Contents

Part I South Carolina ITS Regional Architecture
   Introduction
   Regional Description
   Regional Stakeholders
   South Carolina ITS Concept of Operations
   Using the Architecture
   Maintaining the Architecture

Part II Ten Year Strategic Plan

Part III Turbo Architecture Output

Appendix
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction ................................................................. 1-1</td>
</tr>
<tr>
<td></td>
<td>Background ........................................................................ 1-1</td>
</tr>
<tr>
<td></td>
<td>Project Approach .......................................................... 1-2</td>
</tr>
<tr>
<td></td>
<td><em>Figure 1 – ITS Architecture Development Steps and USDOT Requirements .... 1-5</em></td>
</tr>
<tr>
<td>2</td>
<td>Regional Description......................................................... 2-1</td>
</tr>
<tr>
<td></td>
<td>Regional Overview .......................................................... 2-1</td>
</tr>
<tr>
<td></td>
<td>Overview of ITS in the Region ........................................... 2-6</td>
</tr>
<tr>
<td></td>
<td><em>Figure 2 – Regional Map .................................................. 2-1</em></td>
</tr>
<tr>
<td></td>
<td><em>Figure 3 – Major Highways .............................................. 2-3</em></td>
</tr>
<tr>
<td></td>
<td><em>Figure 4 – 24-Hour Traffic Volumes .................................. 2-4</em></td>
</tr>
<tr>
<td></td>
<td><em>Figure 5 – Commercial Transportation Facilities .................. 2-5</em></td>
</tr>
<tr>
<td></td>
<td><em>Figure 6 – Existing ITS Infrastructure ............................... 2-7</em></td>
</tr>
<tr>
<td>3</td>
<td>Regional Stakeholders ...................................................... 3-1</td>
</tr>
<tr>
<td></td>
<td>Participating Agencies and Other Stakeholders ..................... 3-1</td>
</tr>
<tr>
<td></td>
<td><em>Figure 7 – SCDOT Districts ............................................... 3-2</em></td>
</tr>
<tr>
<td></td>
<td><em>Figure 8 – Stakeholder Regional Locations .......................... 3-3</em></td>
</tr>
<tr>
<td>4</td>
<td>South Carolina ITS Concept of Operations .............................. 4-1</td>
</tr>
<tr>
<td></td>
<td>Operational Concept and Scenarios ..................................... 4-1</td>
</tr>
<tr>
<td></td>
<td>Operations Agreement ....................................................... 4-2</td>
</tr>
<tr>
<td></td>
<td>Functional Requirements .................................................... 4-4</td>
</tr>
<tr>
<td></td>
<td>ITS Interfaces - Interconnects ............................................. 4-5</td>
</tr>
<tr>
<td></td>
<td><em>Figure 9 – South Carolina Statewide ITS System Concept .......... 4-3</em></td>
</tr>
<tr>
<td>5</td>
<td>Using the Architecture ..................................................... 5-1</td>
</tr>
<tr>
<td></td>
<td>ITS Project Initiation Plan ............................................... 5-1</td>
</tr>
<tr>
<td></td>
<td>Defining New ITS Projects ............................................... 5-3</td>
</tr>
<tr>
<td></td>
<td><em>Figure 10 – Development of a Project Architecture using Turbo Architecture .... 5-5</em></td>
</tr>
<tr>
<td>6</td>
<td>Maintaining the Architecture .............................................. 6-1</td>
</tr>
</tbody>
</table>
1 Introduction

The purpose of this document is to describe the recommended system architecture on which future statewide Intelligent Transportation System (ITS) projects will be based. This document follows the organization outlined in the US DOT Final Rule, Section 940.9 on Regional ITS Architecture development dated January 8, 2001.

The South Carolina Statewide ITS Architecture and Strategic Plan (SCSARCH) must be compatible not only with local goals set forth by municipalities and counties, but also with statewide transportation vision and goals as well as national ITS goals. The South Carolina Department of Transportation’s (SCDOT’s) primary ITS operations goal is to provide safe and efficient traffic flow on its highway systems for the state of South Carolina. To this end, SCDOT developed and deployed ITS technologies. SCDOT identified the need to continue expanding ITS throughout the state. Although there are many deployments in place, more is needed to address the growing requirements of South Carolina communities. The purpose of performing a Statewide ITS Architecture and Strategic Plan is to demonstrate a statewide need for ITS technology, identify ITS solutions, and provide a framework for continued deployment throughout the state.

Background

What is ITS?

Intelligent Transportation Systems (ITS) involve the application of advanced and emerging technologies in fields such as information processing, communications, control, and electronics to improving transportation operations. Effective use of these technologies in transportation extends functionality, improves performance, and thereby allows transportation managers to better facilitate safe and efficient movement of people and goods. ITS increases the efficiency of existing transportation infrastructure, in order to increase overall system performance, while reducing the need to add travel lanes. This is achieved by applying technology to better manage the transportation operations, and provide services and information to users so they can make better travel decisions. Through the Transportation Equity Act for the 21st Century (TEA-21) of 1997, ITS has become a national initiative.

National Architecture

The National ITS Architecture provides a uniform structure for the design of intelligent transportation systems. It is not a system design or a design concept. It is the framework around which multiple design approaches can be developed, each one specifically tailored to meet the individual needs of the user, while maintaining the benefits of a common architecture. The architecture defines the functions (e.g., gather traffic information or request a route) that must be performed to implement a given user service. These include the physical entities or subsystems where these functions reside (e.g., the roadside or the vehicle), the interfaces/information flows between the physical subsystems, and the communication requirements for the information flows (e.g., wireline or wireless). In addition, it identifies and specifies the requirements for the standards needed to
support national and regional interoperability, as well as product standards needed to support economy of scale considerations in deployment.

Regional Architecture

The FHWA Rule/Policy requires that the National ITS Architecture be used to develop a local implementation or a regional ITS Architecture. A Regional ITS Architecture is a local implementation, or subset, of the National ITS Architecture, developed with local requirements in mind. A region is defined by local participants and is based on the needs for information sharing and coordination. It can be a metropolitan area, a state, a multi state area, or a corridor.

South Carolina’s Regional ITS Architecture

The SCSARCH provides a framework for the intergovernmental cooperation in deployment of ITS applications. The Statewide ITS Architecture incorporates the existing and planned ITS projects and provides a road map for future deployment.

Additional planning efforts will be required in the future as highway and transit applications within and around the state are considered. While the SCSARCH is contained as a document, it must be considered an iterative process, which will be maintained, revised, and validated as needed. A coordinated effort among the stakeholders will ensure that this effort continues and ITS is mainstreamed into future projects.

Project Approach

The Federal Highway Administration (FHWA) issued a final rule to implement Section 5206(e) of the TEA-21 January 2001. This final rule requires that ITS projects funded through the Highway Trust Fund conform to the National ITS Architecture and applicable standards. FHWA has further established a deadline of April 2005 for regions to have an ITS architecture in place.

To meet these requirements and ensure future federal funding eligibility for ITS, SCDOT initiated the development of a Statewide ITS Architecture and Strategic Plan covering all affected agencies in the State of South Carolina. SCDOT and several other metropolitan regions in the state have ITS project architectures in place or under development. The focus of the SCSARCH is to develop a regional or statewide architecture to encompass all of the remaining areas of the state.

The Statewide ITS Architecture provides a framework for ITS systems, services, integration, and interoperability. The ITS Strategic Plan identifies specific projects and timeframes for ITS implementation to support the vision developed by stakeholders in the architecture. SCDOT’s process for developing the Statewide ITS Architecture and Strategic Plan follows the USDOT’s guidance and process approach to meeting the requirements in the FHWA Final Rule. The process reflects specific multi-agency needs of Statewide Regional plans, and is incorporated stakeholder input. The Strategic Plan provides a road map for regional ITS deployment and integration.
The SCSARCH Team followed the process identified in the FHWA Regional ITS Architecture Guidance Document for Developing, Using, and Maintaining ITS Architectures. The process was tailored to fit the needs of South Carolina. The FHWA process, illustrated in Figure 1, includes six steps that represent the process “lifecycle” of a regional ITS architecture. In the first four steps, the regional ITS architecture products are developed; these products are put into operation and maintained in Steps 5 and 6. The development process begins with basic scope definition and team building and moves through increasingly detailed steps, culminating in specific products that will guide the “implementation” of the regional ITS architecture. An overview of each step in the process is described below.

**Step #1: Get Started**
The first step in the process focuses on identifying the institutions and organizations impacted by the ITS architecture, informing them of the upcoming efforts and encouraging their participation in ITS development and operations.

**Step #2 Gather Data**
Once the stakeholders are identified, the existing and planned ITS systems in the region are inventoried, and the roles and responsibilities of each stakeholder in developing, operating, and maintaining these ITS systems are defined. Functional requirements derived from Early Deployments is used to better understand the needs and the desired ITS services for the region. These documents also provide operational concepts for SCDOT systems in the region. This ITS architecture is institutionally complex given the number of agencies and transportation facilities in the region and consequently map overlap with other ITS architecture efforts. The ITS systems identified as part of the regional ITS architecture were mapped to the National ITS Architecture subsystems. This allowed for further definition of the systems as well as setting the stage for the next analysis step.

**Step #3 Define Interfaces**
Once the ITS systems in the region were identified, the existing and planned interfaces between these systems are defined. The National ITS Architecture contains interface definitions between subsystems. Since the statewide ITS inventory was mapped to subsystems in the National ITS Architecture, the interfaces defined in the National ITS Architecture were used as a starting point to define the interfaces for the SCSARCH. The applicable National ITS Architecture interfaces present integration opportunities to be considered for the SCSARCH region. These connections (or “Interconnects”) between systems are evaluated for whether they existed in the region or are a planned interface or are considered for future implementation. This simplifies information flows by eliminating from consideration connections that do not exist or are planned for the future. The next level of detail in defining the interfaces was to examine each interconnect and determine which information flows existed or were planned for the future between pairs of systems. This was accomplished by examining the information flows that the National ITS Architecture recommends between the mapped subsystems, examination of the SCDOT ITS Early Deployment Projects, and the team’s knowledge of SCDOT and regional systems and needs.
The results were coordinated as a part of Statewide ITS Architecture development efforts in order to maintain continuity among the different agency ITS architectures. After the initial draft of the architecture is completed, the information will be presented to the stakeholder groups. Figure 1 illustrates the process used to develop the South Carolina Statewide ITS Architecture. The three final steps deal with implementation, use, and maintenance of the architecture.

**Step #4 Implementation**

Once the system interfaces were defined, the additional ITS elements were developed to guide implementation of the projects that flow directly from the regional ITS architecture. These include a sequence of projects, needed agency agreements, and the appropriate standards that can be considered for project implementation. Part II of this document contains the Ten Year Strategic Plan, which includes many individual ITS projects and initiatives that are planned for the next ten years. Part III, Turbo Architecture Output, identifies the required standards for future project designs and implementation.

Although the ITS Architecture process seems to be a sequential process, the actual development process is iterative and many tasks are performed parallel or not necessarily in order. Many changes to the Regional ITS Architecture are expected with the addition of stakeholders, new inventory, and additional interfaces.

Figure 1 illustrates the process used to develop the South Carolina Statewide ITS Architecture. The two final steps address the use and maintenance of the architecture. These steps are addressed later in this report.
USDOT Rule/Policy Requirements for a Regional ITS Architecture must include:

- A description of the Region
- Identification of participating agencies and other stakeholders
- An operational concept that identifies roles and responsibilities of participating agencies in the operation and implementation of the systems included
- Any agreements (existing or new) required for operations, including interoperability, utilization of related standards, and operation of projects
- System functional requirements
- Interface requirements and information exchanges with planned and existing systems and subsystems
- Identification of ITS standards supporting regional and national interoperability
- Sequence of projects required for implementation
2 Regional Description

Regional Overview

This section provides an overview of the general demographic characteristics and existing transportation systems. This information is important to development of ITS architecture. The system and demographic data defines the settings into which ITS systems must be deployed and operated. No ITS architecture effort should be undertaken without a thorough knowledge of the region into which systems and projects will be deployed. The general characteristics of the South Carolina region are outlined below and will be used as a frame of reference throughout the ITS architecture and project development efforts.

The South Carolina region encompasses forty-six (46) counties within the state and the incorporated cities and towns within their borders. Figure 2 shows the geographical and regional boundaries established for the SCSARCH. According to the 2000 Census, South Carolina has a population of about four million people. Recent estimates indicate that the state receives up to 29 million visitors annually using South Carolina roadways. The state's boundaries border the state of Georgia to the west, the state of North Carolina to the north, and the Atlantic Ocean to the east.

Major Roadways in the Region

Primary interstates and US highway routes in the state include I-85, I-20, I-26, I-385, I-77, I-95, US Highway 17, US 501, US 29, and US 11. These corridors are key links for inter- and intra-state movement of people and goods and connections for the major metropolitan regions areas of the state. The City of Columbia serves as the intersection for three of the primary interstates, I-77, I-20, and I-26. Figure 3 shows most of the major highways in South Carolina and the metropolitan areas that the interstates connect. Figure 4 shows 24-hour traffic volumes on the major interstates traversing South Carolina. High volume locations are mostly within or adjacent to the metropolitan regions.

Commercial Transportation Facilities and Services

Commercial transportation facilities and services cover the entire state of South Carolina as shown on Figure 5. Commercial trucking plays an important role in the movement of goods using the state’s major interstates and highways. Trucking is the most commonly used mode for transporting freight because of its flexibility and speed.

There are many South Carolina airport facilities representing general aviation, commercial, and utility facilities. The major airports in the state are:

- Augusta Regional Airport
- Charleston International Airport
- Columbia Metropolitan Airport
- Florence Regional Airport
Figure 2

Legend

- City
- Interstates
- County Boundary
- Study Area Region

Source: Environmental Systems Research Institute Data (ESRI)
Legend

- **Interstates**
- **US Routes and Highways**
- **Local Roads**
- **County Boundary**
- **Study Area Region**

Source: Environmental Systems Research Institute Data (ESRI)
24-Hour Traffic Volumes

Legend

- **80,001 and Above**
- **40,001 – 80,000**
- **20,001 – 40,000**
- **10,001 – 20,000**
- **10,000 and Below**

Source: Highway Performance Monitoring System (HPMS) 2001

June 2004
Greenville–Spartanburg International Airport
Hilton Head Airport
Savannah/Hilton Head International Airport
Myrtle Beach International Airport
Charlotte/Douglas international Airport

The major hubs serve jet aircraft from numerous major carriers, including United, Continental, US Airways and Delta. Numerous general aviation and utility airfields exist throughout the state that provide tie-downs for private aircraft, training, maintenance facilities, and airplane-related commercial activities.

In fiscal year 2003, the South Carolina State Ports Authority (SPA) served 2,307 ships and barges at its seaport terminals in Charleston, Georgetown and Port In the Port of Charleston. Top commodities at Charleston docks include agricultural products, consumer goods, machinery, metals, vehicles, chemicals and clay products. Georgetown, a dedicated breakbulk and bulk facility, handles salt, cement, steel, aggregate and forest products. The Port of Port Royal handles breakbulk and bulk cargoes, principally cement and fertilizer.

The Port of Charleston is the busiest container port along the Southeast and Gulf coasts and ranks fourth nationally. On the entire East and Gulf coasts, only the Port Authorities of New York and New Jersey handle more containers than Charleston.

Intermodal Facilities

Intermodal facilities provide the efficient transfer of containers and/or trailers between railroad flatcars and trucks. Some of the major facilities are shown in Figure 5.

Overview of ITS in the Region

There are many ITS deployments that are either fully functional, in construction, or in the planning stages through the state. As part of the process, an inventory of these projects was performed. Figure 6 shows the existing ITS infrastructure in the South Carolina Region. At the core of the existing deployments in the City of Columbia is the Statewide Traffic Management Center (STMC). This center currently manages the system cameras, message signs, and monitors incidents throughout the state and in the future will be the central hub for the entire Statewide ITS Architecture.

The SCDOT has developed a traffic surveillance system/motorist information system on Interstates 26 and 126 in Columbia, and I-85 in Spartanburg. The basic elements of the system consist of changeable message signs, highway advisory radios, and surveillance cameras.

SCDOT, in conjunction with various Metropolitan Planning Organizations (MPO), has implemented motorist assistance programs in several of the state's urban areas. Known as the state incident response units, the program began in Columbia in April 1996, and has since expanded to include Spartanburg.
Legend

- City
- SCDOT Incident Response Zones
- Highway Advisory Radio (HAR)*
- Changeable Message Signs (CMS)*
- Video Camera*

*Note: symbol denotes general location and may represent multiple devices
SCDOT has made a significant investment in upgrading traffic signal systems throughout the state. South Carolina is a participant with other Southeastern states in developing a commercial vehicle operations (CVO) institutional issues study. The effort recognizes that the identification and resolution of institutional issues are important for the deployment of CVO services such as electronic clearance and weigh-in-motion. The Southeastern State Consortium will continue into the second phase to work with FHWA in defining a national CVO system.

Deployments in Charleston

Some major ITS implementation and deployments include the City of Charleston’s fog mitigation system that monitors visibility conditions. The system is in operation on I-526 near the Cooper River in Charleston. When weather conditions warrant, motorists are warned of adverse driving conditions. Closed circuit television cameras are being utilized on the Grace Memorial and Pearman Bridges in Charleston to detect roadway traffic incidents. The cameras are monitored by the Cities of Charleston and Mount Pleasant and have resulted in reduced clearance times for accidents.

Other ITS deployments within Charleston include:

Arterial Management. There are 10 arterial miles monitored by Highway Advisory Radios (HAR) and 10 by Variable Message Signs (VMS). There are 180 signalized intersections covered by electronic surveillance and 50 signalized intersections under centralized or closed loop control.

Electronic Fare Payment. There are 58 fixed route buses that accept electronic fare payment.

Emergency Management. There are 10 emergency management vehicles under CAD.

Freeway Management. There are 14 freeway miles covered by HAR and five freeway miles covered by VMS.

Incident Management. There are 15 arterial miles monitored by service patrols and 14 freeway miles covered by Closed Circuit Television (CCTV). There are 47 freeway miles covered by a free cellular phone call to a dedicated number. There are 14 freeway miles covered by incident detection algorithms. There are 14 freeway miles covered by service patrols.

Transit Management. There are 39 fixed route vehicles with electronic monitoring of vehicle components.

Deployments in Columbia

The Central Midlands Regional Planning Council of Columbia has proposed the Columbia area ITS. The five-year ITS program combines new technology with existing facilities and is comprised of the following components: a traffic operation center (to centralize the detection, dispatch, and response of emergency services); video above-ground detection capabilities; closed circuit television; variable message signs; highway advisory radio; and the state incident responders. A pilot "One Stop Shop" for Commercial Vehicle Operators (CVO) permitting has been implemented in Columbia. Through close coordination and cooperation of several agencies, this shop has resulted in more efficient administration of the International Registration Plan, International Fuel Tax Agreement
(IFTA), vehicle registration, and oversized\overweight permitting.

Deployments in Greenville and Spartanburg

Deployments in Greenville and Spartanburg include:

- Arterial Management - There are 337 signalized intersections covered by electronic surveillance and 288 signalized intersections under centralized or closed loop control.
- Emergency Management - There are 491 emergency management vehicles under CAD. There are 21 emergency management vehicles with in-vehicle navigation capability.
- Freeway Management - There are 24 freeway miles covered by HAR and 24 freeway miles under electronic surveillance.
- Highway Rail Intersections - There are three highway-rail intersections and traffic signals interconnected.
- Incident Management - There are 431 arterial miles covered by a free cellular phone call to a dedicated number. There are 20 arterial miles covered by incident detection algorithms. There are 24 freeway miles covered by CCTV and 63 freeway miles covered by a free cellular phone call to a dedicated number. There are 24 freeway miles covered by service patrols.
3 Regional Stakeholders

Participating Agencies and Other Stakeholders

Involving a range of perspectives in the development of a regional ITS architecture and strategic plan are key components of the process. Stakeholders throughout the state involved with existing ITS deployment and future implementation were identified. There was also an effort to involve agencies with future or planned ITS integration. Ongoing participation in the development of the Regional ITS Architecture and Deployment Plan will include representatives from SCDOT, FHWA, cities, counties, MPOs, Council of Governments (COGs), and transit providers. The stakeholders will provide iterative input and review through ongoing development processes. The process includes stakeholder outreach through project newsletters, architecture development questionnaires, and review of the final project documentation.

SCSARCH stakeholders are listed below. Figures 7 and 8 show the geographic locations of the primary stakeholders for SCSARCH. Figure 7 identifies the SCDOT district areas and Figure 8 identifies the major metropolitan areas, MPOs, and COGS throughout the state. Part III of this document provides the Turbo Architecture output identifying agencies with existing and planned interconnections to the SCSARCH. The Appendix section of this report provides additional detail for the primary agency stakeholders.

- SCDOT
- Beaufort County
- Cherokee County
- City of Charleston
- City of Columbia
- City of Greenville
- City of Myrtle Beach
- City of North Augusta
- City of Rock Hill
- City of Spartanburg
- South Carolina Council of Governments
- South Carolina Metropolitan Planning Organizations
- South Carolina Public Transit Providers
- York County
Legend

- **Interstates**
- **US Routes and Highways**
- **Metropolitan Planning Organization (MPO)**
- **Council of Government (COG)**

Source: Environmental Systems Research Institute Data (ESRI) and South Carolina Department of Transportation

**Figure 8**

June 2004
4 South Carolina ITS Concept of Operations

The process for developing the Regional ITS Architecture for South Carolina includes several key steps:

- Preparing an inventory of planned and existing systems in the Region;
- Identifying needs in the Region that could be addressed by ITS deployment or integration;
- Customizing and prioritizing market packages to address the specific needs and services identified by stakeholders;
- Developing interconnects and interfaces for system elements to map out data flows and agency links;
- Preparing an operational concept to illustrate how the systems, components and agencies will be integrated and function as a result of the architecture framework;
- Identifying high-level functional requirements;
- Identifying standards applicable to the Region, and
- Outlining potential agreements that would be needed to facilitate information or resource sharing as a result of ITS implementation.

South Carolina’s Statewide ITS Architecture includes many project architectures that have already been deployed. Each project architecture contained user services and market packages with defined interfaces and interconnects for implementation. The project architectures were gathered and combined with SCDOT’s 10-year strategic plan to develop the Regional or Statewide Architecture. With many existing market packages already in use and planned for the next ten years, the next step was to develop the regional physical architecture. To develop the state’s architecture, this study utilized FHWA’s Turbo Architecture software tool. Turbo Architecture is a planning and integration aid designed to facilitate the usage of the National Architecture.

Architecture diagrams and Turbo Architecture output with and defined categories are provided in Part III of this report.

Operational Concept and Scenarios

The Concept of Operations defines the roles and responsibilities of the numerous county, city, and state transportation and incident response agencies in the region. The Concept of Operations addresses questions of what transportation management systems and improvements are needed in the region, how individual systems can be integrated so that individual agencies can do a better job of providing transportation services to the public.

The South Carolina ITS Concept of Operations was developed to provide the region with a framework for implementing ITS infrastructure statewide. The concept identifies both existing and planned ITS infrastructure and the existing and future roles of stakeholders involved in implementing ITS services. This framework is important for identifying gaps and provides a foundation for the implementation of ITS infrastructure in the region.
The Concept of Operations provides a blueprint of future integration opportunities and ITS needs and solutions. The concept of one connection to the regional system is shown graphically in Figure 9.

The Concept of Operations for South Carolina was developed as part of the architecture development process to illustrate how systems, components, and agencies will be integrated and function as a result of the framework provided by the Regional ITS Architecture. For the South Carolina Region, a specialized scenario such as a hurricane evacuation plan was developed. South Carolina contains 187 miles of coastline. A hurricane situation will cause hazardous driving conditions along all of the major routes to and from the coast. The Concept of Operations illustrates a sequence of events during a hurricane evacuation, and how SCDOT, emergency services, public safety, and other key agencies can put pre-determined strategies into effect as well as utilize technology and communications infrastructure to alert residents and respond effectively.

Through ITS deployment, agency information sharing, and regional connectivity, agencies are able to work together and benefit from the technologies and systems in place to proactively manage the coastal area transportation system in the event of a major incident and hurricane evacuation conditions.

**Operations Agreement**

Interfaces and data flows among the stakeholder agencies will require agreements that establish parameters for sharing agency information to support traffic and incident management, provide traveler information, and perform other functions identified in the Regional ITS Architecture. Recommended projects will result in systems and interfaces that will require inter-agency agreements, possibly both public and private, to facilitate the exchange of information.

Currently, there are few formal agreements in place. Because past ITS project architectures and deployments mostly involved SDCOT and have received a high degree of cooperation among stakeholder agencies, there hasn’t been a pressing need for formal agreements to facilitate multi-jurisdictional resource sharing, cooperation or mutual aid to date. With the implementation of ITS technologies, integration of systems from one or more agencies, and the anticipated level of information exchange identified in the architecture, it is likely that more formal agreements will be necessary.

There are only two current operating agreements. One agreement is between Beaufort County and SCDOT related to Incident Response and Traffic Management within Beaufort County. The County has been and is currently developing and deploying ITS systems to SCDOT specifications. In return the state has participated in the cost of implementation. Beaufort operates and maintains their own systems, however SCDOT operates the incident response program in Beaufort County and receives reimbursement for the associated costs.

The other operating agreement within the South Carolina region is between SCDOT and television stations. SCDOT provides web based traffic video surveillance and traffic incident information in return for television stations crediting SCDOT.
The following is a list of potential agreements based on the interfaces identified in the Regional ITS Architecture and recommended ITS projects in the Deployment Plan:

- Update any current Municipal Maintenance Agreements between SCDOT and local agencies;
- Initiate Data Sharing and Usage Agreements among all other public agencies;
- Initiate Data Sharing and Usage Agreements among public and private media and information service providers;
- Initiate Shared Video Monitoring Agreements between SCDOT and emergency services agencies, and
- Initiate Mutual Aid Agreements among public sector agencies, primarily fire, police, emergency services and SCDOT.

As ITS services and systems are implemented, part of the planning and review process for those projects should include a review of potential agreements that would be needed for implementation or operations.

An introductory and initial step in developing formal agreements can be managed through a memorandum of understanding (MOU) for all stakeholder agencies. It is recommended that a MOU be prepared for all participating stakeholder agencies. The MOU will serve as an acknowledgement of agency participation and approval of the South Carolina Statewide ITS Architecture and Strategic Plan and request their pledge of support in the implementation and operation of statewide ITS systems. Further formal agreements regarding the share of information to maintain and the operations of the Regional ITS Architecture and Deployment can be pursued once ITS services and system projects are implemented involving agency interconnection.

Functional Requirements

High-level functional requirements for the SCSARCH are derived from the National ITS Architecture and its compendium of equipment packages, the building blocks of the Physical Architecture subsystems. Equipment packages group like processes (or functions) of a particular subsystem together into an “implementable” package of hardware and/or software. Since equipment packages represent the functionality needed to implement market packages (and are shown in market packages), they provide a link between the interface-oriented physical architecture definition and the deployment-oriented market packages.

The functional requirements for the SCSARCH are equivalent to the general descriptions for each subsystem, market package, and equipment packages identified in the National ITS Architecture. Market package entity names can be found in Part III of this document within the Turbo Architecture Output. Each equipment package and its functional requirements whether it is existing or planned can be referenced to the National ITS Architecture version 4.0, which can be accessed at http://itsarch.iteris.com/itsarch/.
ITS Interfaces - Interconnects

Interconnect and Information Flows

The Turbo Architecture program was utilized to identify the connections between ITS systems or “elements” in the SCSARCH inventory that support selected services or “market packages”. The regional ITS architecture interconnects are shown as a list in Part III of this document within the Turbo Architecture Output. It is a list identifying all existing and planned interconnects between ITS Systems in the region.

All existing and planned architecture flows were developed and created with the Turbo Architecture program. The Turbo Architecture output section of this document contains lists and diagrams for the SCSARCH architecture flows and the market packages selected. The output defines all existing and planned information flows between ITS Systems in the region. The information flow output include all connected source and destination ITS elements, a descriptive name for the information flowing between them, and a high-level status of that information flow (existing or planned).

Sausage, Interconnect, and Flow Diagrams are also included in this document to clarify connections to system pairs.
Using the Architecture

The success of a regional ITS architecture is dependent upon effective use of the architecture once it is developed. The regional ITS architecture is an important tool for use in transportation planning and project implementation. It identifies opportunities for making ITS investments more cost-effective. The results of the transportation planning process - the plans and programs – are an important input to the development of a regional ITS architecture. Once a regional ITS architecture is created, it can be used by stakeholders in planning their ITS projects to support regional goals. It can be used to maximize appropriate integration of projects identified by the planning process. For South Carolina’s Metropolitan Planning Organizations (MPO), Council of Governments (COG) and for other areawide and statewide planning agencies, the regional ITS architecture provides information for updating both the Transportation Plan and the Transportation Improvement Program (TIP). It will also provide information for use in other planning studies and activities, including the Congestion Management Plan, Corridor and Sub-Area Studies, performance-monitoring activities, transit development plans, and other locally defined studies or plans. For statewide planning agencies, it will provide information for updating the Statewide TIP, the Statewide Implementation Plan (SIP), and other statewide or multi-region plans and studies.

The work performed to develop the SCSARCH is useful only if it contributes to improving the integration of transportation systems in the State of South Carolina, particularly to SCDOT systems. The SCDOT transportation planning process involves project definition, review, prioritization, approval, funding allocation, and incorporation into the statewide transportation plan. The path a project follows in the planning process is dependent on the funding source being sought for the project. There are a few basic funding sources that the planning process supports: ITS earmark funds, federal, state, Congestion Mitigation and Air Quality (CMAQ), and Surface Transportation Program (STP) funds, and any Special Grant funds. The planning process was compared in relation to some of the various optional funding sources to determine how the SCSARCH and the Strategic Plan could be used as a reference in the pursuit of future ITS integration opportunities.

The process below reflects some of the steps in defining an ITS project. The steps where the SCSARCH is actually utilized are identified.

**ITS Project Initiation Plan**

1. Define SCSARCH Project
   a. Projects briefly defined with estimated budget by SCDOT
   b. **Initial Project Architecture Defined**

2. Review and Prioritization
   a. Examine/Prioritize Project List

3. Approval and Funding Allocation
   a. Approval
   b. Programming
   c. Scheduling
   d. Funding Allocation
4. Incorporation into TIP/STIP
   a. Amended to 6-Year Plan
   b. Project Scope requested

5. Project Development
   a. Refine/Develop Project Scope
   b. Refine/Develop Project Architecture

6. Project Implementation
   a. Update SCSARCH to reflect Project Implementation

The process for defining, planning, and implementing ITS projects involves several SCDOT and non-SCDOT organizations. A project is defined initially and a cost is estimated. There are three areas in the planning process that the SCSARCH Plan should be used. First, as projects are initially defined, the project initiator and SCSARCH Manager (SCDOT Traffic Operations Division), who is responsible for the SCSARCH ITS Architecture, can use the architecture to define a project architecture to better illustrate the project definition. During this step, the definition of the project can include integration opportunities that the architecture identifies. The project then is reviewed and prioritized with other projects and funding is allocated. The Transportation Improvement Plan (TIP) and the Long-Range Plan are amended for the project and its funding. The project scope will be further defined and the project architecture will be updated with more detail to reflect any changes that occur during the planning process. This is an opportunity to reference the SCSARCH again to further detail the project and its architecture. Following project implementation, the project architecture will be incorporated into the SCSARCH definition to reflect its implementation and make sure its other projects are aware of the interfaces and information that is available from the implemented system.

The purpose of this effort is not to impose more work upon the SCDOT staff managing the ITS project development, but to ensure that the projects are defined with integration in mind. Each project should consider all potential integration possibilities. FHWA policy requires the definition of ITS projects that are consistent with a regional architecture to better support integration. The architecture plan provides a guide to integration opportunities between SCDOT and the regional stakeholders. Projects defined without considering integration opportunities will be found to be more costly in the long run due to the cost of redesign in the future. These tools will allow SCDOT to better financially plan ITS investment for ITS deployment within the guidelines of FHWA’s National Architecture.

As ITS projects are processed through SCDOT’s Work Plan, the ITS implementers would use the SCSARCH Plan to scope and define their projects. They would utilize the Turbo Architecture database and application software to develop project architectures based on the SCSARCH. They would provide their project architectures to the SCSARCH Manager (SCDOT Traffic Operations Division) for review and approval for consistency with the SCSARCH.

For local government projects receiving funding for projects with SCDOT, the local government project manager would use the SCSARCH Plan for those projects involving the local government and SCDOT. Following project definition, the local government projects are forwarded to SCDOT for approval and then submitted to the SCDOT Central Office for programming and scheduling.
When other agencies are involved with the local government projects, the local governments are also encouraged to use SCSARCH to define their project interfaces.

After projects have been deployed, the final project architecture reflecting the actual status of implementation will be provided to the Traffic Operations Division for incorporation into the SCSARCH. The completion of this cycle will make the most accurate architecture data available to the region, reflecting what exists and what is planned for future project definition and planning. The SCSARCH should be used at the very beginning of this process when projects are first being defined. This may be an evolutionary step increasing the use of the architecture plan in the process as it matures.

A benefit of using the SCSARCH in this process will be more comprehensively defined projects with attention being paid to integration opportunities. By referencing a larger plan for ITS statewide, projects may be able to take advantage of other information that exists or will be made available in the future. In addition, a more focused plan will be made available throughout the state and to those organizations outside of SCDOT involved in the project planning process helping them make more informed decisions.

When utilizing ITS earmark funds, FHWA requires a project architecture at the initial proposal step and before an agreement is signed. ITS projects are defined and proposed to USDOT in a South Carolina statewide proposal. Upon completion of the review process at USDOT, Congress earmarks the funding for the state and the project is amended to the TIP or long-range plan. The use of the SCSARCH in the development of an earmark project should highlight the integration opportunities and make them evident as a worthwhile project.

**Defining New ITS Projects**

The South Carolina Statewide ITS Architecture identifies subsystems, interconnects, and information flows necessary to deploy an integrated transportation system in South Carolina statewide. The architecture will be used by SCDOT to define ITS projects that implement portions of the architecture in a phased manner. Based on priorities established by SCDOT concerning the immediate goals for ITS, projects will be defined that incrementally deploy the required elements over time.

Some projects may be able to fully deploy all interfaces, while others may require a more phased approach that maximizes the use of available funding over many years or requires that significant deployments take place before the primary objective can be made operational.

In particular, a SCDOT project manager who has identified a need for an ITS improvement system will reference the SCSARCH, the primary systems involved, and any other involved agencies. Figure 10 illustrates a basic process to develop a project architecture using the Turbo Architecture Software, the application that was used to build the SCSARCH. The boxes with the rounded corners are steps that use the Turbo Architecture Tool. By using Turbo Architecture, the project manager will examine the SCSARCH database and analyze the interconnections and information flows pertaining to each of the subsystems of interest. This analysis may identify other subsystems that should be included in the project.
The project manager will then create a project architecture using Turbo Architecture and the SCSARCH. By creating a project architecture in this manner, the project manager is using the SCSARCH as a reference and defining a project that is consistent with the SCSARCH. This maximizes the possible integration opportunities that can be considered for the project. The project manager can make informed decisions about the integration boundaries of the project in the initial implementation and what will need to be supported in the future, therefore defining a project that will support expanded capabilities in the future as the need is identified or funding becomes available. The Turbo Architecture tools can be used to examine and select which systems will be interconnected and the information exchanges that will take place between them. Turbo Architecture also contains several reporting formats that allow the user to produce diagrams and tables to convey the architecture to others for review and approval.

When the project architecture is completed, the project manager will provide it to reviewers in the appropriate project initiation process. By using a common reference point for all ITS projects in the region (statewide), the understanding of the components being deployed in each project should be better understood making the validation of the project much easier. After an ITS project is deployed, the SCSARCH must be updated to reflect the establishment of interconnects and/or information flows or new subsystems in the architecture. If portions of the project architecture were not implemented as planned, they should not be reflected in the updated architecture so they may be considered as an aspect of another project in the future.
Figure 10 – Development of a Project Architecture using Turbo Architecture

1. Define Project Need or Objective
2. Using the Existing SCSARCH Database, Initiate a New Project Architecture Definition
3. Examine/Select Systems and Market Packages to be Included in Project Architecture from SCSARCH Data
4. Apply Interconnections between project systems
5. Select Information Flows to include in Project Architecture
6. Print diagrams / tables to illustrate Project Architecture
7. Discuss/Coordinate Project Architecture with Stakeholders Involved
8. Submit Project to Reviewers
Maintaining the Architecture

As ITS projects are deployed, new ITS priorities and strategies emerge through the transportation planning process, and the scope of ITS expands and evolves to incorporate new ideas, the regional ITS architecture will need to be updated. A maintenance plan is used to guide controlled updates to the regional ITS architecture baseline so that it continues to accurately reflect the region’s existing ITS capabilities and future plans.

The SCSARCH must be kept updated so that ITS implementers using the architecture to define projects have the most accurate information available. To maintain the SCSARCH, ITS implementers representing SCDOT, local agencies, transit agencies, etc., should provide the SCSARCH manager (SCDOT Traffic Operations Division) with project architectures that reflect the projects deployed when the project is completed. These project architectures should be defined using the Turbo Architecture software and the revised database will be imported into the master SCSARCH that is under the control of SCDOT’s Traffic Operations Division. The Traffic Operations Division will be responsible for making the SCSARCH database available to all stakeholders and sending out announcements about any updates.

The SCDOT Traffic Operations Division plans to make the South Carolina Statewide ITS Architecture and Strategic Plan available to all interested stakeholders. Currently, there are no plans to provide the ITS Architecture via website access, however the South Carolina Statewide ITS Architecture and Strategic Plan was developed directly from the National ITS Architecture version 4.0, which can be accessed at http://itsarch.iteris.com/itsarch/. This site is interactive and represents the same market packages, standards, and communication flow elements used to develop the SCSARCH.