in developing and evaluating available and new technology. Field test results will be used to revise the final performance specifications, which will become a resource for industry development and possible NHTSA regulatory actions.

The Department is involved in several cooperative development efforts with industry as part of this research program. These efforts are intended to accelerate the availability of effective commercial products.

Significant accomplishments for each of the program areas are outlined below: