

**Intelligent
Transportation
Systems (ITS)**

**Advanced
Rural
Transportation
Systems
(ARTS)**

**Rural
Intelligent
Transportation
Systems (ITS)
Program Plan**

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**Advanced Rural Transportation Systems (ARTS)
Rural Intelligent Transportation Systems (ITS)
Program Plan**

EXECUTIVE SUMMARY

This Program Plan for the Advanced Rural Transportation Systems (ARTS) implements the goals and objectives established in the U.S. Department of Transportation’s (USDOT’s) Strategic Plan for the ARTS. This Program Plan proposes five years (FY 97—FY 01) of USDOT projects and activities to advance the ARTS in partnership with other national, state and local public agencies, and with the private sector. Public sector activities will be focused on an ARTS infrastructure that will support various services to transportation providers and users. The ARTS will be fully coordinated with the national ITS through a common national architecture and standards. The ARTS will focus on rural needs and conditions, but will be interoperable with extensions of metropolitan ITS, and will be seamless for travelers and commercial vehicles. The Strategic and Program Plans for the ARTS are being coordinated by the multi-administration Rural Action Team within USDOT.

Program Plan Development

The ARTS Strategic Plan organizes rural needs into seven Critical Program Areas (CPAs):

CPA 1	Traveler Safety and Security
CPA 2	Emergency Services
CPA 3	Tourism and Travel Information Services
CPA 4	Public Traveler/Mobility Services
CPA 5	Infrastructure Operations and Maintenance
CPA 6	Fleet Operations and Maintenance
CPA 7	Commercial Vehicle Operations

The ARTS Strategic Plan sets goals and objectives to meet the needs in each CPA through the ITS adapted to rural conditions. These goals and objectives are translated into measurable outputs and outcomes consistent with Government Performance and Results Act (GPRA) requirements. This ARTS Program Plan proposes the USDOT projects and activities that will promote the outputs (integrated ARTS implementations) intended to produce favorable outcomes (improvements in efficiency, effectiveness and mobility) for rural transportation systems and their users.

This Program Plan links the Strategic Plan to favorable outcomes through analysis of the CPAs within the ITS architecture framework. The CPAs relate to the National ITS Architecture through user services, that were stipulated according to the rural needs and conditions. See Figure ES-1. Each applicable user service was developed into a set of functions needed to deliver the service under the rural conditions. Based on this analysis, background information on rural transportation systems, and a compendium of existing rural-related research, knowledge areas were defined—what is known or not known as relevant to implementing the ARTS.

The National ITS Architecture defines various organizing concepts for the ARTS as a *system*. A layered structure includes *infrastructure* that must be provided in common to support many *applications* that ultimately deliver *services*. Following the tradition in transportation, the infrastructure will be provided largely in the public domain and will follow standards to be open to innovative and competitive applications from the private sector. ARTS activities will define the infrastructure needed to serve the CPAs, and then facilitate deployment of this infrastructure. This layered structure also emphasizes issues common to many CPAs, such as communications in rugged and remote areas, that must be addressed by ARTS activities.

This Program Plan promotes the transformation of the CPAs into the ITS architecture context by proposing support of more active rural participation in the architecture and standards. The intent of the ARTS is not to create a separate rural ITS, but to ensure that rural needs and conditions are represented in what will be an interoperable, national and international system.

The Federal Role

The Program Plan's projects and activities are organized into three budgetary and programming categories that indicate the scope of federal involvement in the ARTS:

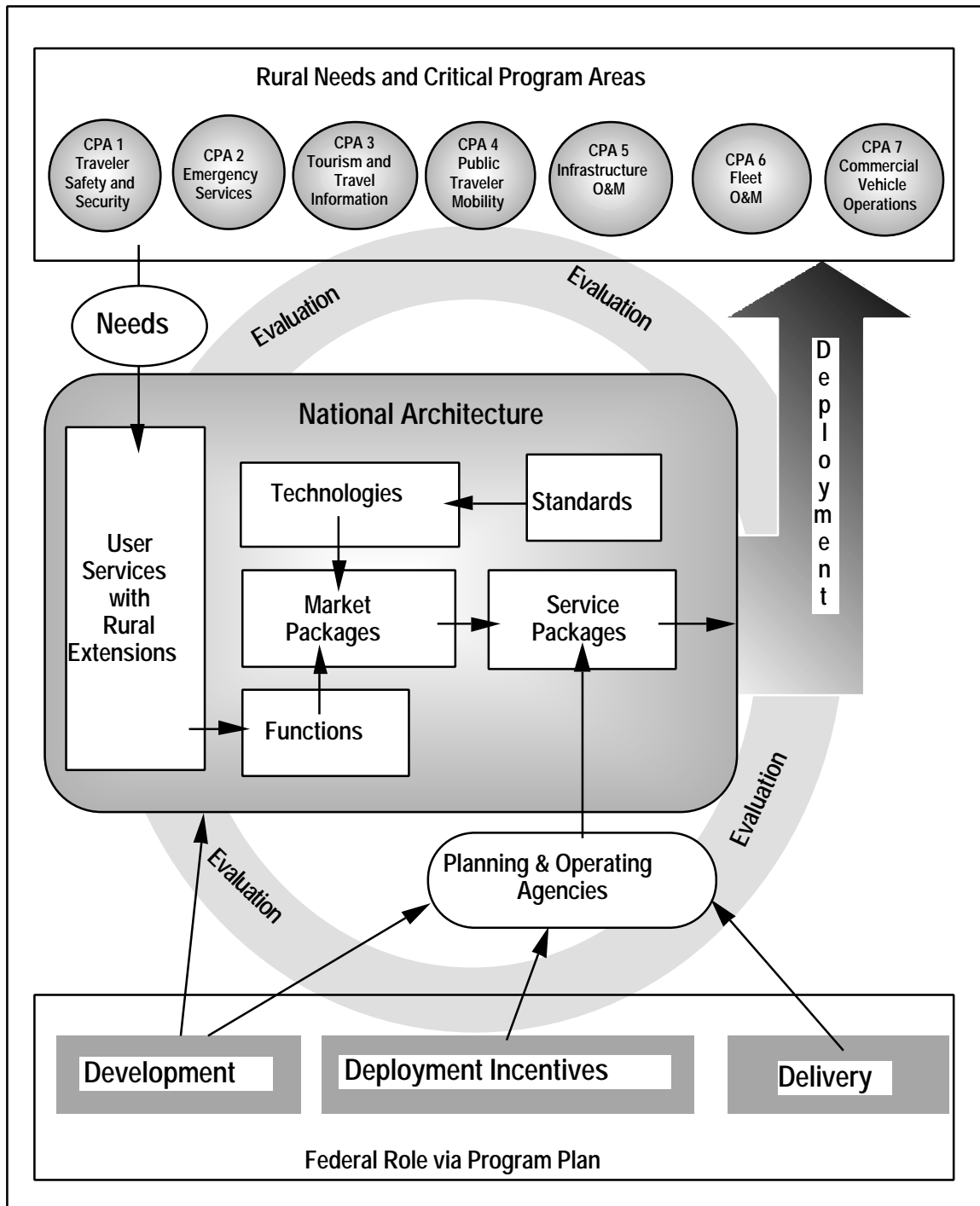
- Development
- Deployment Incentives
- Delivery

The *development* components of this Program Plan will identify technologies and procedures to enhance the ARTS outcomes, especially where private sector development is inhibited by risks or an inability to capture benefits by pricing. Development includes studies and field tests to resolve effectiveness and feasibility issues. Tests will be evaluated under a unified Test Plan. Development activities include the architecture and standards involvements of the ARTS, and other program support such as Strategic and Program Plan updating and dissemination.

Deployment Incentives include grants to states and localities specifically for early ARTS planning activities or for showcase models of integrated ARTS.

Delivery includes training, procedure development, and support tools that will promote ARTS planning, deployment and operation within transportation agencies. This is aimed at *mainstreaming*, which means raising ARTS knowledge and skills to levels that exist for conventional transportation improvements and operations, and incorporating ARTS in normal deployment planning and programming processes. Subsequently, all approaches to improving transportation services and mobility in rural areas should be treated equitably and expertly.

Fig. ES-1: Schematic of the ARTS Program



The ARTS program is coordinated with other federal ITS programs through the ITS Joint Program Office (JPO). The ITS program scope does not include direct deployment of the ITS by USDOT. However, rural areas include federal domain areas, such as the national parks, where other federal agencies may directly fund ARTS deployment. Such deployments will be coordinated under this Program Plan. Otherwise, states and localities will use their own, and regular federal-aid transportation funding, for deployment. Considerable private investment is also expected, including partnerships with public agencies.

The effectiveness of the ARTS according to the outcomes defined in the Strategic Plan will be evaluated within the ITS by the JPO, and is outside the scope of this Program Plan. These programmatic evaluations, along with project evaluations that are part of the ARTS R&D, will provide valuable feedback to the ARTS program.

Knowledge Area Findings

The ARTS program coordinators in the Rural Action Team have contacted rural field staff and constituencies to formulate the CPAs, define program priorities, and learn what is being done. The ARTS have been taken through preliminary system-development steps to define issues. A compendium of existing ARTS-related research has been compiled. Together, these efforts have defined preliminarily what is known, and what is not known about rural transportation related to the ARTS. These knowledge areas divide into:

- General rural context
- Systematic ARTS issues across the CPAs
- CPA-specific issues

Some key facts of rural context are:

- Rural areas account for 83 percent of the nation's land, 21 percent of its population (50 million people), 18 percent of its jobs, and 14 percent of its earnings.
- There are just over 3 million rural road miles, which is 79% of the national total. Half of the rural mileage is not hard, all-weather, paved. State highway agencies spent about \$16 billion on rural highways for capital improvements and maintenance in 1994.
- The rural highway system represents the extremes of highway utilization: Rural Interstates carry 24% of rural vehicle miles traveled (VMT) on only 1% of the rural route miles. Conversely only 5% of total national VMT is carried on the least used, and almost all rural, 50% of national route miles. The rural challenge is to obtain economical, safe and effective operation of that large "tail" of highways.

- From the 1990 census data, 7.7% of the households outside of metropolitan areas have no vehicle available, compared to 9.6% in urban areas. However, rural residents have fewer mobility alternatives since 38% percent of the nation's rural residents live in areas without any public transit service and another 28% live in areas with negligible transit service.
- There are over 1,100 rural transit providers in the U.S.. These vary widely in size, creating problems of efficiency in areas with small and fragmented services. In the rural transit areas of the United States, there are 30 million rural elderly, working poor, and people with disabilities. Rural transit ridership reflects service to the mobility impaired much more than urban transit.
- Rural motor vehicle accidents are only 28% of the national total, but rural fatalities are 56% of the total fatal accidents and 58% of total persons killed, higher than the rural route mile or VMT proportions. In 1994, there were 20,596 fatal rural highway accidents and 23,693 deaths that resulted.
- The rural highway safety problem is a combination of highway deficiencies, driver awareness/familiarity, and emergency medical service (EMS) response. For the fatal crashes with time components given, 46.5% of the rural cases take over 50 minutes from crash to hospital arrival, while the comparable urban proportion is 14.2%.

Among the general ARTS findings across CPAs are the following:

<p>1. We know that most of the technologies needed for the ARTS exist, or are being developed for general ITS user services. The predominate problems are information dissemination, training, and financial resources for deployment.</p>	<p>We don't know how far an ARTS infrastructure can be extended economically, or how new technologies will affect extent.</p>
<p>2. We know that the rural perspective still needs to establish a strong involvement in architecture development and standards.</p>	<p>We don't know which architectural and standards issues will prove most critical to rural distinctions.</p>
<p>3. We know that there will be a wide variety of approaches to deployment of ARTS—building from an urban base, starting from a rural base, area-focused, or corridor-focused, etc.</p>	<p>We don't know how different the federal ARTS program approaches have to be in these various cases.</p>
<p>4. We know that rural needs have been a strong federal concern, and that rural areas contain large federal-domains</p>	<p>We don't know the best way to achieve coordination between USDOT and the various federal-domain operating</p>

where federal agencies will be ARTS operators.	agencies on the ARTS.
5. We know that there is a rural highway safety problem, strongly perceived by users.	We don't know how best to direct ARTS efforts since accident causation is a complex issue.
6. We know that the emphasis of the ARTS program will be less on congestion than in the largest urban areas.	We don't know how best to adapt traffic control and its integration with regional systems for tourist peaks, seasonal events, rural places just below urban threshold, or rural areas on metropolitan fringes.
7. We know that many ARTS functions require good radio propagation for communications and positioning information.	We don't know how serious the problems are in mountainous areas, how much cellular communications will spread in sparse rural markets, or how soon low-orbital satellite systems will be affordable.
8. We know that there are serious economic issues for ARTS, raised by the sparseness and large distances of rural applications.	We don't know exactly how best to focus ARTS solutions to achieve operational efficiencies.
9. We know that provision of rural mobility is constrained by budgets.	We don't know if rural mobility can be guaranteed within budget constraints when ARTS provides service coordination and increased efficiency of operations.
10. We know that rural areas are institutionally diffuse for planning and mainstreaming purposes.	We don't know the best approaches for organizing ARTS planning in rural areas.

In addition to the general findings above, many CPA-specific findings have gone into the Program Plan formulation.

A Roadmap to the Plan

Figure ES-2 shows a simplified matrix of the proposed projects and activities. The program fiscal years are shown against the three programmatic categories.

The FY 97 projects are already being programmed with authorized funding. The Development projects include tourism and transit demonstrations, and development of a surface transportation weather information system project in concert with the National ITS Architecture development. Program support under the JPO, but not from the ARTS

budget specifically, is ongoing. Under Delivery, a set of regional workshops will be conducted through USDOT field offices to initiate state-level ARTS planning.

In FY 98, Development efforts will continue to define the ARTS systematically. Further interaction with ARTS constituencies will refine needs and priorities, to finalize the CPA definition. The CPAs will be developed through the architecture process to define ARTS requirements and general structure for hand-off to the National ITS Architecture and standards activities. One result of this effort will be definition of an ARTS infrastructure as a coherent set of, primarily public-sector, systems that can support all needed services. As issues are better defined and new ARTS subsystems are identified, field tests will be launched. A test plan will subject all ARTS activities to evaluation with programmatic feedback. In Delivery, the capability of states and rural localities to take advantage of deployment funds will be built. Planning procedures for federal aid funding will be drafted, staff training for federal outreach will proceed, and “toolbox” support will be initiated. The architecture work will contribute to a guidance document for rural planners and system operators. FY 98 will see the first Deployment Incentive grants, to help the least advanced areas experience procedures to do initial ARTS planning, and to help more advanced areas develop system integration procedures.

After FY 98, and to the Plan horizon of FY 01, the Roadmap reflects a “waterfall” of ARTS development out of Development. Studies and research identify more problems and likely solutions, at both the architecture level and for subsystems. These move through testing and into readiness for deployment. Deployment Incentive grants will fund the initial efforts to bring ARTS planning to more areas, and to demonstrate higher levels of system integration. Matured planning, through Deployment Incentive experience and disseminated by Delivery, will lead to increasingly mainstreamed deployment from state and local rural planning, with federal-aid funding and public-private partnerships. This deployment will focus on infrastructure that will be increasingly integrated, and private sector activity will add services to those that are already commercialized.

Next Steps

The Strategic Plan has been finalized, but this draft Program Plan will go through further review before being adopted. There will be broad outreach to rural constituencies for comment, and then dissemination.

Each annual element of this plan is subject to internal USDOT review and budget appropriations. The FY 97 and 98 elements will proceed in parallel with Plan adoption. The later years will become better defined through program experience, in time for their annual approvals. The Plan activities will provide the experience for periodic updating of the Strategic Plan.

Advanced Rural Transportation Systems (ARTS) Rural Intelligent Transportation Systems (ITS) Program Plan

INTRODUCTION AND PURPOSE

This Program Plan for the Advanced Rural Transportation Systems (ARTS) implements the goals and objectives established in the U.S. Department of Transportation's (USDOT's) Strategic Plan for the ARTS. This Program Plan proposes five years (FY 97-01) of USDOT projects and activities to advance the ARTS in partnership with other national, state and local public agencies, and the private sector. The Program Plan receives overall, "strategic" approval within USDOT, and recommends projects that will receive specific approval by incorporation into annual USDOT budgets. The projects and activities so approved are not for direct deployment of the ARTS. Deployment will be by state and local public agencies and the private sector, with federal guidance and according to the National ITS Architecture. Deployment will be funded by existing federal-aid transportation programs, and other public or private funding.

Relation to The Strategic Plan

The Strategic Plan described ARTS program outputs and outcomes derived from its needs assessment. Outputs are federal activities to plan and promote ARTS deployment. Outcomes are the impacts of the ARTS on the rural transportation system and its users. This Program Plan formulates federal activities that will become the outputs directed by the Strategic Plan. This Project Plan further analyzes needs, identifies knowledge of how to meet needs, and defines questions that still remain about meeting needs. The result is a list of activities and projects for budgeting over a 5-year horizon. This Program Plan will be updated periodically, to adapt to changes in budget and the increasing experience that will be gained in the ARTS. This Program Plan also will respond to longer-term changes in USDOT and ITS policy, as reflected in revisions to the ARTS Strategic Plan.

Program Performance Assessment

The Government Performance and Results Act (GPRA) requires federal programs to articulate and satisfy specific criteria of success. The federal ITS program, through the Joint Program Office (JPO) has articulated its "few good measures" as the basis of an overall program performance assessment process. The Strategic Plan has stated the goals and objectives for ARTS at a high level. This Program Plan has two jobs with respect to ARTS program performance assessment:

1. The general goals and objectives must be increasingly specified and quantified as outcome and output measures that can be levied against specific activities and projects.
2. The measures must be fed back into program planning, at the Strategic and Program Plan levels, to keep adapting the ARTS program for maximum performance.

Generally the *outputs* (the program in terms of projects and activities) can be defined more immediately, e.g., including ARTS in the planning processes of the 50 states. These are intermediate to creating desirable *outcomes* of the ARTS, e.g., reducing rural accidents. The outcomes are derived from the objectives stated in the Strategic Plan. Defining the outputs is part of the program planning process and requires information about their likely causal relation to the outputs. The greatest challenge is to set meaningful quantitative levels for the outputs. Therefore, the first job is ongoing and will mature as part of accomplishing the Program Plan.

The second job is part of continual ARTS management and Program Plan updating. The managers, with all parties involved in the ARTS, must establish measurement and evaluation of all activities. These evaluations must be fed back to those responsible for ARTS program and implementation planning. Approaches that work must be propagated, new questions that arise must be answered, and whatever is ineffective must be dropped. Building in this managerial feedback requires training, the funding of the evaluative processes, and the mainstreaming of appropriate planning techniques. The evaluation feedback will occur at two levels: The national ITS program is being evaluated under the JPO with respect to its “few good measures”, and this is outside of the ARTS program. Projects and activities, especially the field operational tests, under the ARTS program will be evaluated under this Program Plan.

Program Plan Development

The Strategic and Program Plans have been developed by the USDOT Rural Action Team. This team includes all operating administrations of the USDOT and ensures that the ARTS serves needs multi-modally.

The ARTS Strategic Plan organizes rural needs into seven Critical Program Areas (CPAs):

CPA 1	Traveler Safety and Security
CPA 2	Emergency Services
CPA 3	Tourism and Travel Information Services
CPA 4	Public Traveler/Mobility Services
CPA 5	Infrastructure Operations and Maintenance
CPA 6	Fleet Operations and Maintenance
CPA 7	Commercial Vehicle Operations

The CPAs carry through into the Program Plan to maintain traceability to the original needs. However, the Program Plan is also concerned with building a coherent ARTS—a *system* that serves needs—and the perspective needed for this follows the National ITS Architecture to plan the progression from needs to integrated functionality of deployed service packages. Yet another perspective comes from the budgeting and organizational categories into which this Plan must be translated.

The National ITS Architecture serves as a process template for ARTS planning, and will specify the structure and standards to which the ARTS must conform as part of the national ITS. As a process that is followed in development of this Plan, the architecture is needs driven. The rural needs, clustered in the CPAs, evoke user services as defined in the National ITS Architecture. The user services are to be provided by a coherent, effective, and interoperable system of many components. Some components of this system, like communications systems with their own multi-layered protocol organization, will underlie most user services in most CPAs. The systems structure in the architecture leads to a focus in this Program Plan on overarching issues, such as radio propagation for communications and positioning in rugged and sparse rural areas. It also leads to defining an ARTS layering concept that includes a rural intelligent transportation *infrastructure*.

The development of this Program Plan will focus on coordination and promotion of the ARTS infrastructure. The National ITS Architecture will ensure that the infrastructure, and the applications on it, is open and can evolve technologically. The intent of the ARTS Plan is not to create a separate rural ITS, but to ensure that rural needs and conditions are represented in what will be an interoperable, and largely homogeneous, national and international system. However, this Program Plan also must ensure that particular rural environments and needs are represented in the architecture and its standards. The hand-off of ARTS requirements to the National ITS Architecture effort is therefore an early focus of this Plan.

Individual activities and projects in the Plan can still be needs-focused. In that case they will map clearly to a CPA. Activities and projects that address more systematic aspects of the ARTS will serve one or more CPAs. Traceability to the CPAs will be maintained by indexing activities and projects back to the CPAs, and back to the goals and objectives of the Strategic Plan.

The activities and projects of this Program Plan form a “waterfall”, from research, through testing, to training and deployment support. The waterfall will continue to be renewed by research and development, fed in part by the formal program evaluation. As the program matures, there will be more emphasis on supporting deployment, and guiding completion of an integrated infrastructure with compatible services. It is the intent of an open architecture that research on needs and solutions can always adapt the ARTS to improved performance, so that no “completion” of the ARTS is really definable.

The Federal Role in ARTS

The federal role in the ARTS is constrained, as reflected in the programmatic categories and budgetary amounts. This Plan ultimately transforms the ARTS needs and solutions into a matrix of annual allocation of dollars by program categories. The three major program categories are:

- Research and Development (R&D), including field tests
- Deployment Incentives
- Delivery

The *R&D* components of this Program Plan will identify technologies and procedures to enhance the ARTS outcomes, especially where private sector R&D is inhibited by risks or an inability to capture benefits by pricing. The R&D includes studies, tests to resolve effectiveness and feasibility issues, and demonstrations to create deployment-readiness. Tests and demonstrations will be evaluated under a unified Test Plan. The R&D activities include the architecture and standards involvements of the ARTS, and other program support such as Strategic and Program Plan updating and dissemination.

Deployment Incentives include grants to states and localities specifically for early ARTS planning activities or for showcase models of integrated ARTS.

Delivery (or Mainstreaming) includes training, procedure development, and support tools that will promote ARTS planning, deployment and operation within transportation agencies. Delivery is intended to bring ARTS knowledge and skills up to those that exist for conventional transportation improvements and operations. Subsequently, all approaches to improving transportation services and mobility in rural areas should be treated equitably and expertly.

The federal ITS program generally, and the ARTS program specifically, will not fund deployments of systems. The primary reason for this is to preserve the appropriate federal, state, local, and private sector roles. State and local public agencies can best match needs with deployment investments, by using appropriate planning. Such planning must have access to information on what ARTS solutions are available and how to integrate local deployments into the national ITS. Public agencies can use their allocations of regular federal-aid funding for deployment, and all such federal grants carry procedural requirements that include appropriate planning. A federal role under mainstreaming is to define the federal-aid planning requirements for ARTS. It is expected that these requirements largely will be consistent with existing planning requirements. The Program Plan will examine these requirements and recommend changes if needed, but otherwise will provide guidance and training to bring ARTS into the mainstream of planning, project development and grant application. Federal-aid funding for the ARTS, and its planning requirements, are set by the Intermodal Surface Transportation Efficiency Act (ISTEA) and its successor legislation.

There is a federal interest in promoting coordination and planning interregionally, across state jurisdictions. This has been fostered through the federal-aid highway program.

Functional coordination of the ARTS will be fostered nationally through the architecture, but the ARTS R&D activities leading to mainstreaming will address how to span jurisdictional boundaries institutionally and procedurally.

Deployment incentives are not intended to fund mainstreamed deployments that can use regular federal aid. Deployment incentives will be related to federal objectives that are allied with either R&D or mainstreaming activities. For instance, as part of the development of planning capabilities for the ARTS, initial ARTS planning activities by states or localities, leading to deployments, may be specially funded. Deployments that test ARTS integration, over large areas, among many systems, or between infrastructure and private-sector applications, may be funded as national showcases.

In transportation, the public sector has traditionally provided a common infrastructure for private use. The ARTS will continue this by emphasizing the infrastructure for public deployment. The private sector competitively will provide services to ARTS users, particularly users of private automobiles and commercial vehicles. This allocation of roles also matches needs with investments through the market, and competitive incentives lead to rapid adoption of advancing technologies. It is where the market does not respond well that the public sector predominates. This includes the common infrastructure, deployments with public benefits that cannot adequately be captured by pricing, and high-risk activities where payoffs and penalties are best pooled by a large entity such as government.

It is not intended to make a strict distinction between public and private sector efforts towards the ARTS. Because public budgets are constrained at all levels, public-private partnerships are to be explored and developed by this Plan through field tests, as part of deployment incentives, and by means of mainstreaming guidance.

There are cases where the public sector is involved with direct transportation services. In transit, public safety, and emergency services, public agencies are operators of, or fund transportation. Federal interests follow the funding of rural transit services, and large expenditures for transportation to health and human services. The ARTS, through service coordination and efficiency increases, can be an important tool to reduce costs and increase service coverage in rural areas to the mobility impaired. Rural areas also have most of the public domain lands, such as parks, where activities, including transportation, are operated by the federal government or state and local public authorities. In these cases the public-private and federal-local roles are more intermixed. For the national parks and other federal domain lands, the ARTS program will address inter-agency coordination on deployment.

Coordination with the National ITS Program

The national ITS program is coordinated among the administrations of USDOT, and externally, by the JPO. The National ITS Program Plan establishes overall goals and structure of the national ITS program. Within the National Program Plan, a rural ITS has been established as one organizational focus area. Results of any rural ITS planning and

activities will be integrated back into the National ITS Program Plan, and into its standards and architecture.

The Rural Action Team under the JPO is the organization for identifying specifically rural issues and coordinating the ARTS program among federal agencies. The Rural Action Team draws advice from national and local ARTS interest groups and studies.

The ARTS Program Plan will budget federal activities and projects that promote the ARTS within the national ITS operational framework. The activities identified in this Plan will be carried out by the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), the National Highway Transportation Safety Administration (NHTSA) and the Federal Rail Administration (FRA).

Not every federal activity, or all the budget, for ARTS is in this Plan. The JPO funds general support for ARTS program development, and will fund the national aspects of ARTS evaluation. The JPO also funds the National ITS Architecture development, to which the ARTS program will deliver specifically rural requirements. Since the ARTS will be an extension of many national ITS services, it will borrow the results of other ITS programs. Deployment will be conducted beyond this Plan by use of regular federal aid programs, local public funding and private funding. Where ARTS deployments are carried out by other federal agencies, such as the Department of Agriculture, the Department of the Interior and the Department of Health and Human Services, this ARTS Plan will include inter-agency coordination..

Knowledge Areas

An important step in the development of the Program Plan has been the definition of what is known and what is not known about the ARTS and its needs. Collectively, these are the knowledge areas, whether filled or unfilled. Defining ARTS knowledge areas to date has included reviews of rural attributes, of existing ARTS-related studies, of ongoing ARTS-related projects, and input from constituents. This will continue via Program Plan activities.

What is known about the ARTS can be used to propagate successes and effective approaches, or to cull ineffective approaches. What is not known defines the research and development (R&D) that needs to be conducted, including demonstrations and operational tests to discover the real-life, economic and institutional factors of ARTS deployment.

Knowledge areas will not be defined fully until all needs are characterized and fed into the architecture development process. This will occur over the five-year program developed here, and will be updated continuously thereafter. In the meantime, it is known that many useful service packages are available for deployment, and an emphasis will be placed on information dissemination, training, and planning-mainstreaming for these.

The ARTS knowledge areas benefit from previous work done for the national ITS program, for urban applications, for commercial vehicles and for automated highways/guideways. However, unique rural problems and benefits exist. Problems that continue to be addressed include:

- Fundamental problems of rural transportation over large distances—that are critical for emergency services and the mobility impaired;
- The isolation of rural roads with respect to directional information or emergency communications;
- The small size and customer density of rural transportation providers, and;
- The need to increase operations and maintenance productivity over rural road systems with many route miles but low utilization in remote areas.

Program Plan Organization

This Program Plan is presented in the following sections:

1. The ARTS within the ITS Architecture—explaining the high level system structure of the ARTS, related to Program Plan activities
2. Knowledge Area Assessment—uses the ITS architecture structure to pose knowledge and questions about the ARTS and to structure the federal role in realizing the ARTS.
3. Plan Priorities—establishing the emphases, over time that Plan activities will address.
4. Outputs and Outcomes of the Plan—relating the Strategic Plan’s measures to development of Plan activities.
5. Program Plan Matrix—giving a 5-year program of activities and projects: FY 97 already budgeted and four years, out to 2001, to be proposed for funding.
6. Next Steps—indicates how the Program Plan will be implemented in collaboration with its constituents.
7. Appendix—giving background material on rural areas and transportation relevant to the ARTS.

THE ARTS WITHIN THE ITS ARCHITECTURE

The national architecture for the ITS provides a unifying framework for the ARTS, and the way the architecture was developed also provides a process for ARTS program development.

The National ITS Architecture

The National ITS Architecture has been developed to define the technical coordination for a nationally interoperable and open ITS. This architecture results in standards that will stipulate the design of ITS components. A high-level architecture is complete, but standards are still under development. The architecture generally defines a structure for the ARTS to comply with, but the ARTS program still has the opportunity to define architecture details and standards applied specifically to rural areas and transportation systems. The schematic below relates the Program Plan, as it defines the federal ARTS activities, to the structure and process of the National ITS Architecture.

The ITS architecture is just an overall system description, that can include different perspectives on the same system, and multiple levels of detail for each perspective. Within a general structural description of the ITS, standards allow integration of pieces of the ITS that are designed and deployed modularly. A goal of the architecture and standards is system openness. This means that interfaces between all parts of the ITS are specified uniformly, so that the parts can be modularly added or updated as long as interface standards are obeyed. This applies, for instance, at the scale of subsystems within a vehicle, or at the scale of regional ARTS deployments that can be linked interregionally.

The figure below within the “National Architecture” box shows the high level structural categories that the architecture defines. The relation of these structures can also be interpreted as a process sequence that the ARTS Plan development can follow, and therefore fit directly into the architecture.

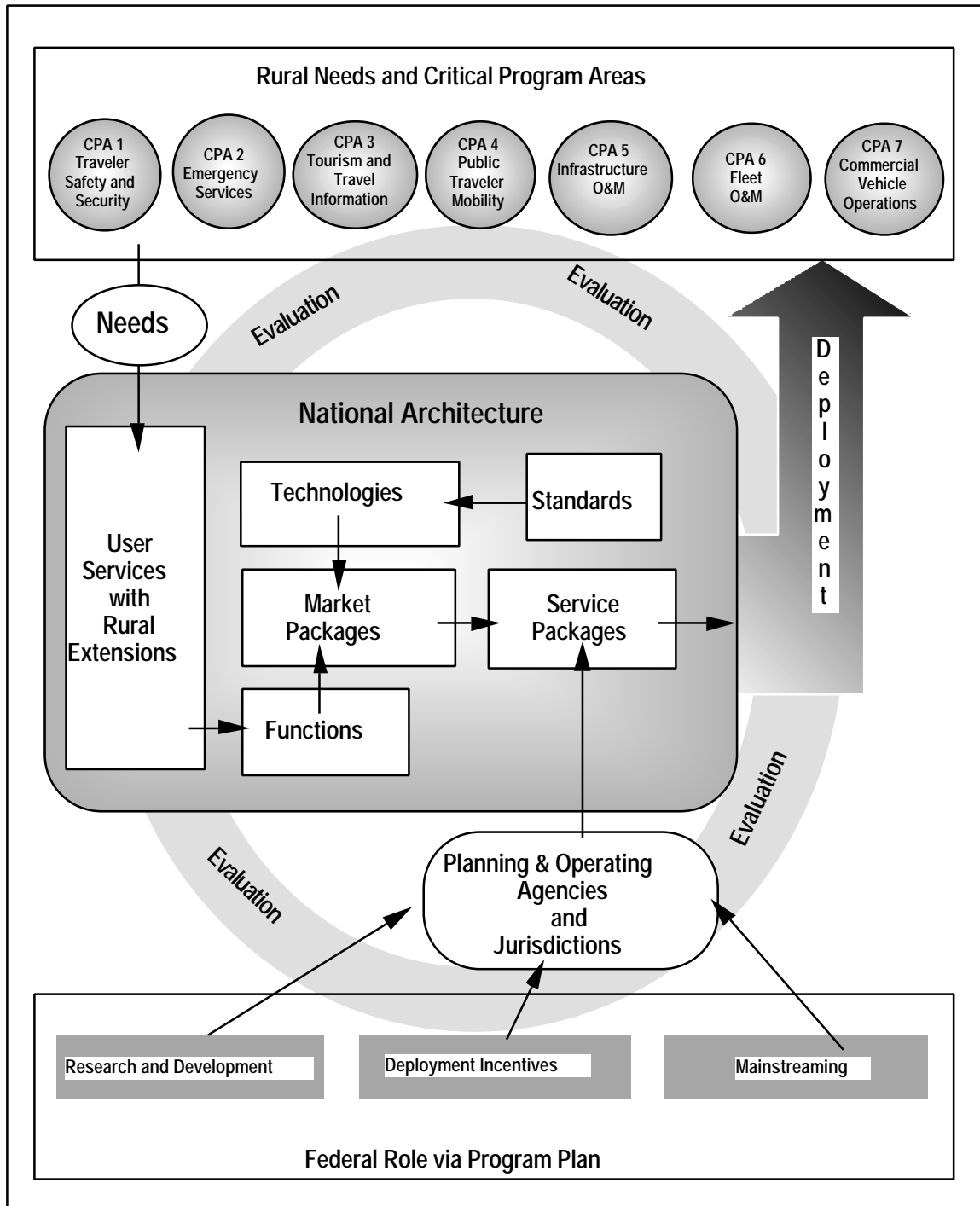
ITS development, including ARTS development, is needs driven. It applies technologies and system integration to meeting expressed needs of transportation providers and customers. Rural needs have been assessed through previous research and specific efforts of the Rural Action Team to involve constituents. The Strategic Plan organized the needs into Critical Program Areas (CPAs).

Needs within the CPAs are met by a list of ITS User Services that is controlled by the national architecture development. The User Services are then translated into functions that must be carried out, and the functions are the basis of system design.

Development of the ARTS will extend an interoperable ITS into rural environments. To do this efficiently and effectively requires that ITS design consider rural needs and conditions. This may result in modifications of a national design, localized adaptations of systems that remain interoperable, standalone rural systems, or just differences in how

systems are used and deployed. National ITS development has always included the ARTS, but it is the responsibility of this Program Plan to bring rural issues forward.

Deployment of ARTS via the Architecture and Program Plan



Needs in the CPAs ultimately will be met by deployments. In the architecture, Service Packages have been defined as modules that will be deployed by jurisdictional units. The ARTS Program Plan works primarily through public sector jurisdictional units for deployment of service packages. The private sector will be guided primarily by the architecture standards, although ARTS R&D will also contribute to specific rural solutions that may be deployed privately as well as by the public sector.

Evaluation provides effectiveness feedback to connect the needs, the architecture, deployments and the ARTS program. Technical evaluation of system performance will be conducted for prototype and field tests under the ARTS program. Otherwise, the main evaluation concerns for the ARTS program are in the effectiveness of program outputs meeting needs, defined as the program outcomes.

A Layering Concept

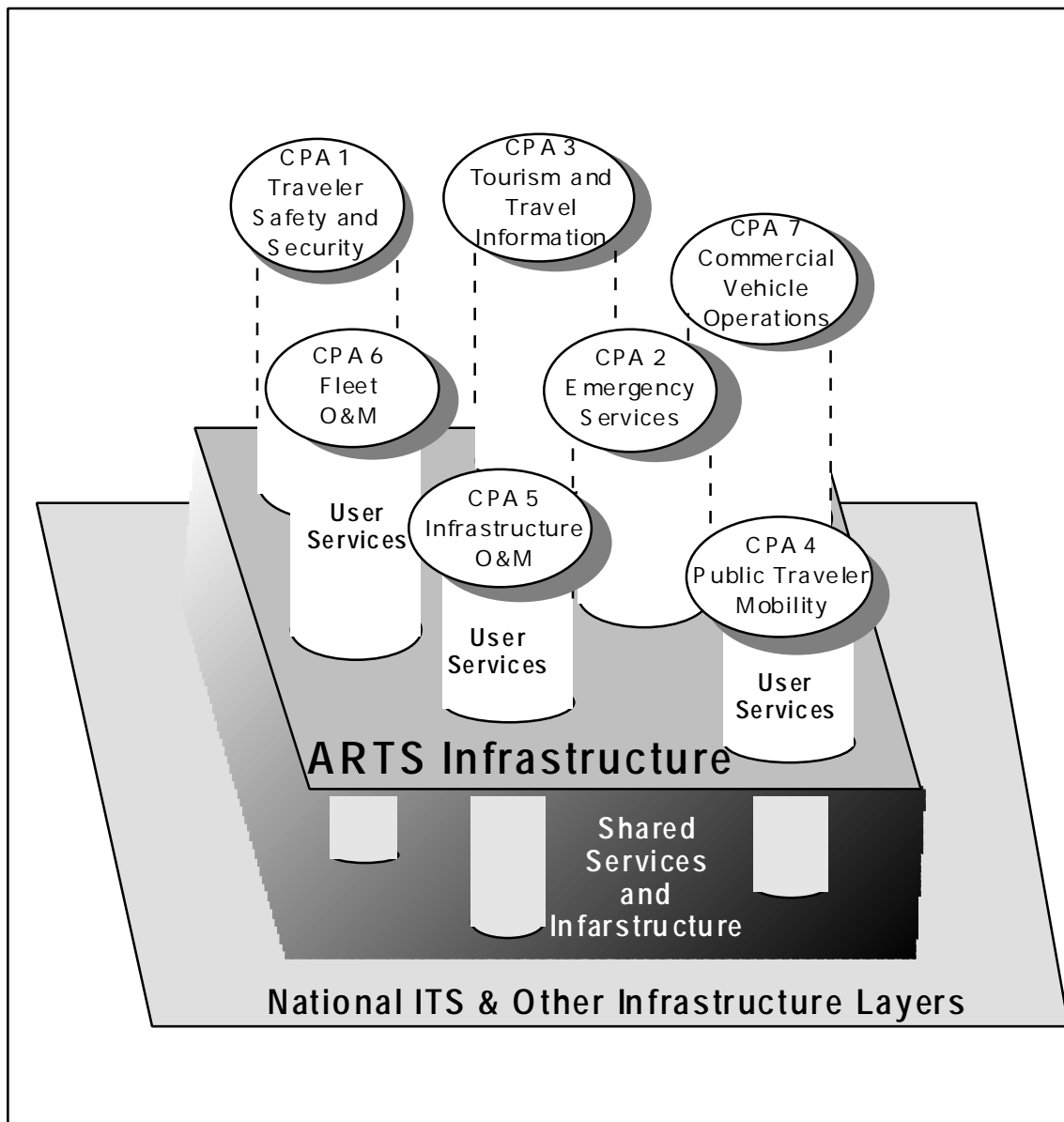
Various layering concepts are important to the architecture, and the ARTS program definition.

At the detailed and technical level, standards apply to interfaces represented by protocol layers. These protocol layers represent different aspects of a system and are specifically used for communications systems. The National ITS Architecture has defined transportation, communications and institutional layers—actually three kinds of systems that interrelate to create and operate the ITS.

There is one layering concept important to the ARTS Program Plan development. By analogy to protocol layers, there are lower layers that provide an “infrastructure” of communications, that is largely transparent to end users, but that allow the open deployment of the “application” layer that directly provides a service to the user. In this sense, highways are the infrastructure that allows “open” access to a variety of trips for user purposes. Communications infrastructure allows a variety of informational links between users. An institutional infrastructure supports programs that deliver services to users. The metropolitan ITS program has already defined its infrastructure. There is no strict definition for this infrastructure because it will mix concepts from various other layer constructs. In general, the ITS infrastructure components underlie applications that will deliver the user services. The infrastructure will be the focus of public sector programs and can be part of operating other public sector infrastructure, while the applications can be provided by the private sector and will be used directly by individuals. For instance “Freeway Management” is a metropolitan ITS infrastructure component, that relates to freeway control, but also produces information on freeway conditions that can then be processed and disseminated by a variety of private sector channels to individual travelers. Or, “Electronic Payment” is a common means (that probably will be provided by private sector financial institutions) to support any applications that use electronic fund transfers.

The figure below shows how the ARTS infrastructure is visualized. The ARTS infrastructure will be defined better by subsequent R&D under this Plan, and will be the focus of ARTS public-sector activities.

Visualization of the ARTS Infrastructure



The figure shows the ARTS infrastructure lying over, and a part of, a more general infrastructure. The ARTS infrastructure may be an extension of other ITS infrastructure into rural areas. The ARTS infrastructure will use communications infrastructure provided nationally, usually by private carriers, for its information transfers. The ARTS infrastructure serves rural transportation infrastructure, primarily highways and the transit service on highways.

User services are supported by the ARTS infrastructure. The user services represent the applications that meet the needs of the CPAs. In some cases, the user services may be distinctly rural and use a distinct ARTS infrastructure. In other cases, as shown by the “roots” of some user services down to the national infrastructure, the CPAs are served by

infrastructure and applications that are not distinctly rural. Further, there is no implication that distinct user services or ARTS infrastructure are fitted to each CPA. Rather, infrastructure and services may be common to many CPAs.

Defining the ARTS infrastructure must be done carefully in order to provide proper program focus, in addition to the needs-focus already provided by the CPAs. Therefore, the ARTS infrastructure will be defined along with the ARTS architecture as early parts of this Program Plan.

User Services

This Program Plan has traced the architecture development process from the needs in the CPAs, through User Services, to functions, as part of defining issues and knowledge areas. In the course of this, it was recognized that the ARTS emphasizes certain user services not readily characterized by the user services list controlled by the National ITS Architecture. In addition to the national set, the following user services have been defined for ARTS program development:

- **Portable Traffic Management.** The alleviation of traffic congestion, the improvement of safety and the minimization of environmental impact by means of traffic surveillance and control that is flexibly and speedily deployable, for highway and traffic conditions that are accidental, sporadic or seasonal.
- **Road Maintenance and Management.** The efficient maintenance and rapid repair of roads, including isolated and low-volume routes, for safe and structurally sound operating condition, especially under conditions of severe weather.
- **Seasonal Harvesting.** The coordination and management of intermodal transportation resources and agricultural production for timely and efficient harvesting of agricultural products.
- **Economic Development/Business Viability.** The improvement of transportation efficiency, the reduction of adverse transportation impacts, and the dissemination of information that sustains the viability and desirability of economic production and facility location.
- **Economic Development/Tourism.** The improvement of transportation efficiency, the reduction of adverse transportation impacts, and the dissemination of information that promotes compatible enjoyment of parks other tourist sites, and services to tourists.
- **ITS Planning and Marketing Data.** The collection and processing of information derived from the operation and evaluation of ITS, for purposes of adapting any component of the ITS architecture and promoting deployment of effective ITS solutions to transportation problems.

The table on the next page shows User Services versus CPAs. The additional ARTS user services are below the double line. This table shows that as the ARTS is traced into the

architecture, there is no one-to-one mapping between CPAs and user services. Rather, many kinds of rural needs can be served in common by some user services.

User Services (Extended) and ARTS CPAs

User Service	Critical Program Area (CPA)						
	1	2	3	4	5	6	7
Pre Trip Travel Information			★	★			
En Route Driver Information	★	★	★	★	★		★
Route Guidance	★	★	★	★			★
Ride Matching and Reservation			★	★			
Traveler Services Information	★	★	★	★			★
Traffic Control	★		★	★	★		
Incident Management				★	★		
Travel Demand Management			★	★	★		
Emissions Testing and Mitigation							
Public Transportation Management		★	★	★	★	★	
En Route Transit Information			★	★		★	
Personalized Public Transit			★	★		★	
Public Travel Security	★				★	★	
Electronic Payment Services		★					
Comm. Veh. Electronic Clearance							★
Automated Roadside Safety Inspection							★
On Board Safety Monitoring	★						
Comm. Veh. Admin. Process							★
HAZMAT Incident response					★		★
Commercial Fleet Management		★					★
Emer. Notification & Personal Security	★	★					
Emergency Vehicle Management		★			★		
Longitudinal Collision Avoidance	★						
Lateral Collision Avoidance	★						
Intersection Collision Avoidance	★						
Vision Enhancement for Coll. Avoid.	★						
Safety Readiness	★			★	★		
Pre-Crash Restraint Deployment							
Automated Vehicle Operation							
Highway Rail Intersection	★						
Portable Traffic management			★	★	★		
Road Maintenance and Management					★		
Seasonal Harvesting					★		★
Econ. Development (Business viability)			★				★
Economic Development (Tourism)			★				
ITS Planning and Marketing Data	★	★	★	★	★	★	★

CPA Functional Relations

The issues for this Program Plan were analyzed by defining user services and then functions under each CPA. In going through the functional analysis by CPA, the relation between the CPAs was made clearer. This is a first step in defining an ARTS architecture structure and also helps to set some ARTS infrastructure emphases.

The ARTS infrastructure is expected to be some combination of the transportation, communications and institutional layers of the National ITS Architecture. The figure below again shows the ARTS infrastructure on a more general infrastructure. The ARTS infrastructure includes its transportation layer, that is predominately the rural highway system that most of the CPAs and user services also lie on. Rail transit is not excluded, but most rural transit will be a service on the highway system (represented by providers in CPA 6 and riders in CPA 4).

The infrastructure concept also defines the centrality of CPA 5: Infrastructure Operations and Maintenance (O&M). This CPA, and its user services, operate the rural transportation infrastructure, and with it much of the other ARTS infrastructure. CPA 5 is qualitatively distinct from the other CPAs in this regard. It is also notable that the user service especially associated with CPA 5—Road Maintenance and Management—is not well represented in the controlled list of users services.

The rural highway system generates roadway and traffic data. This information will be useful and common to all CPAs through their association with highway travel. Highway patrol, maintenance and planning are operations that will be fundamental to the other CPAs through their association with the common highway infrastructure. CPA 5 represents the needs of the rural highway operators (state DOTs, local public works departments, occasionally federal agencies, and in some cases private road operators). Institutionally, the users associated with CPA 5 will be the, mostly public sector, entities collecting the road data and otherwise operating roads. These data provide an infrastructure for further packaging and disseminating highway information while the highways provide the infrastructure for other transportation activity. It is very likely that the same users in CPA 5 will be operating other ARTS infrastructure. CPA 5 therefore relates to every other CPA.

CPA 6—Fleet O&M—represents another “near-infrastructure” CPA that is central to other CPAs. Fleet operation may refer to the road maintenance fleets, road patrol fleets, emergency service fleets or transit fleets. While it can include commercial vehicle fleets, these are largely defined within CPA 7. Fleets can act as probes to generate highway condition data. Fleet O&M, although it can be associated with other CPAs, is rightly identified by itself since most fleet management needs are common, and some needs may be addressed by taking a more consolidated view of fleet management.

KNOWLEDGE AREA ASSESSMENT

The proto-architecture process carried out thus far leads to definition of ARTS knowledge areas—what is known and what remains to be researched. Findings are listed below and form the basis of creating the Plan activities and ARTS program outputs.

Summary Of What We Know and Do Not Know

In a detailed analysis, ARTS needs were derived from literature review, contracted research, and focus groups convened by the Rural Action Team. The needs were collated and organized around the CPAs. The needs were also mapped to an extended list of User Services. Within each CPA, each User Service and its associated need (that carried the rural specificity) was analyzed into a set of functions needed to conduct the User Service. By considering the functions within the particular rural operating context, it was ascertained whether means existed to provide the services, or whether outstanding issues remained before services could be delivered. The findings are summarized below, generally for the whole ARTS program, and for specific CPAs.

General Findings

<p>1. We know that most of the technologies needed for the ARTS exist, or are being developed for general ITS user services. The predominate problems are information dissemination, training, and financial resources for deployment.</p>	<p>We don't know how far an ARTS infrastructure can be extended economically, or how new technologies will affect extent.</p>
<p>2. We know that the rural perspective still needs to establish a strong involvement in architecture development and standards.</p>	<p>We don't know which architectural and standards issues will prove most critical to rural distinctions.</p>
<p>3. We know that there will be a wide variety of approaches to deployment of ARTS—building from an urban base, starting from a rural base, area-focused, or corridor-focused, etc.</p>	<p>We don't know how different the federal ARTS program approaches have to be in these various cases.</p>
<p>4. We know that rural needs have been a strong federal concern, and that rural areas contain large federal-domains where federal agencies will be ARTS operators.</p>	<p>We don't know the best way to achieve coordination between USDOT and the various federal-domain operating agencies on the ARTS.</p>

<p>5. We know that there is a rural highway safety problem, strongly perceived by users.</p>	<p>We don't know how best to direct ARTS efforts since accident causation is a complex issue.</p>
<p>6. We know that the emphasis of the ARTS program will be less on congestion than in the largest urban areas.</p>	<p>We don't know how best to adapt traffic control and its integration with regional systems for tourist peaks, seasonal events, rural places just below urban threshold, or rural areas on metropolitan fringes.</p>
<p>7. We know that many ARTS functions require good radio propagation for communications and positioning information.</p>	<p>We don't know how serious the problems are in mountainous areas, how much cellular communications will spread in sparse rural markets, or how soon low-orbital satellite systems will be affordable.</p>
<p>8. We know that there are serious economic issues for ARTS, raised by the sparseness and large distances of rural applications.</p>	<p>We don't know exactly how best to focus ARTS solutions to achieve operational efficiencies.</p>
<p>9. We know that provision of rural mobility is constrained by budgets.</p>	<p>We don't know if rural mobility can be guaranteed within budget constraints when ARTS provides service coordination and increased efficiency of operations.</p>
<p>10. We know that rural areas are institutionally diffuse for planning and mainstreaming purposes.</p>	<p>We don't know the best approaches for organizing ARTS planning in rural areas.</p>

Program Plan Issues by Activity Areas and CPAs

Although there are only three federal programmatic categories used for the ARTS Plan, these can be divided more finely into ten activity areas. The issues below are organized by activity area, and then by CPA. There are some issues general to the activity area, as well as those specific to CPAs.

Needs Assessment

CPA 1, Traveler Safety and Security: Requires more specificity in accident data and analysis to identify the nature and extent of the problems, and where and how technology may be effective to address these problems.

CPA 2, Emergency Services: The interface between public service answering points (PSAPs) and independent service providers (ISPs) for “Mayday” calls and emergency medical service (EMS) response should be better specified, with respect to specific accident characteristics, to identify where and how procedural changes or technology may be effective.

CPA 3, Tourism and Travel Information Services: Requires careful delineation of the federal role in local economic development, and towards which attitudes vary widely.

CPA 4, Public Traveler/Mobility Services: The dimensions of rural transportation disadvantage need to be assessed more precisely to focus remedies, and estimate their costs. It is not known whether it is feasible to guarantee mobility to the rural transportation disadvantaged, either by more federal/state resources or by extensions of services through operational efficiencies.

CPA 5, Infrastructure Operating and Maintenance: Better operational assessments are needed to define priorities for cost-effective technology applications in rural areas.

CPA 6, Fleet Operating and Maintenance: There are large potential public savings for coordination and consolidation (including with emergency services), but defining cost-effective technology applications requires more detailed operational assessments. The institutional capacity and barriers operators to adopt procedures and technologies must also be better assessed.

CPA 7, Commercial Vehicle Operations: Regulatory and operator needs are being assessed under the CVO program. Special rural issues need to be elaborated, primarily from shippers/local economic development, and public concerns about peak traffic of rural harvesting (these also fall under other CPAs).

Architecture/Functional Definition

General for all CPAs: Requires representation of the rural perspective to ensure that any unique rural opportunities or constraints are recognized. In many CPAs, tradeoffs between centralized and decentralized architectures (e.g., for TMCs) need to be analyzed by functional, reliability and economic criteria. Note: Issues raised here are primarily from a functional-description perspective since that is as far as the analysis was conducted. Other architecture issues that are uniquely rural remain to be uncovered.

CPA 1, Traveler Safety and Security: In safety-critical functions, there are issues of reliability, degree of automation, and user habituation or compensatory behavior. While the functions are not uniquely rural, their importance and feasibility differ in rural driving environments.

CPA 2, Emergency Services: Problems of emergency notification, and location-finding, are exacerbated in rural environments. The coordination of services is critical to cost and effectiveness, especially over large distances, where services are sparse, and in cases of

largescale disaster. This coordination must be achieved flexibly with respect to the nature of the emergency, requiring good characterizations of the incidents. Through emergency services, additional data must be collected necessary to evaluation and adaptation of ARTS safety-related applications. The degree to which vehicle and dispatching systems are common or unique to emergency services should be determined (based on mission criticality, etc.) since this has cost, standardization, and consolidation implications. The informational and functional relation including PSAPs and EMS responders must be designed to “close the emergency services circle” between caller, call receiver, dispatcher, mobile response and medical facility response.

CPA 3, Tourism and Travel Information Services: At the functional level, these services are largely covered in other CPAs and within the metropolitan program. Trans-local services (for travelers to or through a rural area) are not rural-specific. Local services (e.g., at parks) have some rural uniqueness beyond the functional level in terms of remoteness, terrain, low or periodic utilization, etc.

CPA 4, Public Traveler/Mobility Services: There is high commonality of functions with other CPAs, and with urban applications.

CPA 5, Infrastructure Operating and Maintenance: High commonality of functions with other CPAs, and with urban applications. Some functions of remote monitoring (e.g., road surface weather conditions, pass blockage by avalanches) may induce new datasets or standards into the architecture. Vehicle-based remote monitoring needs to be considered in the architecture. This CPA contains public-agency portions of advisories and traffic management, and these functions generally require regional or urban-rural integration.

CPA 6, Fleet Operating and Maintenance: Functions are entirely common with non-rural public transport and fleets, including maintenance monitoring, vehicle location/dispatching, guidance, and scheduling. Operational size will impose different constraints on technology adoption and centralization, and extent of highway infrastructure will limit feasibility of associated fixed facilities (e.g., embedded shoulder detection).

CPA 7, Commercial Vehicle Operations: Functions are, by nature, national in scope and will be represented by the CVO program. Specific rural concerns are contained in related CPAs, e.g., harvesting traffic under CPA 5.

Standards Development

General for all CPAs: Requires representation of the rural perspective to ensure that any unique rural opportunities or constraints are recognized. As for all of ITS, there is the issue of which standards require strong coordination, and which should be allowed to evolve through the market. There is a strong federal role in spectrum allocation as

affected by standards for radio communications, and in motor vehicle safety and equipment standards.

Applied Research

CPA 1, Traveler Safety and Security: Many safety-critical systems require technology development. In some cases these systems require the structured environment of automated highway systems (AHS), but in other cases the rural environment may simplify operational complexities of automated detection and decision, and make vehicle-based systems more feasible. Field evaluations of many existing technologies need to be conducted with respect to outcome effectiveness (e.g., resolution of safety problems).

CPA 2, Emergency Services: Useful technology already exists, but requires more operational testing in rural environments. The usefulness of vehicle-based technologies to provide better vehicle and occupant data on crashes needs to be evaluated. Technologies that enable PSAPs and EMS responders to close the emergency services loop better need to be tested.

CPA 3, Tourism and Travel Information Services: Most applications do not require applied research.

CPA 4, Public Traveler/Mobility Services: Most applications do not require applied research.

CPA 5, Infrastructure Operating and Maintenance: The extension of applications requires cost-reducing applied research. The need is for cheap, simple, reliable solutions along extensive and isolated rural roadways. This includes weather, pavement surface and subsurface data collection (possibly through in-vehicle probes), information dissemination and forecasting techniques that usefully improve safety and maintenance efficiency. The weather information is closely related to applications in other CPAs.

CPA 6, Fleet Operating and Maintenance: The technology largely exists, but cost is a major concern for small operations, and therefore is dependent on consolidations and technical assistance. The need is for low-tech, simple applications.

CPA 7, Commercial Vehicle Operations: The principle of cost effectiveness for carriers attracts private technology development. However, cost versus operational benefit is a different concern for small carriers. Public-regulatory criteria should foster applied research since it can greatly impact the extent and effectiveness of regulation.

Operational Tests

CPA 1, Traveler Safety and Security: Demonstrations are planned and underway. There is a problem of how to demonstrate safety-critical systems both safely and realistically, and there may have to be reliance on actuarial data for deployed systems.

CPA 2, Emergency Services: Demonstrations are planned and underway, and Mayday services exist commercially. It is an inherent problem to demonstrate effectiveness of systems for rare accidents where new problems may be uncovered. Demonstrations should be conducted on economic efficiencies of coordinating emergency and non-emergency transport. Systems a close the emergency services loop between callers, PSAPs and EMS responders need test and evaluation.

CPA 3, Tourism and Travel Information Services: There are many demonstrations planned and underway, but few are specifically rural, and the extent and type of rural applications needs more investigation.

CPA 4, Public Traveler/Mobility Services: There are many demonstrations planned and underway, or that were conducted long ago and need to be recognized. Many urban demonstrations of technologies are applicable, but the dimensions of operational- and cost-feasibility do need better definition.

CPA 5, Infrastructure Operating and Maintenance: Demonstrations are planned and underway. Applied research should add new techniques to be demonstrated. Some urban demonstrations of technologies are applicable, but the rural environment requires better definition of operational- and cost-feasibility do need better definition.

CPA 6, Fleet Operating and Maintenance: Some demonstrations are planned and underway. The rural environment requires better definition of operational- and cost-feasibility for techniques and organizational approaches of consolidation and coordination.

CPA 7, Commercial Vehicle Operations: There are many demonstrations planned and underway. The demonstrations are inherently national in scope, but the dimensions of operational- and cost-feasibility to small-carrier and rural operations (e.g., agricultural) do need better definition.

Delivery

CPA 1, Traveler Safety and Security: Liability is a major issue for safety-critical systems, and this is tied to regulatory requirements.

CPA 2, Emergency Services: Integration of dispatching, the ISP-PSAP relation, sharing of actuarial data, and coordination with non-emergency transportation are important issues with institutional resistance. Coordination of several federal agencies and their local counterparts must be tried.

CPA 3, Tourism and Travel Information Services: The National Park Service is an important federal player in tourism, but otherwise a federal role in local economic development must be defined carefully. Local interests versus integration of information services can lead to institutional issues.

CPA 4, Public Traveler/Mobility Services: Traffic management and public mobility services raise issues of appropriate jurisdictional integration and regionalization for achieving effectiveness and economy. This includes coordination issues among several federal agencies and their local counterparts involved in the delivery of health and human services through transportation.

CPA 5, Infrastructure Operating and Maintenance: State DOTs will be dominant players and should lead in planning ARTS and working out institutional arrangements. Often, there will be no sharp distinction between rural and urban, where both road systems are under state auspices or where traffic management needs to be conducted across the urbanized boundary. Discrete rural places may promote separate solutions needing integration later, especially in traffic management, as urban growth spreads.

CPA 6, Fleet Operating and Maintenance: State DOTs will be dominant players (both as highway operators and rural transit coordinators), but there is no one, existing, mechanism to bring all relevant fleets and providers together. Technical outreach to small providers (county or township departments) is essential.

CPA 7, Commercial Vehicle Operations: The public-sector regulatory and private-sector efficiency interests partly overlap and partly differ. Similarly for large versus small carriers. These define institutional issues and differences in how ITS can be mainstreamed. The role of ARTS in CVO will not be dominant, but may be indirect, through other CPAs (information to operators, safety on more remote rural roads, and traffic management of harvesting fleets).

Funding and Partnerships

General: Funding is always tight in the public sector, especially rural, and small markets limit the extension of private communications or other infrastructure.

CPA 1, Traveler Safety and Security: Requires that liability issues be addressed to gain private sector participation. In-vehicle systems that increase traveler security without significant liability (e.g., Mayday) are already penetrating markets. Public-private partnerships in road safety patrols will be fertile and may merit communications and dispatching integration.

CPA 2, Emergency Services: Public sector funding will be mostly outside of USDOT. Emergency services generally find funding and the issue is to identify priorities, especially for new technologies with uncertain impacts. Private operators of emergency

services (e.g., ambulances) must be included and they will participate where vehicle systems increase efficiency or reduce insurance liability.

CPA 3, Tourism and Travel Information Services: There will be high local and private interest in funding services. Public-private partnerships need to be defined carefully based on true public benefit.

CPA 4, Public Traveler/Mobility Services: There is inadequate funding for a public guarantee of rural mobility. Fiscal transfers necessary for increased mobility of the rural-transportation disadvantaged are federal and state prerogatives, but realistically the most will be accomplished by efficiency improvements of providers within budget constraints. This particularly includes efficient brokerage and service coordination for Medicaid and other federal/state human services programs. Private partnerships for funding of the transportation disadvantaged are not likely except through non-profit/charitable organizations. Operational approaches should include private paratransit.

CPA 5, Infrastructure Operating and Maintenance: There is inadequate funding for equal attention to all rural-route miles. Proper emphasis for defined highway systems (i.e., National Highway System or its functional subcategories), or by other attributes (e.g., volumes) must be established. Fiscal transfers for adequate rural mobility have always been a federal prerogative and the issue is continually reexamined in national programs. It is still vital to identify cost-saving technologies and consolidations, and extension to more route miles by efficiency improvements. Private partnerships not likely, except for loosely-related cases like trades of fiber optic service for granting public right-of-way.

CPA 6, Fleet Operating and Maintenance: See both CPA 4 and 5 for the public transport and other fleet (e.g., highway maintenance) issues. Private partnerships not likely.

CPA 7, Commercial Vehicle Operations: There are distinct public and private deployment funding issues, that will be addressed mostly outside of ARTS. ARTS can have an impact through technologies and operations that change regulatory cost-effectiveness in rural areas (particularly off the Interstates) and thereby promote more public sector effort. Partnerships with carriers are vital in developing acceptable regulatory requirements (meaning small if not reduced cost to compliant carriers).

Information Dissemination and Training (ID&T)

General: The Rural Transportation Assistance Program (RTAP), the Local Transportation Assistance Program (LTAP) and the overall structure of the federal-state partnership in highway programs instituted in the American Association of State Highway and Transportation Officials (AASHTO) are important mechanisms for rural technical assistance and outreach. Many other federal agencies have specific rural interests and presences related to transportation and must be coordinated in the ID&T role.

CPA 1, Traveler Safety and Security: For new systems, that are safety-critical, it is premature for ID&T while more R&D is needed. Safety issues related to road design are continuously instituted in engineering and planning standards. Information systems should be treated jointly with other CPAs (especially 2, 3 and 5).

CPA 2, Emergency Services: Activity is needed where emergency service issues intersect with non-emergency public transportation or highway patrol issues intersect. This includes ID&T on practices to promote shift of services from an emergency to non-emergency basis. Since LTAP and RTAP do not normally reach PSAPs and EMS providers, the most appropriate outreach means must be identified.

CPA 3, Tourism and Travel Information Services: Issues of economic competition may make it desirable to avoid a dominant federal role, except for NPS and other federal domain sites.

CPA 4, Public Traveler/Mobility Services: A great need exists to disseminate proven technologies and operational practices to small operators and rural regions, to provide consolidated technical support, and to establish low-tech information sharing (e.g., fax-network) among agencies to fulfill mobility needs. Need to enhance RTAP and LTAP roles in this, and enlist private agencies.

CPA 5, Infrastructure Operating and Maintenance: Greatest and traditional role for LTAP, with a need to improve capabilities for ARTS technology areas by better training of the LTAP cadre.

CPA 6, Fleet Operating and Maintenance: See CPAs 4 and 5 for public transportation and infrastructure agencies, respectively.

CPA 7, Commercial Vehicle Operations: State regulatory agencies benefit from continued LTAP and regulatory agency assistance. Can expect mainly private, profit-driven, dissemination among carriers and shippers, but they have to be informed of regulations through public sector. Smaller carriers need more attention.

Evaluation

General: The federal program requires improved data feedbacks to assess and adapt federal programs in the ARTS. Basic data are reported through normal channels associated with accident reports and grant requirements. Special federal data collection (e.g., through the National Passenger Transportation Study) is expensive. Augmented data collection, especially of an actuarial type for safety systems, is needed and requires more data sharing with private agencies and more data collected by local public agencies. The ability to require this is always limited, but can be incentivized through grants programs. A careful review of data requirements should be undertaken to get the most value for ARTS with minimum cost and local burden.

CPA 1, Traveler Safety and Security and CPA 2, Emergency Services: There is an inherent problem of timely outcome analysis for systems that affect accidents. Actuarial data becomes valid only over large samples, and time periods. Also, there is high risk in implementing some safety critical systems with only preliminary effectiveness or fault evaluation. Better means for forecasting impacts and reliability as a means to select among alternatives is needed.

Existing Projects and Research

ARTS and ARTS-related research and projects have occurred before formalization of this Program Plan. This makes it necessary to collate several sources as the foundation for further efforts under this Program Plan. This was done in a compendium by the FHWA Office of Research and Development¹. The compendium combed eighteen (18) sources, including the existing USDOT listing of ITS projects², program lists and individual project reports. A total of 167 projects with relevance to the ARTS was identified. Most of these projects were undertaken within the last three years and most are still in progress. The projects are being classified and matched to ARTS research issues (the “don’t know”) in a database to provide the baseline of further ARTS research.

A related effort is being performed under contract to FHWA to compile “Simple Solutions” for the ARTS from existing experience. This work has so far discovered 56 projects that are being further culled for examples that will be publicized.

The mass of information and the previous lack of central ARTS oversight make it clear that not all the relevant information from existing projects, and perhaps a wealth of prior knowledge, can be extracted and used here. This suggests that the Program Plan provide

¹ “Compendium of ARTS and ARTS-Related Projects”, Eileen Singleton, Traffic and Driver Information System Division, Office of Research and Development, FHWA, Nov. 8, 1996.

² “Intelligent Transportation Systems (ITS) Projects”, USDOT, ITS Joint Program Office, January 1996.

for ongoing research and project results abstraction, through conferences and contracted surveys. Then results of this work will feed the Information Dissemination and Training (ID&T) efforts, ensure that the same ground is not covered twice in future projects, provide more issues to be researched, and become part of the evaluation feedback to ARTS management.

PLAN PRIORITIES

This Program Plan moves from the national ITS policies and goals, through the ARTS Strategic Plan, to specific activities. This section sets the priorities of federal activities in the ARTS as the basis for Plan elements.

Prioritization Indicators

Preliminary prioritization of the Program Plan activities and projects has occurred under previous ATIS and APTS activities using preference indicators from consumer surveys and focus groups. Efforts are continuing to collect user and provider group data that will indicate priorities, especially for transit.

The analyses of ATIS user needs resulted in a numerical prioritization for types of ATIS information (in rank order)³:

- Mayday—medical
- Vehicle activity—collision
- Vehicle activity—speed
- Mayday—mechanical
- Vehicle conditions
- Driver conditions
- Road closures
- Weather conditions
- Diversion
- Roadway geometrics
- Weather and visibility
- Routing
- Construction and maintenance
- Incidents
- Lodging and restaurants
- Tourist attractions
- Assistance services
- Road conditions
- Travel time
- En route facilities
- Recurrent congestion

Several service/technology concepts were evaluated to meet the expressed needs, according to criteria of commercial viability, related projects or products, and benefits.

³ “Rural Applications of Advanced Traveler Information Systems (ATIS)”, JHK and Associates, for FHWA, August 1995.

Also, major issues associated with each concept were defined and discussed with the project Expert Panel. These issues include⁴:

- effectiveness in meeting user needs
- standardization requirements
- deployment
- technical complexity
- cost liability

As a result of the evaluation, specific projects have been prioritized for development, listed below in order of priority⁵:

1. Work Zone Delay Advisory Systems (WZDAS)
2. Electronic Flare Warning System
3. Read-Only Portable Tourist Information Systems (PTIS)
4. Comparative analysis of selected satellite communication systems for rural Mayday applications.
5. Real time interactive kiosk development and field test
6. In-vehicle safe speed head-up display

These projects are being addressed at various stages through the Program Plan. An extensive needs survey and weighting was performed for Minnesota DOT as part of the Polaris ITS Partnership. One result was a ranking of traveler wants and needs according to a weighted of importance and satisfaction, as in the following ranked list (most priority is first)⁶:

1. Fair, aggressive, law enforcement
2. Timely, accurate road construction, maintenance information
3. Free of stressful experiences
4. Get help quickly in event of accident, emergency, breakdown
5. Timely information on alternatives to avoid delays
6. Timely, accurate accident, traffic and congestion information
7. Timely, accurate weather and road conditions
8. Safe from accident, injury, theft and violence

⁴ Pg. 2-5, JHK and Associates, op. cit.

⁵ Pg. 4, Rural ATIS Action Plan, Priority Action Items, JHK and Associates, November 13, 1995.

⁶ "ITS Architecture Wants and Needs Analysis", Appendix C, Prepared for MNDOT by Lockheed Martin Federal Systems, 24 May, 1996.

9. Best route plan based on specified criteria
10. Choice of travel modes
11. Clear, timely directions to follow desired route
12. Good value for cost
13. Get to destination directly without unnecessary stops, delays
14. Easy access to comprehensive travel services and information
15. Able to make good use of travel time
16. Travel mode is available wherever needed
17. Travel mode is available whenever needed
18. Comfortable and easy to use

Problems with rural transit that can be addressed by Advanced Public Transportation Systems (APTS) have long been identified. In 1985, Congressional Oversight hearings identified the lack of coordination among agencies involved in rural transportation, and this continues federal involvement from the 1970's. As a result, the USDOT and DHHS again took initiative to coordinate their provider, agency and client support programs involving transportation. Some recent APTS research has characterized, but not prioritized, complaints from travelers using public transportation in rural areas⁷:

- No transit service in isolated rural areas.
- Lack of information or misinformation about existing services.
- Confusion about who to call for information.
- No weekend or evening services.
- Bus service available only on specific days.
- Negative images associated with public transportation.

From the rural transit provider perspective, needs have been identified including:

- Efficiency and economy of transit services, including the coordination of existing services.
- Higher quality, more responsive public transit services (such as real-time scheduling for route deviation services and other demand-responsive options).
- Coordinated traveler information systems.
- Improved safety and security with monitoring and faster emergency response.
- Transit as a viable alternative to the auto in rural congested areas (tourist areas, etc.).
- Better transit fleet management using the latest technologies.

⁷ Report by EG&G Dynatrend to FTA, January 29, 1996.

APTS benefits have already been documented, but primarily not in rural contexts, and many developmental questions remain regarding feasibility and effectiveness of ITS for typically small providers in rural environments. The benefits sought include:

- Reduced capital cost by requiring fewer vehicles to service the same or greater population.
- Reduced operating and maintenance costs by automatic versus manual information, reservations, dispatching, accounting and billing
- Reduced vehicle hours per passenger served, through more efficient dispatching, driver route guidance, and customer alert of demand service arrival.
- Increased level of service through coordination and sharing of services of multiple providers in the same area, to make better use of existing resources.
- Ability to provide route-deviation service
- Wider information dissemination on travel services and opportunities for the transportation impaired
- Increased safety and security for passengers and in case of accident
- Dispatching of the appropriate vehicle to meet the client's needs
- Identification of the traveler, if subsidized service is provided, with validated fare payment and recording of trip
- Billing services where cash is not used.

ARTS Priorities Over Time

The emphasis in the activity areas will shift over time as the ARTS program matures. The exact scheduling of the Program Plan will depend on many factors, including the baseline of projects, program management capabilities, approved budgets and the nature of the projects themselves. Broad priorities will be set in three time horizons: a Near Term for the first half of the 5-year Program Plan period, Mid Term for the second half, and Long Term to the end of the 12 year Strategic Plan horizon.

Near Term Priorities

In the next three years, the ARTS Program Plan should focus on:

- N-1. Completing a compilation of ARTS-related needs through publication of program documents for review, and feedback from constituencies. Define safety needs at the next level of detail.
- N-2. Ensuring the recognition of unique rural needs by establishing a review and participation role in national architecture and standards activities. Defining the ARTS infrastructure.

- N-3. Using allocated funding to address outstanding applied research issues while continuing to keep the R&D pipeline full through establishment of the technology monitoring process.
- N-4. Using allocated funding to carry out outstanding proposals for pre-deployment implementations, while rapidly imposing the discipline of a formal Test Plan for each project.
- N-5. Initiating planning conferences at state levels across the country for mainstreaming and identification of institutional issues.
- N-6. Establishing cooperative relations with other federal agencies that have a role in ARTS, particularly in deployment in federal domains in rural areas.
- N-7. Making preliminary policy input for ARTS funding in the cycle for the federal-aid transportation legislation that will come early in this period.
- N-8. Devising initial procedural guidance for ARTS planning, and revising federal-aid regulations as required.
- N-9. Compiling simple solutions for the ARTS and basic information on the ARTS from existing sources and disseminating them widely through LTAP, RTAP, publications and conferences.
- N-10. Including rural techniques and ARTS expertise in the ITS Professional Capacity Building Program.
- N-11. Compiling a simple Toolbox of techniques for ARTS mainstreaming.
- N-12. Finalizing the initial output and outcome measures. The evaluation and data compilation channels necessary for evaluating those measures will be put in place.
- N-13. Updating the Program Plan and managing the other activities. Adding members to the Rural Action Team as the nucleus of the ongoing ARTS Management.

Mid Term Priorities

Over the 3 to 5 year horizon, the ARTS Program Plan should focus on:

- M-1. Involving ARTS in a mature architecture mainly by inclusion of new technologies and ensuring conformity of the ARTS with the national architecture. Developing lower levels of architectural detail for the ARTS infrastructure.
- M-2. Addressing standards issues that arise from experience with deployments and integration of the ARTS infrastructure and services, through established committee participation.
- M-3. Keeping the R&D pipeline full through the technology monitoring process, and generating a thin but steady stream of R&D projects.
- M-4. Implementing the formal Test Plan approach to change pre-deployment projects from opportunistic and proposer-driven to issue-resolution driven.
- M-5. Moving earlier R&D projects into field tests and deployment readiness.

- M-6. Focusing R&D, deployment incentives and mainstreaming on higher levels of ARTS infrastructure and services integration, and extending the ARTS to more difficult rural environments, as determined by the bounds of economic and operational feasibility.
- M-7. Maturing ARTS planning capabilities at the state level, including curricula to be made a permanent part of the National Highway and Transit Institute curricula. Inter-federal agency cooperation will have been formalized and joint planning efforts will be continued for ARTS deployments in rural federal domains.
- M-8. Making ARTS input to the USDOT budget allocation process and through the Program Plan, on an annual basis. Federal-aid deployment funding will have been essentially established by the authorization that should occur in 1997.
- M-9. Disseminating the best approaches for partnerships through ID&T. Public-private partnerships will emerge from the ARTS services pre-deployments and deployments.
- M-10. Developing LTAP, RTAP fully to aid planners and operators of ARTS deployments. Training for the outreach cadres will be formalized and made part of regular staff development and induction curricula. The Toolbox of techniques will be added to annually.
- M-11. Effecting the evaluation and data compilation process under GPRA. An annual cycle of internal performance review will be established in-phase with annual updates of the Program Plan.

Long Term Priorities

Over the 6 to 12 year horizon, the ARTS Program Plan will be extended and will respond to new information. In general, all the activities that matured in the last time frame will be ongoing. In addition, it is expected that some long term priorities will include:

- L-1. Consideration of new technologies, policies or external constraints that may change the scope of needs. These include telecommuting trends and urban design initiatives.
- L-2. Periodic updating of the National ITS Architecture, usually with minor changes, and infrequently by modifying large parts of its structure under changes in technologies or operational contexts. The ARTS organization and its constituents will have an established identity to participate in these revisions.
- L-3. Continued addressing of standards issues, that are expected to keep emerging, through established committee participation.
- L-4. Keeping the R&D pipeline full through the technology monitoring process.
- L-5. Continuing to generate pre-deployments tests, in response to R&D progress and contextual changes. Emphasis will change from testing technical packages to pressing the bounds of economic and operational feasibility. An ARTS database will be compiled and accessed through consolidated USDOT and other federal database systems.
- L-6. Continuing to adapt the ARTS portion of the planning process as different processes, different models, and different allocations of responsibilities arise in

- the planning process. Transportation planning in general will go through technical, policy therefore procedural, changes in the long term.
- L-7. The ARTS program will play an early and vigorous policy role in the third generation of ISTEA authorization. There are likely to be novel policy issues requiring participation and analysis. Deployment of the ARTS infrastructure will approach roughly a midpoint of completion—the easiest and most cost-effective parts will be done, and the rest will put additional pressures on funding, technology and planning technique. The more infrastructure that is completed, the more ARTS services will be overlaid, raising ongoing integration and partnership issues.
- L-8. Shifting the long term ID&T role as deployment matures. Techniques and training will become more institutionalized within the professions and deploying agencies. The federal role will become less active except where innovations are needed. The Toolbox will become increasingly provided through non-federal auspices, including commercially.
- L-9. Intensifying the evaluation and data compilation process under GPRA as the program becomes more feedback-driven. As the ARTS matures and becomes more complex, it will be harder to see causal links, and more analysis of evaluation measures will be required. ARTS effects also will become less isolated as the entire ITS integrates and the ARTS evaluation will be absorbed by a larger domain of “infrastructure policy” evaluation.
- L-10. Embarking on the next Strategic Plan update in addition to the annual Program Plan update through program support. A completion of the ARTS infrastructure may not be definable, but substantial completion probably will take at least 20 years. The ARTS program should persist for that long, and will change substantially in its second decade.

OUTPUTS AND OUTCOMES OF THE PLAN

The Strategic Plan defines the GPRA framework and defines the higher level directives required by this framework—the Vision, Mission, Goals and Objectives. The goals and objectives are outcome statements. For the purposes of Plan development, the goals and objectives are set against the program categories to devise outputs under each category that are likely to promote the desired outcomes.

Outputs, Outcomes and CPAs

The development of ARTS program outcomes derived from consideration of the needs under the CPAs. The outcomes also relate to the more general national ITS program outcome measures. In defining Plan outputs, it is desirable to retain the traceability to the CPAs as well as to outcomes.

The step of defining outputs also represents the transformation from a needs-focus to a system- and program-category focus. As such, no unique mapping between Plan activities and outcomes or CPAs is expected. This is true in the table below, as it is for the Plan matrix later where individual activities are indexed to CPAs. Also, the relation of activities to CPAs is not straightforward because of a hierarchical relation among the activity areas. An activity like architecture development in R&D obviously affects all CPAs, although a specific field test may address a CPA.

Among the three program categories of R&D, Deployment Incentives and Delivery, the first and third are most important to relate to outcomes and CPAs. Deployment Incentives are concerned with promoting the deployment of solutions otherwise believed to result in serving needs through outcomes. The Deployment Incentive activities are driven more by the results of R&D and Delivery than by the original needs and outcomes.

ARTS Activities Related to Outcomes and CPAs

Goal/ Objective	CPA	Research and Development	Delivery
Safety & Security			
Reduce # of crashes	1,5	Vehicle, driver and roadway safety systems: Research technical and enforcement issues. Improve efficiency of highway O&M to decrease unsafe conditions. More research to characterize accidents and causal factors.	Increase feedback of incident data for safety analysis. Improve interface of safety systems with highway design.
Reduce freq. of crashes	1,5	Ditto above.	Ditto above
Reduce severity/fatalities	1, 2	Incident detection, response dispatching, diagnosis and hospital-readiness systems.	Instill more extensive communications for detection, response and treatment among all

		Communications for emergency notification in remote and rugged areas. Cooperation between characterization of accident morbidity and trauma research.	parties in highway use, operations, emergency response and trauma treatment. More publicity on relation of response to survivals for all agencies involved in hwy. ops. and emergency service.
Reduce exposure to unsafe situations	1,3,5	Comm. systems that increase service coverage, especially to remote areas, for surveillance and warnings. Better forecast & detection of adverse weather.	Establish process for local police assessment of tourist danger areas for inclusion in traveler info. services. More consumer and PSA publicity on unsafe conditions, how to get help.
Mobility/Convenience/Comfort			
Increase % of Pop. with available transportation	4	Technologies that increase cost effectiveness of public transportation services. Technical and institutional means to coordinate fragmented services. Accountable and automated user-side subsidy systems.	Use federal grants to promote coordination of service and transportation. Mobilize human service agencies to identify and refer the mobility impaired to transportation services. More training and technology support for smallest providers.
Efficiency			
Increase throughput, decrease delay	3,5	Traffic management systems. Faster and more reliable traffic/road condition updates tied to route guidance.	Instill more awareness of traffic. mgt. systems in highway planning. Promote urban-rural and interstate coordination of traffic mgt. info. and control. Upgrade traffic mgt. curricula for latest ARTS approaches. Sponsor joint urban/rural coordination. conferences.
Improve incident response time	2,5	Improved detection/ characterization and response guidance, especially in remote areas. More cost effective communications and reliable surveillance to extend detection.	Promote more intensive info. transfer between response agencies. Promote equipage of vehicles with location/ guidance systems. Sponsor confs. for all agencies involved in hwy. ops. and emergency service.
Reduce travel time	3,5,6,7	Faster and more reliable traffic/road condition updates tied to route guidance.	Increase tie-in of hwy. and other modal O&M info. with traffic. mgt. and traveler info systems. Increase awareness of effective systems among agencies and consumers.
Economic Vitality/Productivity			
Improve O&M resource mgt. and allocation	5	More cost effective methods for monitoring, repairing and replacing O&M assets. More reliable prediction of roadway plowing, salting, repair needs.	Foster better asset management in state and local DPW operations. Promote consolidation of services. More training curricula for asset mgt. for O&M managers. Fund a technical service program for efficiency audits and improvement.

Improve fleet mgt.	6	More cost effective methods for monitoring, repairing and replacing fleet assets.	Ditto above.
Improve economy of rural areas	3,5,7	Any technology that preferentially serves rural locations and transportation access, or that increases efficiency of services in remote, low density areas.	Since this is place-competitive, federal role in promotion has lower priority than state and regional promotion.
Environmental Conservation			
Reduce SOVs	3,4	Technologies that make pricing incentives for HOV more practical. Technologies that spread use of intermodal information in pre-trip planning.	Encourage via planning and regulatory requirements of federal aid programs. More consumer info. on alternatives. Activities to bring hwy. and other modal operators together.
Reduce VMT	3,4	(See Reduce SOVs, and all Efficiency) Technologies that promote comm. in place of travel.	Consumer and provider info. on availability and impact of tele-services.
Improve HAZMAT response	2,5	(See Improve Incident Response Time.)	(See Improve Incident Response Time.)
Reduce emissions/trip	3,4,5	(See Reduce SOVs)	(See Reduce SOVs) Also more consumer sensitization to environmental impacts of tourism through NPS etc.

ARTS PROGRAM PLAN MATRIX

The ARTS Program Plan activities and projects are shown in a table. The rows of the table are the program areas. The columns are the fiscal years 1997-2001, the five year horizon of this Program Plan. Fiscal year 1997 is the spending plan that is already approved.

Within each activity area/year cell, each activity or project is formatted with the following information:

Key to the cells:

FY-AA-N—The project number with the fiscal year, the program category number (matrix row number), then a project sequence number within the cell.

•**Project Title - Status** (Completed, in-progress or new start, duration)

•Description of the proposed project

• The Outcome and CPA indexing code in format [M1, M2...:N1, N2...]

In the Outcome and CPA indexing code, M is an Outcome code (possibly more than one) and N is a CPA number (possibly more than one). See number codes below. For the activities that cover all CPA and outcomes, the code will be [all:all].

The CPA numbers are as enumerated in the Strategic Plan:

1. Traveler Safety and Security
2. Emergency Services
3. Tourism and Travel Information Services
4. Public Traveler Services/Public Mobility Services
5. Infrastructure Operating and Maintenance
6. Fleet Operating and Maintenance
7. Commercial Vehicle Operations

The Strategic Plan objectives are coded as follows:

Goal/ Objective

1. Safety & Security
 - 1.1. Reduce # of crashes
 - 1.2. Reduce freq. of crashes
 - 1.3. Reduce severity/fatalities
 - 1.4. Reduce exposure to unsafe situations
2. Mobility/Convenience/Comfort
 - 2.1. Increase % of Pop. with available transportation
3. Efficiency

- 3.1. Increase throughput, decrease delay
- 3.2. Improve incident response time
- 3.3. Reduce travel time
4. Economic Vitality/Productivity
 - 4.1. Improve O&M resource mgt. and allocation
 - 4.2. Improve fleet mgt.
 - 4.3. Improve economy of rural areas
5. Environmental Conservation
 - 5.1. Reduce SOVs
 - 5.2. Reduce VMT
 - 5.3. Improve HAZMAT response
 - 5.4. Reduce emissions/trip

The page preceding the Plan matrix is a condensed “Roadmap” of the Plan. This gives the activity titles by year and program category.

Insert Roadmap here

ARTS Program Plan Matrix—FY 97 through FY 01

Program Area	FY 97 (budgeted)
<p>Research and Development</p>	<p>97-1-1 <u>Surface Transportation Weather Information Project</u>, new start. Formulate a program and requirements to promote better decisionmaking with improved weather and road condition information, achieved by integrating the Roadway Weather Information System (RWIS), other weather information sources (e.g., National Weather Service), and ITS-based transportation management activities. Will be used to develop requirements within the National ITS Architecture. Measure the operational cost savings, from better decisionmaking due to improved weather and road condition information, for a rural part of the transportation system and compliant with the National ITS Architecture. [1.all, 4.1:1,5]</p>
	<p>97-1-2 <u>Rural APTS Needs Study</u>, ongoing. A needs assessment of rural transit operators and users that was initiated in FY 1996 will be completed. [2.1, 4.2:4, 6]</p>
	<p>97-1-3 <u>Rural Applications of ATIS</u>, ongoing. 1. Evaluate the effectiveness of satellite communications, over wide areas and in challenging rural terrains, for transmitting MAYDAY messages. 2. Evaluate the effectiveness of portable work zone changeable message signs (CMS) in reducing work zone accidents and expediting traffic. [1.all, 3.1:1,3,5,7]</p>
	<p>97-1-4 <u>APTS Operational Field Tests</u>, ongoing. 1. Evaluate the use and cost savings of using mobile data terminals (MDTs) and automatic vehicle location (AVL) for dispatching rural transit vehicles (Sweetwater County, WY/UT). 2. Demonstrate cost savings and service improvements from a coordinated human services transportation system (Northern FL panhandle). 3. Build upon an intelligent transportation infrastructure, adding MDTs and electronic fare transactions to demonstrate integrated transit service for the public and human service agencies (Cape Cod, MA). [2.1, 4.1:4]</p>
	<p>97-1-5 <u>Tourism and Traveler Information Systems Field Test</u>, new start. Test effects of advanced and integrated systems on safety, efficiency, environmental impacts and local economies. Also evaluate opportunities for public/private partnerships and the self-sustainability of systems. [1, 3, 4, 5:3]</p>

	<p>xx-x-x <u>Evaluation of Operational Tests and CPA Integration</u>—Ongoing Not separately funded under ARTS. Umbrella evaluation contracts that include rural tests and rural integration projects.</p>
Deployment	None
Delivery	<p>97-3-1 <u>ARTS Strategic Plan Coordination Workshops, New Start.</u> Fund 4-5 regional workshops for headquarters, field and local transportation agency staff, as well as non-governmental interests. Will promote and receive feedback to proposed ARTS program. [all:all]</p> <p>97-3-2 <u>ARTS Simple Solutions, Ongoing.</u> Disseminate to practitioners a collection of case studies that represent tried and generally practicable approaches to applying ITS solutions to rural operational problems. [all:all]</p> <p>97-3-x <u>Develop Deployment Incentive Guidance, new start.</u> Part of program support, to develop guidelines to be used by applicants for deployment incentive grants.</p>

Program Area	FY 98
<p>Research and Development</p>	<p>98-1-1 <u>ARTS Critical Program Area (CPA) Definition</u>, new start for 3 year duration. This project will further define each CPA to derive an ARTS architecture, ARTS infrastructure requirements, research plan and operational test plan. Awards for individual CPA studies as well as integration studies will be made. Task objectives include: 1. Create a component of the ARTS Toolbox that includes the definition of each CPA as the organizing theme, and that will allow local planners to translate their transportation needs into ARTS solutions. 2. Develop a methodology and provide an initial benefit-cost estimate to prioritize deployment of rural ITS components. 3. Define rural user services and translate them for each CPA into functional requirements. Evaluate the National ITS Architecture to determine if the rural functional requirements are properly addressed. Identify standards issues and coordinate them with the existing standards development efforts. 4. Group similar functions across clusters and identify the required public infrastructure. Develop a methodology for tracking the deployment of the rural infrastructure components. 5. Develop a long term research plan based on the identification of unmet requirements for meeting needs in each CPA. 6. Identify and prioritize operational testing issues and create an Operational Test and Evaluation Plan containing recommended projects and evaluation methodology. [all:all]</p>
	<p>98-1-2 <u>Surface Transportation Weather Information Project</u>, ongoing.</p>
	<p>98-1-3 <u>Tourism and Traveler Information Systems</u>, ongoing. Additional technologies and levels of integration will be tested based on further research and rural infrastructure definition.</p>
	<p>98-1-4 <u>Emergency Services</u>, new start. This project will combine communications technologies, AVL and dispatching methods with improved institutional arrangements between ISPs, PSAPs and EMS, to reduce response times, decrease morbidity and fatality, and improve the efficiency of emergency services in remote and rugged rural areas. Traveler MAYDAY service, direct emergency calls and calls from patrol agencies will be included. [1.3, 3.2, 5.3:2]</p>
	<p>98-1-5 <u>Traveler Safety and Security</u>, new start. Rural accident and incident data will be analyzed to define high priority demonstrations of available technology and methods will be identified and</p>

	<p>selected for conduct. An evaluation methodology that considers the need to measure impact on relatively rare accident events, and where accident data are often scant, will be developed. Promising developmental or conceptual technologies that can be effective will be identified for further development. [1.all:1]</p> <p>98-1-6 <u>Rural Public Mobility</u>, ongoing. Methods will be demonstrated to increase the population of the mobility impaired that is served and to increase overall transit and paratransit ridership of one or more rural areas, through operational efficiencies from application of APTS technologies, improved operational procedures, coordination of multiple transportation providers, and brokerage of client transportation with third party payment. An evaluation of the increase in service delivery to rural residents in need of non-emergency health and human service agency treatment will be included. [2.all, 4.all, 5.1:4,6]</p> <p>98-1-7 <u>Rural Highway Operations and Maintenance</u>, new start. Rural highway departments, representing different operating environments, will be analyzed to identify the operations where improved technologies, procedures and coordination of resources can reduce costs, and increase effectiveness within budget constraints. High priority demonstrations of available approaches will be identified, and selected for evaluated tests. The demonstrations will include a range of capital-intensity and suitability for operations of different sizes and extent of roadway. Technologies, procedures and institutional coordination will be tested to improve the management of traffic in a rural area subject to event-related and seasonal traffic peaks, and that involves multiple jurisdictions including interfaces with metropolitan areas. [3, 4.1, 5:3,5]</p> <p>98-1-8 <u>Rural Fleet Management</u>, new start. A rural area with a diversity of public service fleets will be selected to demonstrate technologies, operations and institutional coordination that can reduce fleet operating costs while maintaining or improving fleet readiness and effectiveness of service delivery. Attention will be paid to consolidation of fixed facilities, joint dispatching for efficient vehicle assignment, use of AVL and MDTs for monitoring service progress and vehicle location, and cost allocation for payment by various jurisdictions of joint fleet operation. The demonstration may include partnerships with private fleet operators. [4.1, 4.2:6]</p>
<p>Deployment</p>	<p>98-2-1 <u>Deployment Incentive Phase 1/Early Starts</u>— Initiate FY98 Evaluated demonstrations of ARTS planning, deployment, integration and sustainment. Pending authorizing legislation. [various:various]</p>

<p>Delivery</p>	<p>98-3-1 <u>ARTS Toolbox 1 and Expanded Success Stories</u>, ongoing. Task order contract will continue to identify and disseminate a collection of case studies that represent tried and generally practicable approaches to applying ITS solutions to rural operational problems. [all:all]</p> <p>98-3-2 <u>Development of Early Rural Deployment Planning Guidance</u>, new start. Will support subsequent deployments by establishing initial procedural guidelines for transportation planners to incorporate ARTS projects into transportation improvement plans and programs, especially the statewide long range plan and transportation improvement program. Will establish checklists for federal reviewers for federal-aid grant approval for ARTS projects. Will recommend any changes needed to the appropriate CFRs to incorporate ARTS planning procedures. [all:all]</p> <p>98-3-3 <u>Professional Capacity Building</u>, new start. The federal staff training will be initiated to provide ongoing ARTS deployment and planning technical support to state and local agencies. Curricula will be developed for incorporation into existing training programs. An initial staff cadre will be trained to deliver the curricula. [all:all]</p>
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Program Area	FY 99
<p>Research and Development</p>	<p>99-1-1 <u>Development of Rural ITS Services</u>, ongoing.</p> <p>99-1-2 <u>Tourism and Traveler Information</u>, ongoing.</p> <p>99-1-3 <u>Emergency Services</u>, ongoing.</p> <p>99-1-4 <u>Traveler Safety and Security</u>, ongoing</p> <p>99-1-5 <u>Rural Public Mobility</u>, ongoing.</p> <p>99-1-6 <u>Rural O&M and Traffic Management Systems</u>, ongoing.</p> <p>99-1-7 <u>Rural Fleet Management</u>, ongoing.</p> <p>99-1-8 <u>Rural CVO</u>, new start. In coordination with the CVISN program, techniques will be demonstrated in rural areas that address commercial vehicle inspection, clearance and routing issues relevant to non-interstate rural routes, economic competitiveness of rural areas, and agricultural fleets. [1.1, 3.1, 4.3, 5.3:7]</p> <p>99-x-x <u>Incorporation of ARTS Architecture and Standards</u>, new start. Hand-off of ARTS requirements to existing architecture and standards efforts. Not funded by ARTS program. [all:all]</p>
<p>Deployment</p>	<p>99-2-1 <u>Deployment Incentive Phase 2</u>, ongoing. Evaluated demonstrations in rural areas will test increasing levels of integration and sustainment among more advanced deployment areas, and will initiate planning and deployment among less advanced areas. Inclusion of federal domain areas [various:various]</p>

<p>Delivery</p>	<p>99-3-1 <u>State/local Workshops in ARTS Planning</u>— Initiate FY99 This will provide for a contractor to assist in conducting state and local workshops for ARTS planning agencies. The contractor will provide technical training materials and conduct the workshops in coordination with USDOT and other national ARTS experts. Contractor and agency experience gathered through the workshops will be used to produce a finalized Deployment Planning Guidance. [all:all]</p>
	<p>99-3-2 <u>Toolbox 2 Development</u>, ongoing. Advanced version of the tool box resulting from additional research. Includes guidance on all ARTS infrastructure and integration of infrastructure components and applications. [all:all]</p>
	<p>99-x-x <u>Professional Capacity Building</u>, ongoing, off ARTS budget. The federal staff training will be continued under existing USDOT training mechanisms, to provide ongoing ARTS deployment and planning technical support to state and local agencies. [all:all]</p>

Program Area	FY 00
<p>Research and Development</p>	<p>00-1-1 <u>Development of Rural ITS Services</u>, ongoing.</p> <p>00-1-2 <u>Tourism and Traveler Information</u>, ongoing.</p> <p>00-1-3 <u>Emergency Services</u>, ongoing.</p> <p>00-1-4 <u>Traveler Safety and Security</u>, ongoing</p> <p>00-1-5 <u>Rural Public Mobility</u>, ongoing.</p> <p>00-1-6 <u>Rural O&M and Traffic Management Systems</u>, ongoing.</p> <p>00-1-7 <u>Rural Fleet Management</u>, ongoing.</p> <p>00-1-8 <u>Rural CVO</u>, ongoing.</p> <p>00-x-x <u>Incorporation of ARTS Architecture and Standards</u>—ongoing. Not funded by ARTS program. [all:all]</p>
<p>Deployment</p>	<p>00-2-1 <u>ARTS Deployment Incentive, Phase 3</u>, ongoing. Progress will be continued in all phases of deployment. Projects will evaluate the effectiveness of component integration and deployments in additional rural environments, and over new coordination areas or corridors. [various:various]</p>
<p>Delivery</p>	<p>00-3-1 <u>State/local Workshops in ARTS Planning</u>, ongoing. This will provide for a contractor to assist in conducting state and local workshops for ARTS planning agencies. The contractor will provide technical training materials and conduct the workshops in coordination with USDOT and other national ARTS experts. [all:all]</p> <p>00-3-2 <u>Toolbox 3 Development</u>, ongoing. Continued development of the tool box resulting from additional research.</p>

	<p>[all:all]</p> <p>00-x-x</p> <p><u>Professional Capacity Building</u>, ongoing, off ARTS budget.</p> <p>The federal staff training will be continued under existing USDOT training mechanisms, to provide ongoing ARTS deployment and planning technical support to state and local agencies.</p> <p>[all:all]</p>
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Program Area	FY 01
<p>Research and Development</p>	<p>01-1-1 <u>Research on Needs in all Critical Program Areas</u>, ongoing. Ongoing research will respond to, and update, issues in the Rural Research Plan. [various:various]</p> <p>01-1-2 <u>Tourism and Traveler Information</u>, ongoing.</p> <p>01-1-3 <u>Emergency Services</u>, ongoing.</p> <p>01-1-4 <u>Traveler Safety and Security</u>, ongoing</p> <p>01-1-5 <u>Rural Public Mobility</u>, ongoing.</p> <p>01-1-6 <u>Rural O&M and Traffic Management Systems</u>, ongoing.</p> <p>01-1-7 <u>Rural Fleet Management</u>, ongoing.</p> <p>01-1-8 <u>Rural CVO</u>, ongoing.</p>
<p>Deployment</p>	<p>01-2-1 <u>ARTS Deployment Incentive, Phase 4</u>, ongoing. This is the fourth phase of ARTS infrastructure and services integration projects. States graduating from previous capacity building efforts will be emphasized. This phase will extend evaluation of the effectiveness of new levels of component integration in new rural environments, and over new coordination areas or corridors. [various:various]</p>
<p>Delivery</p>	<p>01-3-1 <u>State/local Workshops in ARTS Planning</u>— Ongoing. This will provide for a contractor to assist in conducting state and local workshops for ARTS planning agencies. The contractor will provide technical training materials and conduct the workshops in coordination with USDOT and other national ARTS experts. [all:all]</p> <p>01-3-2 <u>Toolbox 4 Development</u> , ongoing. Advanced version of the tool box resulting from additional research. Includes</p>

	<p>guidance on all ARTS infrastructure and integration of infrastructure components and applications. [all:all]</p> <p>01-x-x <u>Professional Capacity Building</u>, ongoing, off ARTS budget. The federal staff training will be continued under existing USDOT training mechanisms, to provide ongoing ARTS deployment and planning technical support to state and local agencies. [all:all]</p>
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NEXT STEPS

This Plan is being implemented in FY 97. FY 97 is also being devoted to public review and finalization of the Strategic Plan and review of this Program Plan. Successive years will require further review of Program Plan activities and projects, and their submission to the annual budgeting process.

It is intended that as this Program Plan is updated, it will be submitted for public review. This will become a part of the ongoing program review, providing indicators of effectiveness and outstanding needs. Review of this Plan will first occur in FY 97 and will require participation of:

- The Rural Action Team within the JPO, and any successor ARTS-focused organization.
- JPO and USDOT programmatic review, as part of the annual budget cycle.
- Constituencies that are polled through existing ITS organizations or Plan activities.
- The general public as notified through the Federal Register of Plan availability, including through Internet website access.

As the Program Evaluation activity becomes formalized, there will be more quantitative indications of the Plan's outcomes. These will motivate changes in the Plan internal to the ARTS Management within the JPO. Results of the National ITS Architecture development, standards developments, the R&D activities, and the Pre-Deployment Incentives will provide more technical and performance information on the ARTS. As indicated in the Strategic Plan, this is part of a progression toward implementation of the ARTS infrastructure and its dependent services. The intent is to make this Plan adaptive to new information, both as provided by Plan results and from the constituencies for the ARTS, and generally for improved rural transportation.

APPENDIX

Background on Rural Transportation

A useful starting point for any system design is specification of the context in which the system will operate. The attributes of rural America and its transportation systems distinguish the ARTS as a focus within the ITS. Some relevant rural attributes are summarized here.

Rural America

Rural areas⁸ account for 83 percent of the nation's land, 21 percent of its population (50 million people), 18 percent of its jobs, and 14 percent of its earnings. Of the nation's 3,041 counties, 2,288 of them were classified as non-metropolitan, or rural, according to the 1990 Census.

Rural populations are diverse and changing. Compared to urban areas, rural areas contain greater percentages of elderly, persons in poverty, households with income below the national median, and homeowners. On a per square mile basis, more rural areas lost population than gained it in the 1980 to 1992 period, but total rural population is growing again in the 1990s. Rural communities with recreation and retirement economies and those near urban areas have shown the greatest recent growth, but this leaves the more isolated areas with dependent population groups and limited tax base. Farm employment has now declined to only 7.6 percent of the rural workforce, while services, government, and manufacturing all have substantially larger proportions of the rural labor force than does farming. The services sector in rural areas—with almost 51 percent of the rural workforce—contributes the largest share of jobs and employment growth.

Rural Travel

Average data on rural areas hide a great diversity, and some extreme problems, in rural travel. People who don't own cars or can't drive face significant difficulty because many rural areas lack adequate public transportation services. The most isolated rural residents, and much through or tourist travel, encounter poor roads and difficulty in obtaining services, particularly emergency aid.

From the 1990 census data, 7.7% of the households outside of metropolitan areas have no vehicle available, compared to 9.6% in urban areas⁹. Rural residents have fewer mobility

⁸ Understanding Rural America, Economic Research Service, U.S. department of Agriculture, Agriculture Information Bulletin No. 710, Washington, DC, February, 1995.

⁹ Pg. 3-iii, 1990 National Personal Transportation Survey databook, Vol. I, Oak Ridge National Laboratory, November, 1993.

alternatives since 38% percent of the nation's rural residents live in areas without any public transit service and another 28 percent live in areas in which the level of transit service is negligible¹⁰. Accordingly, the percentage of trips taken by public transit is 0.5% by residents living outside of metropolitan areas, while it is 2.4% for urban residents¹¹. The characteristics of urban and small town/rural (Section 18) transit system users differ markedly. The elderly (over 65 years) are 11 percent of the urban population but less than 7% of urban riders, while the Section 18 systems report 36% elderly ridership, about twice the population proportion. The disabled are less than 2% of urban ridership but 25% of Section 18 ridership¹².

Rural residents annually take 1109 person trips per person, compared to 1106 in the central cities of metropolitan areas, and 1147 in non-central city metropolitan areas¹³. The person miles traveled by rural residents annually is 10,781, midway between the 8,815 of central city residents and the 11,628 of non-central city metropolitan residents¹⁴. The average trip length for the rural resident is 9.8 miles, again midway between the 8.3 miles and 10.3 miles of central city and non-central city metropolitan resident¹⁵. Rural households annually accrue 15,991 vehicle miles, again midway between the 11,359 of central city households and the 17,716 of non-central city metropolitan households¹⁶.

Tourism, that focuses to a large extent on rural areas, as well as long distance travel for other purposes, creates a population of highway users unfamiliar with the local routes. The 1990 data from the National Personal Transportation Survey (NPTS) estimates that 21% of non-commercial vehicle miles traveled, or 337 million, are in the "long trip" (not normal daily) category¹⁷. Of the trips in that category, 89% are by private highway vehicle.

For the private vehicle long-trips, the trip distance distribution starts at 75 miles. There are 36% of long-trips between 75 and 100 miles, another 36% between 100 and 200

¹⁰ Status Report on Public Transportation in Rural America, 1994. Community Transportation Association of America, December, 1994.

¹¹ Table 4.22, *ibid.*

¹² "Rural Transit", Fact Sheet 9, National Transit Resource Center, January, 1995.

¹³ Table 4.21, *ibid.*

¹⁴ *Ibid.*

¹⁵ *Ibid.*

¹⁶ Table 5.11, 1990 National Personal Transportation Survey databook, Vol. II, Oak Ridge National Laboratory, November, 1993.

¹⁷ Table 8.3, *op. cit.*, Vol. II.

miles¹⁸. The problem of area nonfamiliarity is less a matter of rural versus urban environment, than the regularity of the trip. The unique rural aspect is the remoteness and lack of conventional information access for trips.

Of person miles traveled (PMT), 30% are in the long-trip category, or 886 million in 1990. The higher percentage is indicative of more shared-occupancy on the longer trips. Of those long-trip PMT, the largest percentage is for “visiting friends and relatives” (30.2%), followed by 24.7% for “vacation”, then 18.3% for “other social and recreational”¹⁹.

Rural tourism tends to involve long trips to remote locations, but there can still be significant concentrations of traffic at attractive tourist sites. There are many rural areas in the U.S. that might fit this description: areas in or near national parks, monuments, forests and recreation areas, ski areas, seashores, areas with popular annual festivals and fairs, and highways with high percentages of seasonal tourist traffic (Florida's I-95 in winter, Blue Ridge Parkway, California Routes 1 & 49, Maine's Route 1 and the Alaska Highway, etc.). These areas will violate the general rule of low rural congestion at their peak periods, that may be concentrated into a few months per year. Informational services, as well as public transportation services, can be significant in meeting transportation needs of these areas. ATIS can provide significant assistance in the support of transportation services that are provided to reduce congestion, or to assist in providing directional information to the actual destinations or roadside services or in the provision of Mayday emergency GPS services.

Rural Transportation Service and Mobility Problems

Rural travel is predominately on the highways, whether by personal vehicle or public transportation. Personal vehicle is the predominate mode, but rural transit and paratransit plays an important role for the transit-dependent. Intercity bus and rail passenger service can be included in ARTS applications. Freight rail remains strong—rail and highway intersecting at numerous grade crossings that are hazardous. The rural highway trip differs significantly from the urban highway trip, in terms of other traffic encountered, and isolation from places and services.

The total public road and street mileage classified as rural is 3,092,953, and this is 79% of the total mileage²⁰. The national highway system is characterized by concentration of traffic on a small percentage of the route miles. Only five percent of total U.S. route miles, including the rural Interstates, carry 50% of vehicle miles traveled (VMT). Conversely, the last 50% of route miles, that is predominately rural, carries only 5% of

¹⁸ Table 8.17, *ibid.*

¹⁹ Table 8.7, *ibid.*

²⁰ Compiled from various tables in Highway Statistics, 1994. Federal Highway Administration, October, 1995.

total VMT. This fact has strong implications for the distribution and economics of ARTS applications for highway operations and use.

Regular congestion on the rural highways affects only small portions. Only the Interstates, with 23.8% of rural VMT on only 1% of the rural route miles, show significant lengths with volume/capacity ratios (V/C) greater than 80%. A large part of the route mileage has very sparse traffic. Average daily traffic (ADT) counts by mileage show that for the major collectors, 9% of the mileage has less than 100 vehicles per average day, for the minor collectors 31% of the mileage has less than 100 vehicles, and for the local roads 46% of the mileage has under 50 vehicles per day²¹. Regular traffic management can be focused on a relatively small rural mileage, and much of that adjacent to urbanized areas and logically tied to urban traffic management systems. However, localized, periodic, seasonal and event-related traffic congestion must still be addressed.

The minor collectors and local rural roads, that are 77% of the rural mileage or 2.4 million miles, typically have negligible traffic. But this is the network most in need of innovative ARTS solutions to provide service for emergencies, for travelers who are lost, for residents who are isolated, and for reduction of high accident rates per vehicle mile. There are also great opportunities for more efficient road operations and maintenance.

The key parts of the rural highway network are good, paved, all-weather roads. The Interstates, other principal arterials and minor arterials are 100% paved, have 63% of the VMT, but are only 8.6% of the total rural route miles. Collectors and local roads, the other 91.4% of rural route miles, are only paved in part, leaving 1.5 million route miles, or fully 50% of the rural mileage, that is not hard, all-weather, paved.

In 1994, state highway agencies expended about \$16 billion on rural highways for capital improvements and maintenance. That is 42% of total state expenses on highways, comparable to the mileage proportion. The typical economic problem for rural highways is the large "tail" of route mileage, requiring ongoing maintenance and patrolling, under local funding, but carrying small amounts of traffic. This creates a productivity and economic efficiency problem comparable to that of rural transit. Any investment in systems that require along-route facilities (whether pavement or ITS) will tend to be most efficient along the small portion of rural route miles with reasonable traffic (e.g., Interstates and principal arterials). For other routes, economic justification will be more difficult and will require innovation to reduce per-unit costs. Similar problems occur for area-based facilities, such as terrestrial radio communications: Costs of such communications are high if terrain interferes with propagation; power supplies are costly in isolated areas, and; low densities of users affect economic viability.

Another characteristic of the sparseness of rural routes is the lack of alternative routes. The network is less gridded, particularly in areas where natural topography, such as ridgelines and valleys, limit the feasible routes. In general, the density of routes and

²¹ Tables HM-57 and HM-67, *ibid*.

crossings will be less, requiring more circuitry in getting from one point to another. Limited mountain pass routes or water crossings make it more critical to monitor and respond to blockages by construction, accident or natural obstruction.

Rural rail and bus transit service, both local and intercity, generally has contracted in past decades, leaving many service gaps. Presently, thirty-eight percent of the nation's rural residents live in areas without any public transit service and another 28 percent live in areas in which the level of transit service is negligible—equivalent to less than 24 yearly trips for each household without a vehicle²². The comparative level of transit service in urban areas is equivalent to 955 trips for each car-less household. Demand-responsive services predominate in rural areas. In 1994, thirty-four percent of all services were reported to be demand-responsive only, another 31 percent were demand-responsive and fixed-route, and another 22 percent were demand-responsive and other service types (not fixed route). Fixed-route-only systems accounted for only nine percent of those responding and 4 percent were “other”.

Rural transit programs previously under the FHWA and now under FTA's Section 18 funding have helped to maintain and develop some rural transit services²³. The majority of these are public services, but approximately one third of rural transportation providers are private, non-profit, organizations serving clients of a variety of social and medical agencies²⁴. The Medicaid program has become the largest purchaser of non-emergency medical transportation in this country, spending nearly one billion dollars in 1995²⁵. All kinds of rural services, including taxis, informal ridesharing, and a variety of social service agency transportation, face challenges of price, cost and availability.

The need to make rural transit and paratransit services efficient and effective is greater than ever, due to serious constraints on public budgets. However, the fleet size of rural providers is small. There are numerous rural public systems with only one vehicle; there are also several systems with more than 50 vehicles. The mean vehicle fleet size of Section 18 providers is 11 and the median is 6²⁶. Lack of service coordination, and an

²² Status Report on Public Transportation in Rural America, 1994. Community Transportation Association of America, December, 1994.

²³ Note that the definition of “rural” corresponding to coverage of the Section 18 program includes the portions of metropolitan areas outside the urbanized area boundary. It is, therefore, larger than the “outside metropolitan area” definition, which is county-based.

²⁴ Directory of Rural Public Transportation Providers Funded by FTA's Section 18 Program. FTA, December, 1994.

²⁵ “Innovative State Medicaid Transportation Programs”, Ecosometrics, Inc., March 15, 1995.

²⁶ Atlas of Public Transportation in Rural America, Community Transportation Association of America, Fall, 1995. Based on 1992-3 Section 18 data.

accountable means to allocate client costs to sponsoring agencies, often fragments service among providers in overlapping areas, meaning higher costs and less service per user. This issue is amenable to APTS solutions, as in a mobility management system²⁷.

The average rural public transit system annually provides more than 82,000 passenger trips, while the median figure is 33,270. This indicates a large spread between the largest and smallest systems. The demand-responsive plus fixed-route services tend to be the largest. They are followed by demand-responsive and others (not fixed-route), fixed-route, and demand-responsive.

Annual expenditures for a rural public transportation system range all the way from over \$8 million to less than \$1,000. System expenditures broken down by quintiles for all Section 18 operators show that operators in the first quintile have average operations greater than one million dollars per year while those in the second quintile average below a \$400,000 annual expenditure level. The middle quintile ranges from \$315,000 to \$153,500. Average systems in the fourth and fifth quintiles show expenditures of \$75,000 and \$20,000, respectively.

The systems reporting the most effective and productive services tended to be those that provided demand-responsive and other services, too. Some of the best were reporting:

- costs per trip of less than \$1.00,
- costs per mile around \$0.65,
- costs per hour in the \$5-6 range,
- about three passengers per vehicle mile, and
- 25-30 passengers per vehicle hour.

Performance will depend on the service environment as well as system management. Unfortunately, it is in the least dense and remotest areas where the transportation disadvantaged have the most need and the providers are least able to provide service efficiently. The smaller the rural community, generally the more isolated it is and the less available is any kind of public transit or paratransit. Of the smallest rural communities, those with 2,500 persons or less:

- Half have no public transportation at all, that is, no taxi, no intercity bus, no paratransit and no local public transit service.
- Ninety percent do not have taxi service.
- Ninety percent do not have intercity bus service.
- Ninety percent do not have paratransit service.

Of the next largest communities, between 2,500 and 10,000

²⁷ Mobility Management and Market Oriented Transportation, Jeffrey A. Parker and Associates, March, 1991.

- Fifteen percent have no public transportation at all
- Twenty percent have no taxi service
- Sixty percent have no intercity bus service
- Sixty-five percent have no paratransit service

Of the 90 million residents in the Section 18 areas of the United States, there are 30 million rural elderly, working poor, and people with disabilities. Rural public transit trip purposes differ from those in urban areas: More than half the urban trips are job related, whereas 20 percent of rural trips are job related. Rural riders are different from urban riders: 7 percent of urban riders are 65 or older whereas 36 percent of rural riders are 65 or older. Less than two percent of urban riders have disabilities, whereas 25 percent of rural riders have disabilities.

Rural Highway Safety Problems

Rural highway accidents are a serious concern. Rural motor vehicle accidents are only 28% of the national total, but rural fatalities are 56% of the total fatal accidents and 58% of total persons killed, higher than the rural route mile or VMT proportions²⁸. In 1994, there were 20,596 fatal highway accidents and 23,693 deaths that resulted.

The number and rate (per 100 million VMT) of 1994 highway accidents and persons involved are tabulated below for rural highways by functional class²⁹. The rates of accidents are higher in the lower functional classes. This means that rural accidents will be diffused throughout the network, and can occur in remote sections where response time will be long. This applies even moreso to recreational or other accidents that are off-road.

Rural Highways:	Interstate	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local
Fatal acc., rate	2140 0.99	4375 2.11	3562 2.38	5316 2.92	1430 2.94	3773 3.59
Non-fatal acc., rate	NA 19.49	NA 45.7	NA 64.92	NA 103.14	NA 104.10	NA 133.54
Fatal, persons, rate	2534 1.17	5244 2.53	4166 2.78	6037 3.31	1598 3.29	4114 3.91

²⁸ Table FI-1, Highway Statistics, op. cit.

²⁹ Table FI-1, Highway Statistics, op. cit. Some data on non-fatal accidents are not available because of incompleteness of state data.

Non-fatal, persons, rate	NA 32.94	NA 77.46	NA 106.36	NA 164.25	NA 149.25	NA 216.43
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The vast majority of rural roads are not divided, and fully 90% of rural road mileage has two lanes or less. With less traffic and some poor road design, a higher proportion of rural than urban accidents involve collisions with fixed objects—29% of rural fatal accidents—although 46% are still with other vehicles.³⁰

Fatalities and morbidity in rural highway accidents can be linked to emergency service response times as well as care quality. Urban and rural emergency medical service (EMS) response times to fatal highway crashes from 1994, by their several components, are compared below³¹:

Response Component	Rural (minutes)	Urban (minutes)
Crash to notification	8.16	3.93
Notification to EMS arrival	11.41	6.20
EMS arrival at crash to hospital arrival	36.08	25.5
Total, crash to hospital arrival	52.41	34.94

The average rural response time is higher in all components. All the averages obscure the tails of response times to remote areas or where some failure in notification or site location occurred. For the fatal crashes with time components given, 46.5% of the rural cases take over 50 minutes from crash to hospital arrival, while the comparable proportion is 14.2% for urban cases³².

³⁰ Based on Accident Facts, 1994 Edition, National Safety Council.

³¹ Tables 111 and 112, Traffic Safety Facts-1994, National Highway Traffic Safety Administration, August, 1995. Note: a large percentage of cases have unknown times, so the averages cited may be biased.

³² Table 26, *ibid.*

Emergency response is not just a matter of distance, but also of knowing where the accident is and how to get there. The problems in this regard are exacerbated by rural conditions where locational information is scarcer, and there is less frequency of passers-by to spot and report trouble. Response time, that translates into lives saved, depends on prompt accident notification and efficient access by response teams to accident sites. It is even more critical, in terms of absolute times involved, to improve these factors in rural areas. ITS addresses problems of emergency service dispatching, navigation, information and constrained route choices that can improve all response time components. Reduction of morbidity and fatality also depends on the quality of immediate care and preparation for receiving accident victims at medical centers. Communication for medical advice as part of ITS infrastructure can improve these factors.