Final Report

GREAT SMOKY MOUNTAINS INTELLIGENT TRANSPORTATION SYSTEM (ITS)

VOLUME II of II: GRSM ITS ARCHITECTURE

PROJECT NAME:
GREAT SMOKY MOUNTAINS NATIONAL PARK
ITS Strategic Deployment Plan
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PREPARED FOR:
NATIONAL PARK SERVICE AND
FEDERAL HIGHWAY ADMINISTRATION
EASTERN FEDERAL LANDS HIGHWAY DIVISION

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EXECUTIVE SUMMARY

The National Park Service (NPS) in association with the Federal Highway Administration (FHWA), Eastern Federal Lands Highway Division, directed completion of this Strategic Intelligent Transportation System (ITS) Deployment Plan for the Great Smoky Mountain National Park (GRSM). The GRSM straddles the border between the states of Tennessee and North Carolina, and is one of the most heavily visited parks in the NPS. This work was conducted to determine how ITS in and around GRSM could be implemented and operationally coordinated over a period of time, establishing a framework for the Park. The ITS Deployment Plan aims to "link" both in-park and surrounding community ITS activities with other regional and statewide ITS activities in Tennessee and North Carolina.

The result of this effort is a two volume set that includes Volume I, *GRSM Strategic ITS Plan*, and this Volume II, *GRSM ITS Architecture*. Volume I focuses on plan process, project development and prioritization, leading to a list of recommended ITS projects to enhance the overall safety and operations of transportation in GRSM. A total of 20 projects were identified, of which eight are considered Early Start. Volume II on ITS architecture lays the necessary foundation to ensure that design, deployment and operations of ITS subsystems are fully in conformance with FHWA requirements for federal funding, and fit well in the regional Tennessee and North Carolina environment.

The National ITS Architecture calls for a structured, comprehensive approach to define vision, concepts, requirements, user services and supporting market packages, equipment packages and process specifications. Since 2001, it has been a Federal requirement that regions and major projects have formally developed architectures in order to qualify for Federal funding. To be in conformance, this project has followed the prescribed steps. This Volume II provides more detailed documentation of the GRSM ITS Architecture. The supporting Turbo Architecture electronic files are also available.

This volume first presents five Operational Concepts, and then lays out the associated ITS Market Packages that support, including an initial review of roles and responsibilities. Next, a GRSM ITS Architecture is developed including specific elements for regional compatibility of the greater geographic regional architectures in Tennessee and North Carolina. Roles and responsibilities are further elaborated, focusing on the five divisions of the NPS in GRSM. An overall interconnect diagram is developed.

The overall (high-level) interconnect diagram is then expanded to a comprehensive series of more specific interconnect diagrams connecting the five GRSM divisions to all other internal (i.e., division to division) plus external (park to other agency) entities. These diagrams include and illustrate detailed data and information flows. The architecture is based on National ITS Architecture Version 5.0 and the corresponding Turbo Architecture 3.0 for the detailed interconnect diagrams.

This architecture is intended to be a living document. Elements within the architecture will need to be updated to reflect ITS project advancement within the park, and to reflect updates of the greater regional architectures of Tennessee and North Carolina as they relate to the park.

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Section A: Introduction

The National Park Service (NPS) and FHWA Eastern Federal Lands Highway Division (EFLHD) has completed a Strategic Intelligent Transportation System (ITS) Plan for the Great Smoky Mountains National Park (GRSM). This plan has followed the procedural guidelines of the Federal Highway Administration for ITS planning, and is the result of a comprehensive stakeholder involvement effort. To assist in plan preparation, the NPS and EFLHD employed Wilbur Smith Associates (WSA) to coordinate and lead several plan activities, and to assemble the final report.

This strategic assessment for GRSM occurred by bringing together various stakeholders, reviewing existing conditions, and identifying relevant needs for structuring an approach to ITS in the park. An initial set of four theme areas was identified to lead the effort.

A Steering Committee and a Core Team guided project completion. Over 30 Stakeholders participated as well, representing a broad spectrum of interests in the park and its environs. Additional Interested Parties took part in key activities over the approximately four year life of the planning effort. In all, seven Stakeholder Meetings were held from 2003 through 2007. The meetings brought together the many park interests in a common forum, providing the opportunity to air viewpoints, discuss needs and work towards common ends.

This work was conducted to determine how ITS in and around GRSM will be implemented and operationally coordinated over an extended time period. The results establish an ITS framework for the park that addresses its transportation needs. GRSM lies within a regional transportation network that serves Tennessee and North Carolina, and provides local access and connections to gateway communities.

The work product is a two volume set consisting of Volume I, *GRSM Strategic ITS Plan*, and this Volume II, *GRSM ITS Architecture*. Volume I focuses on plan process, project concept development and prioritization, leading to a list of recommended ITS projects to enhance the overall safety and operations of transportation in GRSM. Volume II lays the necessary foundation to ensure that design, deployment and operations of ITS subsystems are fully in conformance with FHWA requirements for federal funding, to explore institutional agreements and technical integration for ITS projects, and to maintain the regional context as applicable in the greater Tennessee and North Carolina regional environment. Together, the contents of this Volume and material contained in Volume I provide the programmatic and procedural materials to satisfy federal ITS Architecture regulations (23 CFR Part 940, "Intelligent Transportation System Architecture and Standards," January 8, 2001) calling for conformance with the National ITS Architecture.

Section B: Roles & Responsibilities - Operational Concepts

An **operational concept** identifies the roles and responsibilities of participating agencies and stakeholders in the implementation and operation of regional systems. For the GRMS ITS Architecture, the operational concept documents these roles and responsibilities for selected transportation services in specific operational scenarios. It provides an "executive summary" view of the way the collaborative systems will work together to provide ITS services, or ITS Market Packages, that were selected and tailored to meet GRSM transportation issues.

Volume I, Section C, presented the National ITS Architecture Market Packages that were selected and then used to define GRSM ITS Strategies. The strategies in turn led to Project Concepts and ITS Architecture development, and finally to selected specific projects for GRSM to advance into design and implementation.

The Market Packages first considered were grouped into five Operational Concepts in addressing GRSM issues. The five Operational Concepts were:

- Public Transportation
- Traveler Information
- Traffic Management
- Emergency Management
- Maintenance and Construction Management

These correspond to five of the eight Market Package Service Areas defined in the National ITS Architecture.

Details of Market Packages can be found on the National ITS Architecture web site: http://www.iteris.com/itsarch (Note: This project was completed using Version 5 of the National ITS Architecture, dated October 2003. Version 6 was released in the spring of 2007, but supporting software has not yet been released. Only a few Market packages were added in Version 6).

Details of the applicable Market Packages are presented in Appendix A, along with an initial review of roles and responsibilities for GRSM stakeholders and interests. The architecture "stakeholders" in this context pertains to the team that is involved in the development and update of the architecture, whose existing and planned systems are included in the architecture. This is *different* from ITS Deployment Plan Stakeholders, which represented the larger team guiding the ITS planning effort.

The presented information should lead to more detailed discussions of institutional relationships and organizational roles needed to develop and implement GRSM ITS projects. Roles and responsibilities involve both NPS Divisions and external stakeholders. The entire review is a starting point for all stakeholders to see how they fit into unfolding GRSM ITS activities.

Section C on GRSM ITS Architecture provides related insight, focusing on roles and responsibilities of park divisions. In that section, the Operational Concepts, as embodied in the Market Packages, are translated into the GRSM ITS Architecture, including the associated interconnect diagrams and information flows.

The Market Packages identified for the GRSM ITS Architecture are the following:

PUBLIC TRANSPORTATION
- Transit Vehicle Tracking
- Transit Fixed-Route Operations
- Demand Responsive Transit Operations
- Transit Traveler Information

TRAVELER INFORMATION
- Broadcast Traveler Information
- Interactive Traveler Information
- Yellow Pages and Reservations

TRAFFIC MANAGEMENT
- Network Surveillance
- Traffic Information Dissemination
- Traffic Incident Management Systems
- Emissions Monitoring and Management
- Parking Facility Management
- Regional Parking Management
- Speed Monitoring
- Roadway Closure Management

MAINTENANCE AND CONSTRUCTION MANAGEMENT
- Maintenance and Construction Vehicle and Equipment Tracking
- Road Weather Data Collection
- Roadway Automated Treatment
- Roadway Maintenance and Construction
- Work Zone Management
- Maintenance and Construction Activity Coordination

EMERGENCY MANAGEMENT
- Emergency Call-taking and Dispatch
- Emergency Routing

Section C: ITS Architecture

One principle charge of this GRSM ITS study is the development of a park-based ITS architecture, which is compatible with the regional ITS architectures of Tennessee and North Carolina. State- and MPO-based architectures are being developed and are in various stages of implementation.

The GRSM ITS Architecture is specific service area Regional ITS Architecture, where the group of services is for the National Park and gateway travel.

The GRSM ITS Architecture is a regional ITS architecture on a scale commensurate the scope of FHWA/FLHP investments in the region. Being that FLHP Park Roads and Parkway Program funds transportation improvement of roads and transit facilities within or providing access to national parks, the project's park-centric approach to ITS planning is appropriate.

The region has been described as being "in and around the park" and "an integral part of the [Tennessee and North Carolina] regional ITS programs", with the subject area defined in terms of both Primary (park functions within and immediately adjacent to park property) and Secondary (extent of the Tennessee and North Carolina regional systems and local networks affected by and affecting park operations), or as based on the needs of the park and other stakeholders upon its development.

The GRSM ITS Architecture is developed with the use of the National ITS Architecture, tailored to the specific needs of this defined area, and compatible with the regional architectures being developed in Tennessee and North Carolina, i.e., the Knoxville Regional ITS Architecture, The Tennessee Statewide ITS Architecture, and the North Carolina Western Region ITS Architecture, respectively.

The Knoxville Regional ITS Architecture is an example of a Metropolitan Planning Area based architecture, with the Knoxville TPO maintaining the architecture in coordination with TDOT.

The NC Western Region ITS Architecture focuses predominately on tourism and weather services.

For proper integration, an architecture is necessary to identify current, planned, and needed technology applications for an efficient transportation system. An ITS architecture provides for:

- The framework and vocabulary for planning, defining, and integrating systems;
- Descriptions of functions and processes;
- Definitions of subsystems, and;
- Identification of boundaries.

I. NATIONAL ITS ARCHITECTURE OVERVIEW

Rapid advances in technology have created many new opportunities for transportation professionals to deliver safer and more efficient transportation services, and to respond proactively to increasing demand for transportation services in many areas and mounting customer expectations. However, many of these new opportunities are predicated upon effective coordination between organizations – at both an institutional and technical level.

To encourage this coordination, the USDOT has developed the National ITS Architecture and related tools to help identify and exploit these opportunities for cost-effective cooperation.

In 1997, Congress passed the Transportation Equity Act for the 21st Century (TEA-21) to address the need to begin to work toward regionally integrated transportation systems. In January 2001, FHWA published a rule 23 CFR 940 and FTA published a companion policy to implement section 5206(e) of TEA-21. This Rule/Policy seeks to foster regional integration by requiring that all ITS projects funded from the Highway Trust Fund be in conformance with the National ITS Architecture and appropriate standards. "Conformance with the National ITS Architecture" is defined in the final Rule/Policy as using the National ITS Architecture to develop a "regional ITS Architecture" that would be tailored to address the local situation and ITS investment needs, and the subsequent adherence of ITS projects to the regional ITS architecture.

FHWA rule 23 CFR 940.9 Regional ITS Architecture states, in part:

> *"(a) A regional ITS architecture shall be developed to guide the development of ITS projects and programs and be consistent with ITS strategies and projects contained in applicable transportation plans. The National ITS Architecture shall be used as a resource in the development of the regional ITS architecture. The regional ITS architecture shall be on a scale commensurate with the scope of ITS investment in the region. Provision should be made to include participation from the following agencies, as appropriate, in the development of the regional ITS architecture: Highway agencies; public safety agencies (e.g., police, fire, emergency/medical); transit operators; Federal lands agencies; State motor carrier agencies; and other operating agencies necessary to fully address regional ITS integration.*

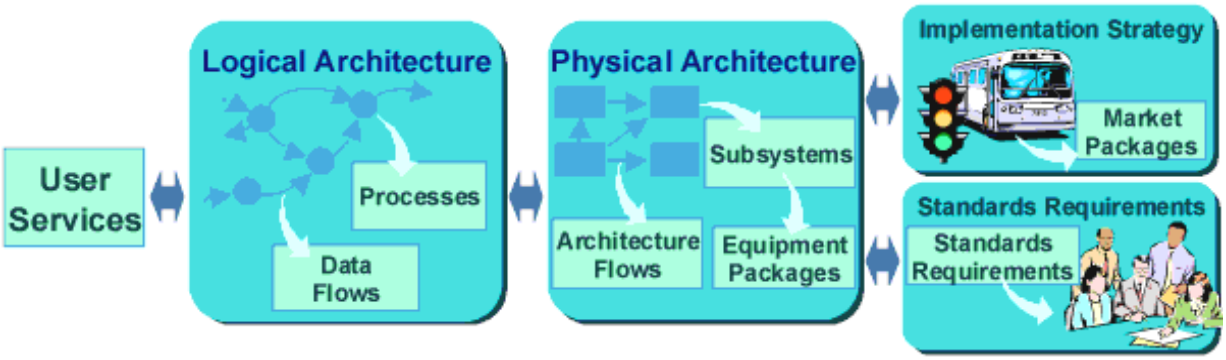
ITS projects funded under the FLHP are subject to this regulation. FHWA encourages States and MPOs to consider Federal land management agencies' participation in developing and maintaining regional ITS architectures when defined regions encompass or adjoin Federal lands.

Details of the National ITS Architecture can be found at http://www.iteris.com/itsarch .

The National ITS Architecture was developed because of the increasing sophistication of systems, stakeholders, and interdependence. It helps to develop a coherent plan for improving the transportation system over time and identify needs and opportunities for integration of ITS technologies. The National ITS Architecture is implemented through a more geographically-minded local subset of the National Architecture, developed with local requirements in mind.

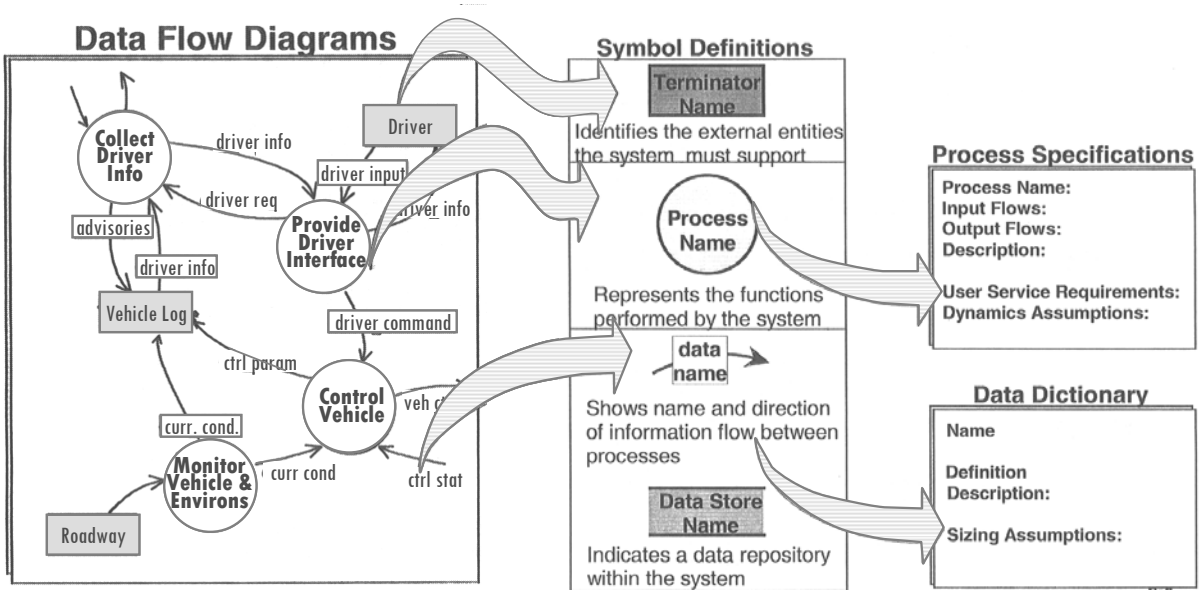
The use of the National Architecture for the development of state, regional, and local ITS architectures permits the integration of these systems providing for a much broader benefit of increased efficiency. The National Architecture is divided into logical and physical architectures. The logical architecture defines functions and relationships, and the physical architecture defines physical entity interfaces and distributes functions. An architecture flow diagram is illustrated in **Figure 1.**

FIGURE 1. ARCHITECTURE FLOW DIAGRAM



The logical architecture addresses the requirements of the User Services, which are the users of the information and data (drivers, information service provider (ISP), transit user, emergency personnel, various operators including toll, parking transit), environment (roadway, potential obstacles, and traffic), and related systems (department of motor vehicle (DMV), financial institutes, other vehicles, event promoters, and weather service). Elements included in the logical architecture are data flow diagrams, terminators, process specifications, and data dictionary. The user services requirements are related to process specifications and the data flow diagrams defines the exchange of information between processes and to the terminators. **Figure 2** illustrates the logical architecture.

FIGURE 2. LOGICAL ARCHITECTURE ELEMENTS



The physical architecture, illustrated in **Figure 3**, consists of three layers including, Communications, Transportation, and Institutional. The transportation layer, comprised of subsystems, with the communication layer interfacing between the transportation subsystems, is illustrated in **Figure 4**. The institutional layer is the supporting structure, policy and strategies, which relate to objectives and requirements. The physical architecture subsystems are further defined by the Equipment Packages, which are the deployment of technologies, each comprised of process specifications from the logical architecture. Understanding of logical and physical architectures permits the development of the necessary ITS standards which can be employed for an ITS deployment.

Subsystems and terminators are the 'entities' that represent systems in ITS. Subsystems are the highest level building blocks of the physical architecture, and the National ITS Architecture groups them into four major classes:

- Centers
- Field
- Vehicles
- Travelers

FIGURE 3. PHYSICAL ARCHITECTURE ELEMENTS

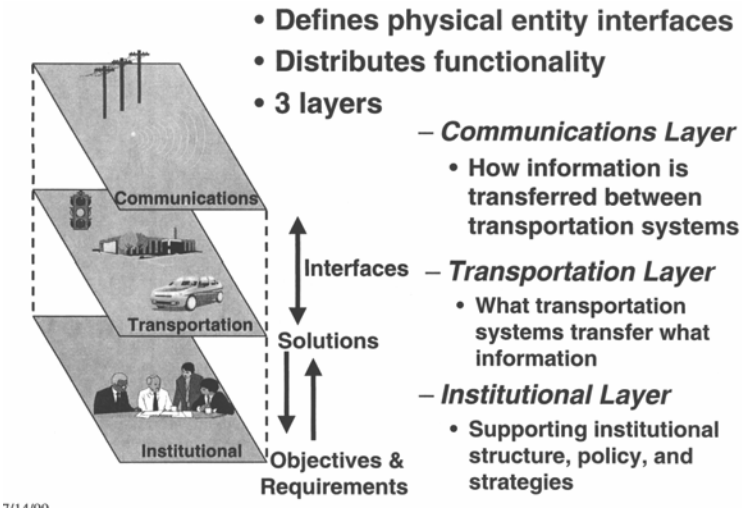
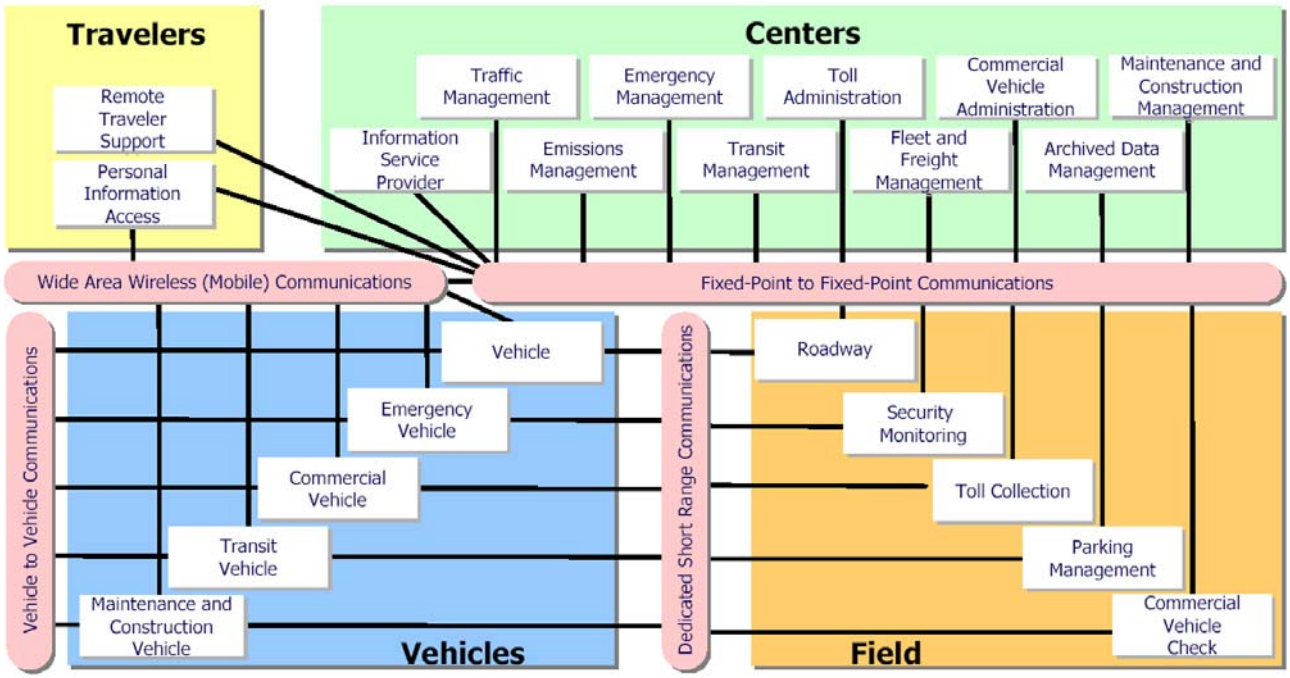


FIGURE 4. NATIONAL ITS ARCHITECTURE, PHYSICAL SUBSYSTEM INTERCONNECT DIAGRAM



Each of these major classes includes various subsystems that represent a set of transportation functions (or processes) that are likely to be collected together under one agency, jurisdiction, or location, and correspond to physical elements, such as traffic operations centers, traffic signals, vehicles, and so on. The twenty-two National ITS Architecture subsystems are shown as rectangles in Figure 4, within the four major classes listed above. Security Monitoring was incorporated in the October 2003 architecture update.

This figure, also known as the "sausage diagram" is a standard interconnect diagram, showing the relationships of the various subsystems within the architecture. Communication functions between the subsystems are represented in the ovals. It should be noted that "wireline" communication refers to fixed-point to fixed-point communications, which include not only twisted pair and fiber optic technologies, but also such wireless technologies as microwave and spread spectrum.

Terminators are the people, systems, other facilities, and environmental conditions outside of ITS that need to communicate or interface with ITS subsystems. They help to define the boundaries of the National ITS Architecture, as well as a regional system. Examples of terminators include drivers, traffic operations personnel, information service providers, weather effects (snow, rain, fog), telecommunications systems, and government reporting systems, among others.

II. REGIONAL ITS ARCHITECTURES

Because it is unlikely that the entire National ITS Architecture would be fully implemented by any single metropolitan area or state, the 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. Tennessee

TDOT has a Statewide ITS Strategic Plan, called *SmartWay*, that was first produced in 1998 and is updating annually. This plan presents TDOT's priorities involving the use of ITS and ongoing ITS projects within the State. The applications primarily address TDOT's principal arterial highways statewide. The issue of integrating local agency strategies is concentrated in the four major urban areas: Chattanooga, Memphis, Nashville, and Knoxville, with each area having a regional ITS architecture.

In relation to the park travel, TDOT is currently involved with ITS technologies through the following applications:

- Highway advisory radio (HAR) in Knoxville
- Statewide truck pre-clearance program (PrePass).
- Traffic monitoring and detection cameras monitor traffic congestion and improve incident management capabilities in Knoxville

- camera and dynamic message sign (DMS) availability through TDOT's website for the public to view current traffic conditions in Knoxville
- Freeway service patrols in, Knoxville
- Real-time weather, construction and travel information at welcome centers and rest areas.

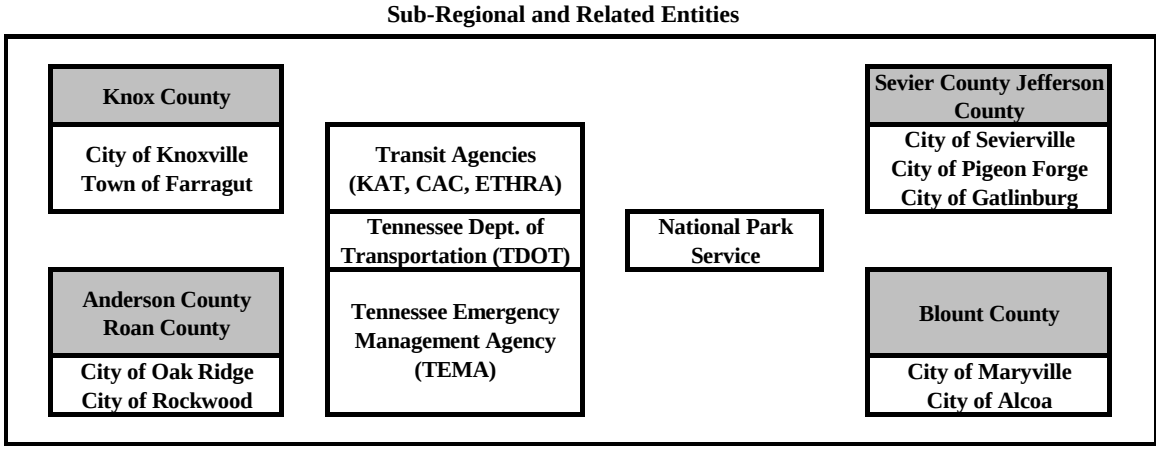
This plan is intended to enable GRSM as TDOT's stakeholder to coordinate park efforts towards an integrated approach for ITS in Tennessee. More information can be found here: http://www.tdot.state.tn.us/tdotsmartway/itannualreport.pdf

Tennessee Department of Transportation states that any real time traffic information generated from the park area would enhance TDOT's ongoing efforts to provide travel information to the public utilizing the TDOT website and future deployment of the freeway management system in the Knoxville area as well as a future statewide 511 travel information service.

The Knoxville Regional ITS Architecture was developed in 2000 and included connectivity between the park and the following agencies: TDOT (Freeway Management), Tennessee Emergency Management Agency, Knoxville Area Transit, Pigeon Forge, Sevierville, Gatlinburg, Jefferson County, Sevier County, Maryville, Alcoa and Blunt County. The GRSM park is noted as *National Park Service.* Details on the park were very limited, but it served in the development of this GRSM (park-centric) architecture. It also included the GRSM park, noted as *National Park Service.*

The regional architecture is divided into four sub-regions described in **Figure 5**. Sub-regions are essentially the Counties of Knox, Blount, combined Roan and Anderson, and combined Jefferson and Sevier.

FIGURE 5. KNOXVILLE AREA REGION ITS ARCHITECTURE



Within each municipal jurisdiction or ITS related entity, the physical architecture include Traffic and Emergency Management Centers, Roadway, and Emergency Vehicle subsystems integrated with the sub-regional Traveler information and Parking (Knox Co.) subsystems. A separate ITS related entity is established for GRSM, labeled as *National Park Service*, which was illustrated

with Traffic Management Center (TMC) and Roadway subsystems. The sub-regions are then integrated with the region through the TDOT Freeway Management System, Tennessee Emergency Management Agency (TEMA), and Transit, which includes Knoxville Area Transit (KAT), CAC, and Eastern Tennessee Human Resource Agency (ETHRA). Regional subsystems include a Transit Management Center and Transit Vehicle systems. Sevier County sub-region also includes a Transit Management Center and Transit Vehicle subsystems.

The Knoxville Regional ITS Architecture has been updated and is presented in the 2005-2030 Knoxville Long Range Transportation Plan, dated May 2006. The architecture is now maintained by the Knoxville TPO, who ensures coordination with TDOT. As a geographic local entity, the park is listed as part of the Knoxville region. Integrating the GRSM ITS into TDOT activities is part of the architecture's scope. This latest update, however, did not include the many instances for potential system interoperability with GRSM as it did before.

Currently, the Knoxville ITS plan calls for ITS coverage throughout Knox County only and does not reach beyond to include the entire Knoxville Region. The plan provides information on the interstate and expressway system in Knox County and does not currently go beyond to include the arterial and collector system or specific congested intersections. A key objective of that plan is to promote traffic management system deployment throughout the region, including placement of CCTV cameras and dynamic message signs in Blount, Sevier and Cocke Counties.

For more information on the Knoxville Regional ITS Architecture, refer to the following Knoxville TPO site: http://www.knoxtrans.org/plans/lrtp.htm

B. North Carolina

ITS architectures components by the North Carolina Department of Transportation (NCDOT) that related to GRSM are included in this section. Statewide ITS guiding principles are stated as follows in the North Carolina Statewide Intelligent Transportation System Strategic Deployment Plan[1]:

- Increased motorist safety and security
- Preserve infrastructure and services
- Ensure transportation system efficiency
- Increased economic development opportunities
- Incorporate the ideas and concerns of a broad cross-section of stakeholders in the State's transportation system
- Provide both static and dynamic transportation information, including road conditions, closures, and incident management.
- Develop a mechanism to facilitate the sharing of information between NCDOT and other public and private agencies

The statewide architecture is divided into nine regions, six urban and three rural, and addresses short and long range deployment strategies. Adjacent to the park is the Western Region including

[1] North Carolina Statewide Intelligent Transportation System Strategic Deployment Plan prepared by Kimley-Horn and Associates.

Cataba, Cleveland, Burke, Caldwell, Wilkes, Rutherford, Lincoln, Haywood, McDowell, Watauga, Alexander, Jackson, Macon, Transylvania, Ashe, Cherokee, Madison, Polk, Yancy, Avery, Mitchell, Swain, Alleghany, Clay, and Graham Counties. Larger cities in the Western Region include Hickory, Boone, Forest City, and Waynesville. Other cities are Conover, Newton, Statesville, Shelby, Kings Mountain, Boiling Springs, Morganton, Lenoir, Wilkesboro, Millers Creek, Mulberry, Spindale, Lincolnton, Etowah, Marion, Blowing Rock, Dobson, Taylorsville, Sylva, Cullowhee, Franklin, Highlands, Brevard, Jefferson, Andrews, Murphy, Marshall, Mars Hill, Burnsville, Newland, Spruce Pine, Elkin, Bryson City, Sparta, and Hayesville.

The Western Region is one of the rural ITS regions, of which the North Carolina portion of GRSM is a part. For the rural regions, emphasis is the provision of tourist and traveler information, which would include advising of weather conditions, and accident response. Through the process of developing the Western Region architecture, it was determined that the immediate issues were traveler information, truck safety, and tourist information. The architecture concept is the NCDOT control of local signal systems, an Incident Management Assistance Patrol (IMAP) program, and travel information using rural workstations and other traffic operations centers.

Regional ITS goals are divided for short- and long-term. Short-term goals include:

- Increasing motorist safety and security,
- Preservation of infrastructure and services,
- Ensuring transportation system efficiency, and
- Incorporation of stakeholders' input in the planning process.

In addition to the short-term goals listed, a long-term goal is the increased opportunities for economic development.

User Services groups and critical program areas for rural regions are described in Table 1.

TABLE 1. NORTH CAROLINA ITS USER SERVICES GROUPS AND RURAL PROGRAM AREAS

USER SERVICES GROUP	PROGRAM AREAS
Travel and Transportation Management	Traveler Safety and Security
Travel Demand Management	Tourism and Travel Information Services
Urban Transit Systems	Public Traveler/Mobility Services
Emergency Notification & Emergency Management	Emergency Services
Electronic Payment Services	Fleet Operations & Management
Commercial Vehicle Operations (CVO)	Commercial Vehicle Operations (CVO)
Advanced Safety and Control Systems	Infrastructure Operations and Maintenance

Source: NC Statewide ITS Strategic Deployment Plan, Western Regional Report, KHA

The NCDOT perceived role of the NPS development of an ITS architecture and ITS deployment is the partnership with NCDOT and local municipalities to share traveler information over several modes of travel that would be beneficial to both travelers and service providers. The NCDOT identified the following benefits from the coordination of the NPS ITS architecture and deployment and NCDOT's:

- Integration with NCDOT's current ITS deployments in the region.
- Opportunity to pursue special funding for rural ITS deployments.
- Opportunity for system integration between future transportation management centers in North Carolina and Tennessee.

For the Western Region that includes the North Carolina portion of GRSM, short-term deployment is through fiscal year 2006 and long-term deployment is through fiscal year 2011. Recommended short-term technologies include:

- Traveler information kiosks
- Truck safety on mountain grades
- Web-based mapping and route identification
- Broadcast video and data
- Internet travel information system enhancements (NCSMARTLINK)
- Interim traveler information clearinghouse
- Traffic Operations Center and information clearinghouse
- Portable changeable message signs
- Road weather information systems (RWIS)
- Transit dispatching, demand forecasting, and automated passenger counting

Long-term technologies are:

- TOC (Traffic Operations Center) and ATIS second phase
- Smart Cards
- Voice Remote Access System (VRAS)
- Internet travel information system enhancements (Western Rural NCSMARTLINK)
- Regional archived data warehouse
- Regional system integration

For more information on the North Carolina Western Region ITS Architecture, see http://www.ncdot.org/doh/Operations/dp_chief_eng/its/download/Western_Report.pdf.

III. GRSM ITS ARCHITECTURE DEVELOPMENT

The Great Smoky Mountain National Park ITS architecture development provides an appropriate mechanism for the interface the coordination between the park's plan and the plans developed for both Tennessee and North Carolina. The architecture developed for Great Smoky Mountain National Park expands on the Tennessee's Knoxville and North Carolina's Western Area regional architectures. With coordinated and compatible architectures, traveler information and data can

be further disseminated allowing for earlier traveler choices and greater ability to coordinate transportation systems between states, cities, towns and NPS.

This section includes a description of the GRSM-centric ITS Architecture. The reason the architecture is considered GRSM-centric is that data flows between entities external to GRSM (such as those between Gatlinburg and Pigeon Forge) are not defined in this architecture. Such data flows have already been defined in the Knoxville Regional ITS Architecture. The aim was to develop a GRSM ITS Architecture with inter-relationships of the ITS strategies between themselves and those of the Knoxville Regional ITS Architecture and the North Carolina West Region ITS Architecture, both of which address the park, for appropriate linkages to these respective regional ITS architectures. Material in this section includes:

- A general overview of ITS Architectures
- Identify the GRSM Region
- Identify the GRSM Stakeholders
- Identify the GRSM ITS inventory assessment
- Identify ITS Needs and Market Packages

This GRSM ITS Architecture represents a specific service region, i.e., the National Park. While not developed as a State or Metropolitan regional ITS Architecture, it does represent a local implementation of the National ITS Architecture with centricity about the park's geographic location as well as the park's management and operational functions, outward to those transportation elements, systems, and entities with which the park currently does or potentially may collaborate and interface. By having the GRSM ITS Architecture linked to the regional ITS architectures on its Tennessee side and North Carolina side, this not only satisfies the federal ITS regulation for future ITS projects by the park, it also expands the park's definition and interfaces within those respective regional architectures. The Federal Lands Highway Office of the FHWA anticipates that many other NPS units in similar regional transportation environments would satisfy architecture conformity requirements in this manner. The terminology "ITS Architecture" comes from the United States Department of Transportation (USDOT) that has set forth a framework for how ITS should be planned and deployed across the nation. This framework allows each agency to design and develop their respective systems (freeway management, traffic signal systems, transit management, etc.) with an understanding of the data structure needed to support a regional effort to share data.

Through stakeholder involvement and understanding of the regional and local architectures, market packages were identified for the Great Smoky Mountains National Park. Market packages are the identification of architecture components that may be implemented for a particular service to be provided. Included in the Market Packages are physical architecture subsystems, equipment packages, architecture flows and logical architecture elements. Market Packages provide clear ties to transportation problems.

The GRSM Regional ITS Architecture has been developed in accordance with Version 5.0 of the National ITS Architecture and the corresponding Version 3.0 of FHWA's Turbo Architecture tool. As noted previously, Version 6.0 has recently been released, but a corresponding Turbo Architecture update is pending.

Significant input to the architecture development process was provided by GRSM staff. The resulting Regional ITS Architecture is intended to provide a basic ITS architecture, that will serve as input to and the basis for further discussions with other stakeholders, as the architecture continues to evolve in the future.

A. GRSM Region

The region for which this ITS Architecture is being developed corresponds to the GRSM Park geographic region.

The GRSM region consists of the GRSM National Park which is located along the borderline of Tennessee and North Carolina. As mentioned before, this ITS architecture is GRSM-centric and focuses on the park jurisdiction; however, efficient co-ordination and planning cooperation with Gateway Communities is central to GRSM park transportation operations. To that effect, this architecture also includes the Gateway Communities and other service providers to the extent that their interaction with all the GRSM divisions is included within the architecture.

B. GRSM ITS Architecture "Stakeholders"

The success of any ITS architecture depends on participation by a diverse set of participants. Please note that USDOT refers to ITS Architecture participants as "stakeholders". The Architecture "stakeholders" are different from this project's Stakeholder group. For the purpose of ITS Architecture discussions, please note that the reference will be "stakeholder" which is described in this section – not the Stakeholder group for the Project. As mentioned before, this architecture effort is GRSM-centric and treats the park (divisions within the park organization) as the key stakeholders for this architecture. This architecture effort also addresses the Internal Stakeholder's (the park's) interaction with Gateway Communities and other transportation service providers for transportation operations and information coordination. Hence, the stakeholders in this ITS architecture are divided in two groups; GRSM Internal Stakeholders (GRSM Divisions), and GRSM External Stakeholders (Gateway Communities and other transportation service providers).

GRSM INTERNAL STAKEHOLDERS: In order to understand this internal stakeholder group, it is extremely important to understand GRSM Organizational Structure (refer to Vol I, Section B.-IV. for detailed information on GRSM organizational structure).

Considering the organizational structure and involvement of different divisions in transportation related operations, **Table 2 – GRSM Architecture Internal Stakeholders and Responsibilities** presents the list of internal stakeholders for this architecture along with their roles and responsibilities.

TABLE 2. GRSM ARCHITECTURE INTERNAL STAKEHOLDERS AND RESPONSIBILITIES

Stakeholder	Roles and Responsibilities
GRSM Division of Administration	The Division of Administration is one of the five divisions under the park Superintendent. The division of administration is responsible for securing funding for transportation activities within the park. The Division of Administration is also responsible for maintenance of the GRSM intranet for information exchange within various park divisions. Also, GRSM Division of Administration serves as the official channel for information exchange between any of the park divisions and Gateway Communities or any other stakeholders outside the GRSM park organization.
GRSM Division of Facility Management	GRSM Division of Facility Management is responsible for planning, design and maintenance of the transportation network within the park. The major components of the Division of Facility Management include the two districts: North and South; as well as the support staff with landscape architecture, engineering and transportation planning backgrounds.
GRSM Division of Resource and Visitor Protection	The GRSM Division of Resource and Visitor Protection is responsible for law enforcement, emergency operations, HAZMAT management, and the day to day operations on the transportation network within the park.
GRSM Division of Resource Management and Sciences	GRSM Division of Resource Mgmt. and Science is responsible for weather data collection and analysis, and Forest Fire Management.
GRSM Division of Resource Education	GRSM Division of Resource Education has a chief that is supported by park rangers. The primary responsibility of the Resource Education division is to get the message out about the park attractions and the information related to park activities. The Division of Resource Education is responsible for majority of traveler information distribution activities for the park.

GRSM EXTERNAL STAKEHOLDERS: Although this architecture is GRSM-centric, the interaction between various GRSM divisions with Gateway Communities and other transportation service providers is critical for efficient transportation system operations within and around the park. Hence, the Gateway Communities are addressed as GRSM External Stakeholders in this architecture development. While all the responsibilities and elements of the GRSM External Stakeholders are covered in detail under this architecture development effort, the extent of this document extends only up to their interaction with various GRSM divisions. The following list identifies the GRSM External Stakeholders.

- Cherokee Nation
- Cherokee Transit
- FHWA – Eastern Federal Lands Highway Division (EFLHD)
- Gatlinburg Mass Transit – TN
- Knoxville Transportation Planning Organization (TPO)
- Land of Sky Planning Organization
- Local Emergency Response Providers
- Local Fire Response Providers
- Media
- National Interagency Fire Center
- National Park Service – Denver
- National Park Service – SERO
- National Park Service – WASO
- National Weather Service
- North Carolina Cities (Bryson City, Maggie Valley, City of Cherokee, and City of Waynesville)
- North Carolina Counties (Haywood County, Graham County, and Swain County)
- North Carolina Department of Transportation
- Pigeon Forge Fun Time Trolley – TN
- Regional ISPs
- Rural Planning Organization NC
- Tennessee Department of Transportation
- Tennessee Localities (City of Gatlinburg, City of Pigeon Forge, City of Sevierville, City of Townsend, Sevier County, Cocke County, and Blount County)
- Visitor Welcome Centers

C. GRSM ITS Inventory Assessment

The next step in the architecture development process is to assess the existing ITS inventory as well as non-ITS equipment inventory operated and maintained by the GRSM Internal and External Stakeholders. Such an assessment will provide a conceptual background regarding functional responsibilities of the stakeholders and necessary information exchange for seamless day to day operations as well as future ITS deployment.

As this is a GRSM-centric architecture developed specifically for the park, it is important to look at functional responsibilities and inventory elements maintained and operated by various GRSM divisions. Functional responsibility and inventory information for all the other stakeholders are included in architecture development materials. Please refer to **Table 3** for the functional responsibilities and inventory elements for all the internal Stakeholders.

TABLE 3. FUNCTIONAL RESPONSIBILITIES AND INVENTORY ELEMENTS

Stakeholder	Functional Responsibility	Inventory
GRSM Division of Administration	Secure Funding Communications Customer Service(Special Events) Maintain GRSM intranet Vehicle Fleet Control	Operations Center Division Fleet Vehicles GRSM Intranet Service 2-Way Communications
GRSM Division of Facility Management (planning, design and maintenance)	Communications Surface Street Maintenance Data Collection and Analysis Incident Detection Vehicle Fleet Control Planning Maintenance of Communication Systems (HAR,2Way Comms,etc.)	Vehicle Detectors Division Fleet Vehicles Operations Center 2-way Communications Communication Towers
GRSM Division of Resource and Visitor Protection (Law enforcement and Day to Day Operations)	Emergency Management Incident Management Traffic Management Traffic Control at Incident Sites Communications/Dispatch Disabled Vehicle Assistance Patrol Vehicle Fleet Control Incident Detection Monitor Traffic Data Collection and Analysis HAZMAT Responsibility	Patrol vehicles 2-Way Communications Dispatch Center Operations Center DMS Weather Information Collection Systems (5 manual)

TABLE 3. FUNCTIONAL RESPONSIBILITIES AND INVENTORY ELEMENTS (cont.)

Stakeholder	Functional Responsibility	Inventory
GRSM Division of Resource Management and Science	Emergency Management (fire)	Fire Response Vehicles
	Communications	Operations Center
	Incident Detection	Division Fleet Vehicles
	Monitor Air Quality	2- Way Communications
	Weather Data Collection and Analysis	Weather Information Collection Systems
	Forest Fire Condition Assessment	Air Quality monitoring devices
	Vehicle Fleet Control	Fire Response Air Plane
GRSM Division of Resource Education	Customer Service	Website
	Incident Detection	Operations Center
	Communications	HAR
	Vehicle Fleet Control	Division Fleet Vehicles
		2-Way Communications

Regional ITS Subsystems and Terminators

Each identified system or inventory component in the GRSM ITS inventory was mapped to a subsystem or terminator in the National ITS Architecture. As mentioned in Table 2 above, the inventory items are associated with different divisions within the GRSM Park division and hence all the inventory items are associated with an architecture element denoted by the particular division name. See Figure 4 for reference. For example, GRSM architecture terminators include GRSM divisional vehicles, traveler, other emergency vehicles, personnel (local, non-GRSM), etc.

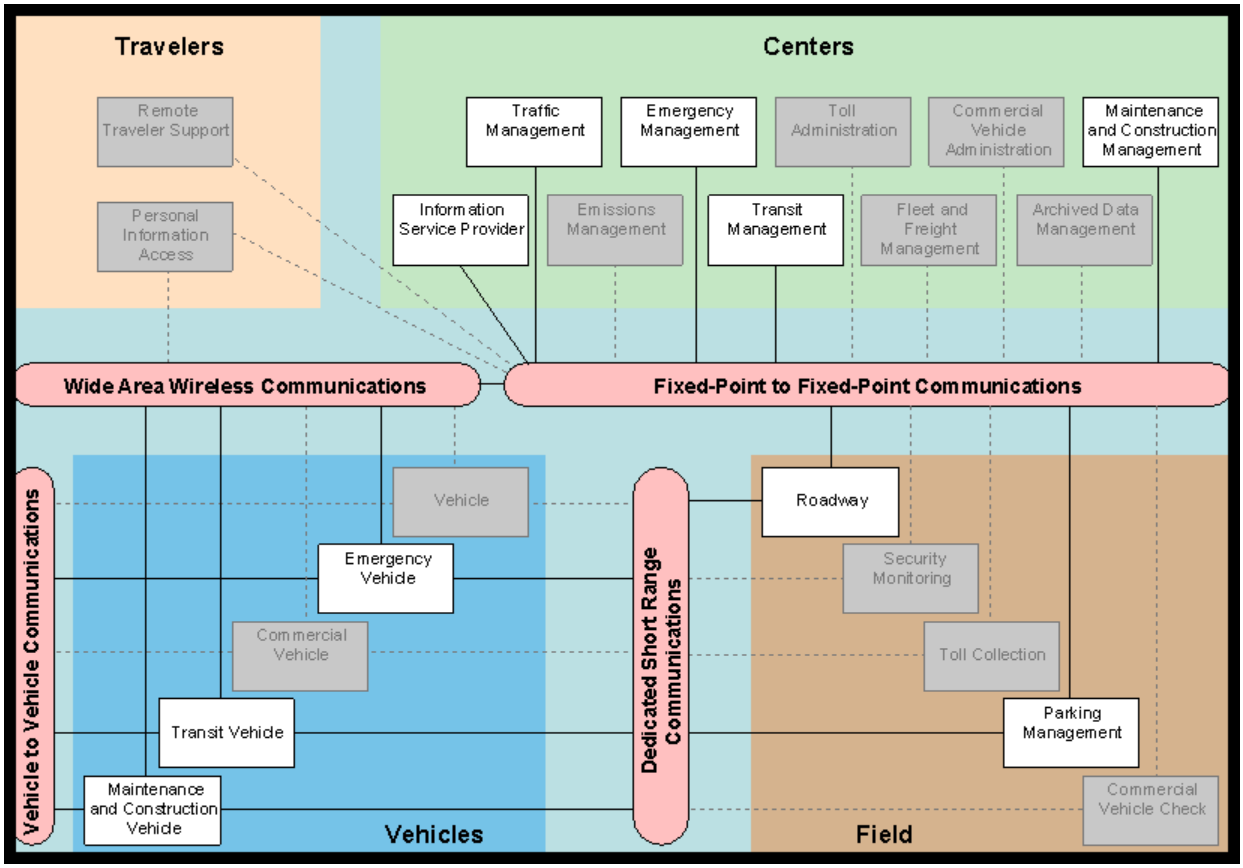
D. The GRSM "Sausage" Diagram

The identified architecture stakeholders and existing inventory/needs described above, plus the selected Market Packages and associated Operations Concept, all represent major inputs to the ITS architecture development process. This information was entered into Turbo Architecture Version 3.1 to facilitate subsequent steps in the development process. The National Architecture and Turbo Architecture use a variety of abbreviations and terms to describe the many components and relationships represented by the Architecture.

The GRSM ITS Architecture is represented by a series of Interconnect Diagrams (see Appendix A), which show existing and planned connections between the various physical elements of the ITS Architecture. These Interconnect Diagrams were presented to GRSM staff for review and discussion to ensure accuracy.

The ITS Architecture Framework for the GRSM Region is shown in **Figure 6 – GRSM High-Level Interconnect Diagram**. Those elements in the figure that are highlighted apply to the GRSM Region.

FIGURE 6. GRSM HIGH-LEVEL INTERCONNECT DIAGRAM



Appendix A: ITS Market Packages

The Market Packages first considered were grouped into five Operational Concepts in addressing GRSM issues. The five Operational Concepts were:

- Public Transportation
- Traveler Information
- Traffic Management
- Emergency Management
- Maintenance and Construction Management

Below are the diagrammatic portions of the architecture which are presented in figures for each Market Package in the following sections:

The **Subsystem** contains equipment packages included in the Market package. Subsystems are individual pieces of the Intelligent Transportation System defined by the National ITS Architecture. Subsystems are grouped into four classes: Centers, Field, Vehicles, and Travelers. These correspond to the physical world.

The **Equipment Package** is contained in a subsystem and part of the Market Package. Equipment packages are the building blocks of the physical architecture subsystems. Equipment Packages group similar processes of a particular subsystem together into an "implementable" package.

Subsystem that participates in the Market Package operation through **data sharing**. The equipment packages that support the data sharing are defined as part of a separate Market Package.

Terminator participates in the Market Package operation. Terminators represent the people, systems, and general environment that interface to ITS.

Architecture flows that support the Market Package operation. Shows Information that is exchanged between subsystems and terminators in the physical architecture.

Note that most Market Packages are composed of multiple equipment packages and information flow links interfacing between various subsystems. The undertaking of an ITS project may not necessarily include the deployment of the entire Market Package as defined in the National ITS Architecture. The scope and phasing of ITS deployment project(s) is determined through a systems engineering analysis and project-level architecture development on a capital program level and project-by-project basis. Also note that some equipment packages may be presented in multiple Market Packages. Therefore, deployment of the equipment packages should be coordinated on the capital program level and on a project-by-project basis.

Prior to the deployment of any ITS project, a systems engineering analysis must take place that assesses the operational and maintenance requirements. A systems engineering approach for the National Park Service is described in Volume I, Section E-III. These requirements must be satisfied with a resource plan that will assure more effective operations and maintenance. The resource plan should include personnel needs, with specific responsibilities identified, and equipment resources that will facilitate the staff resources to keep all systems and equipment in operation.

I. PUBLIC TRANSPORTATION

This Service Area covers the Market Packages that relate to transit operations. The Market Packages that have been selected for the Regional ITS Architecture include:

- Transit Vehicle Tracking;
- Transit Fixed-Route Operations;
- Demand Responsive Transit Operations;
- Transit Traveler Information.

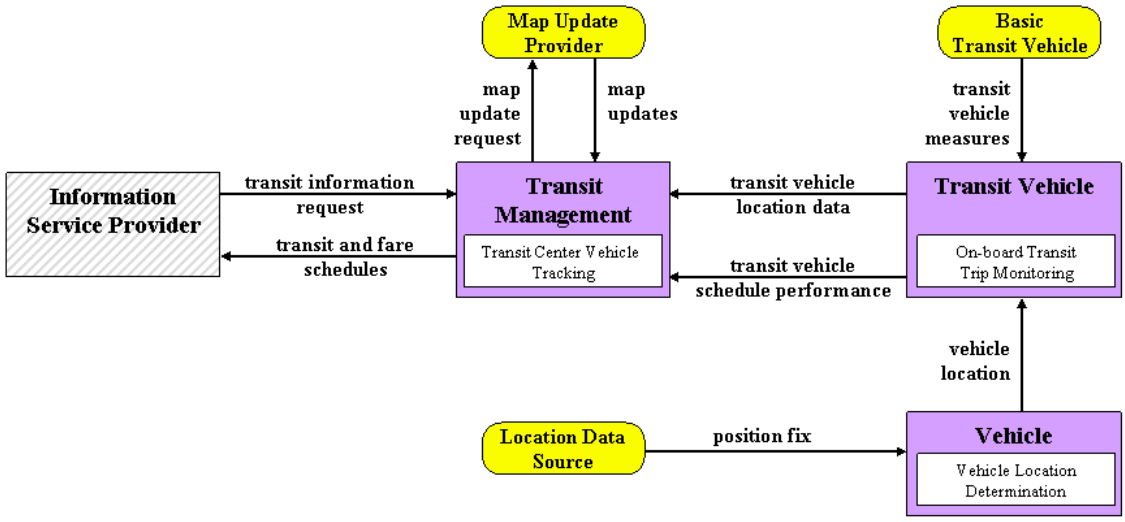
This Service Area of Market Packages will relate to the transit systems which offer services into and out of the GRSM Park. Currently, the systems that offer such trolley services are: Gatlinburg Mass Transit, Pigeon Forge Fun Time Trolley, and Cherokee Transit.

A. Transit Vehicle Tracking

This market package monitors current transit vehicle or trolley locations using an Automated Vehicle Location (AVL) System. It serves as a building block for other transit related ITS applications and transit traveler information systems. The location data is collected by the Transit Management subsystems, situated with the *Gatlinburg Mass Transit, Pigeon Forge/Sevierville Fun Time Trolley, and Cherokee Transit operating agencies*, where it may be used to determine real time schedule adherence and update the transit system's schedule in real-time. The data is disseminated to Information Service Providers (ISPs) who store the information in a central database, and may use the information to support various ATIS elements.

The figure below represents the Market Package Graphic for the *GRSM Architecture*:

APTS1 – Transit Vehicle Tracking



1. Subsystems

Vehicle - This subsystem provides the sensory, processing, storage, and communications functions necessary to support efficient, safe, and convenient travel. These functions reside in the identified vehicles, in this case transit vehicles or trolleys belonging to the respective transit agencies.

Transit Vehicle - This subsystem resides in the transit vehicle or trolley and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers.

Transit Management – This subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It includes the capability to monitor for a transit vehicle being off the assigned route. A separate Transit Management subsystem resides with each of the respective transit agencies.

Information Service Provider (ISP) - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. There are multiple stakeholders who serve as ISPs in this architecture, including the transit agencies themselves and their existing partners, any other agency or third party interested in providing transit traveler information, and the *GRSM*. *The GRSM, through its Division of Resource Education*, will store the transit vehicle location and other related transit information in a central traveler information database at its Operations Center, and use it to support their ATIS elements in the architecture.

2. Terminators

Location Data Source - provides accurate position information. Systems which use GPS, terrestrial trilateration, or driver inputs are all potential examples of Location Data Sources.

Map Update Provider - Represents a third-party developer and provider of digitized map databases used to support the Transit Management System. It supports the provision of the databases that are required for display by transit management operators.

Basic Transit Vehicle - The trolley, or may be any other type of vehicle that is designed to carry passengers.

3. Equipment packages

Transit Center Vehicle Tracking - Monitors transit vehicle or trolley location within the Transit Management Subsystem. The location information is collected via a data communication link between the trolley and the transit agency operations center. The location information is presented to the transit operator on a Geographical User Interface (GUI) digitized map of the transit service area. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. The real-time schedule information is provided to ISPs equipment packages, which furnish the information to travelers.

On-board Transit Trip Monitoring - Tracks trolley location, monitors fuel usage, collects operational status (doors opened/closed, running times, etc.) and sends the collected, time-stamped data to the Transit Management Subsystem.

Vehicle Location Determination - This equipment package determines current location of the trolley using GPS or similar location referencing capability and provides this information to other equipment packages on the trolley that use the location information to provide various ITS services.

4. Operations and Maintenance

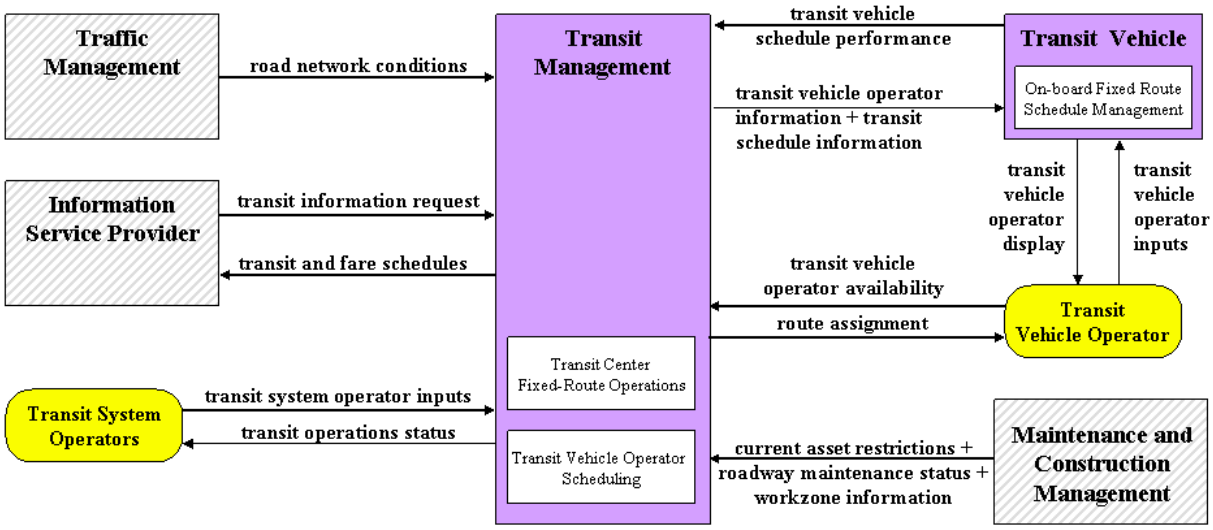
Each respective transit agency will be responsible for all the subsystems, equipment packages, and information flow links in this Market Package, except for the information flow link to the *GRSM*, and *GRSM data management* of its traveler information database. *GRSM* will develop an agreement for information link responsibilities, and they will be solely responsible for their own ISP services.

B. Transit Fixed-Route Operations

This market package supports the transit management agencies to maximize the efficiency of their fixed-route operations by performing vehicle routing and scheduling, as well as system monitoring for fixed-route and flexible-route transit services. This service determines current schedule performance using trolley AVL data from APTS-1, and provides information displays for system management function at the Transit Management Subsystem. Static and real time transit data is exchanged with Information Service Providers (ISPs) where it is integrated with that from other transportation modes (e.g. highway) to provide the public with integrated multimodal information. Road closure and incident information from highway agencies Traffic Management and Maintenance and Construction Management subsystems is collected by the transit agencies to make routing and scheduling adjustments.

The figure below is the Market Package Graphic from the National ITS Architecture.

APTS2 – Transit Fixed-Route Operations



1. Subsystems

Transit Vehicle - This subsystem resides in the transit vehicle or trolley and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers.

Transit Management – This subsystem manages transit vehicle fleets through a computer-aided dispatch (CAD) system, integrated with an AVL system, and coordinates with other modes and transportation services. It includes the capability to monitor for a transit vehicle being off the assigned route. A separate Transit Management subsystem resides with each of the respective transit agencies. The Transit Management and Transit Vehicle Subsystems belong to each transit agency which integrates their respective systems (*Gatlinburg Mass Transit, Pigeon Forge Fun Time Trolley, and Cherokee Transit*).

Information Service Provider (ISP) - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. There are multiple stakeholders who serve as ISPs in this architecture, including the transit agencies themselves and their existing partners, any other agency or third party interested in providing transit traveler information, and the *GRSM*. *The GRSM, through its Division of Resource Education*, will store the transit vehicle location and other related transit information in a central traveler information database at its Operations Center, and use it to support their ATIS elements in the architecture.

Traffic Management – This subsystem monitors and controls traffic and the road network. It represents centers that manage a broad range of transportation facilities including Interstate/freeway systems, local/arterial highway systems, and traffic signal control systems. Basically any traffic management agency having roadway jurisdiction in which

one of the transit operations utilizes on its fixed-route operations, or may impact the operations, is included in this Market Package. For the *GRSM*, this information would come from the *Division of Resource and Visitor Protection*.

Maintenance and Construction Management – This subsystem monitors and manages roadway infrastructure construction and maintenance activities. Information of any such activities that are blocking lanes or restricting roadway access is transmitted to the Transit Management Subsystem. Basically any traffic management agency having roadway jurisdiction in which one of the transit operations utilizes on its fixed-route operations, or may impact the operations, is included in this Market Package. For the *GRSM*, this information would come from the *Division of Facility Maintenance*.

2. Terminators

Transit Vehicle/Trolley Operator - This terminator represents the human entity that receives and provides additional information that is specific to operating the ITS functions in all types of transit vehicles.

Transit System Operators - This terminator represents the human entities that are responsible for all aspects of the transit system operation including fleet management, maintenance operations, and scheduling. This entity actively monitors, controls, and modifies the transit fleet routes and schedules on a day to day basis (dynamic scheduling). The modifications will be to take account of abnormal situations such as vehicle breakdown, vehicle delay, detours around work zones or incidents (detour management and service restoration), and other causes of route or schedule deviations.

3. Equipment Packages

Transit Center Fixed Route Operations - It supports planning and scheduling of fixed transit services. The package allows fixed-route transit services to develop and disseminate schedules and automatically updates customer service operator systems with the most current schedule information. This equipment package also supports automated dispatch of transit vehicles. Current vehicle schedule adherence and optimum scenarios for schedule adjustment are also provided.

Transit Vehicle Operator Scheduling - Automates and supports the assignment of transit vehicles and operators to enhance the daily operation of a transit service. It provides the capability to assign operators to routes or service areas in a fair manner while minimizing labor and overtime services, considering operator preferences and qualifications, and automatically tracking and validating the number of work hours performed by each individual operator. This operator scheduling function may be performed at the CATS Transit Garage facility rather than its operations center.

On-board Fixed Route Schedule Management - Monitors schedule performance and identifies corrective actions when a deviation is detected. It provides two-way communication between the transit vehicle and center, enabling the center to communicate with the vehicle operator and monitor on-board systems.

4. Operations and Maintenance

The On-board Fixed Route Schedule Management equipment package will reside in the transit agency trolleys, permitting the trolley service driver to view on-board displays with schedule performance information. It will also provide this information to the respective agency's Transit Management subsystem based on the fixed-route schedule information sent to the trolley by the Transit Management subsystem.

The Transit Management subsystem will have the Transit Center Fixed-route Operations and Transit Vehicle Operator Scheduling equipment packages integrated within it. It will provide route assignments to trolley service drivers upon their providing availability information. It will provide transit operations status information to transit operations center staff based on their request inputs. It will collect road network conditions information from highway Traffic Management systems for the roadways traveled, and workzone related information from the highway agencies' Maintenance and Construction Management (MCM) subsystems.

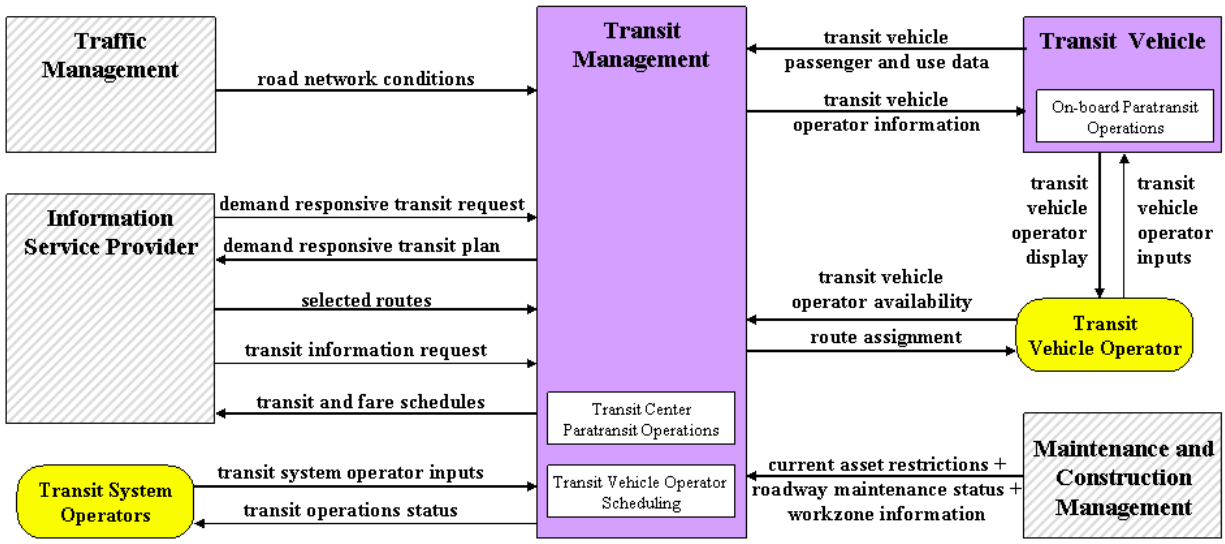
The respective transit agencies will be responsible for the operations and maintenance of all equipment packages and information flows in this Market Package, except for the information flow links between the Transit Management Subsystems and the Traffic Management/Maintenance and Construction Management subsystems. Interagency agreements between those agencies will determine specific responsibilities.

C. Demand Responsive Transit Operations

This market package performs vehicle routing and scheduling for demand responsive transit services, versus the fixed-route services in APTS-2, although it builds upon the systems from APTS-2. In addition, this market package performs functions to support dynamic features of flexible-route transit services. This package monitors the current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service while also considering traffic conditions. The Transit Management Subsystem provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet. This service includes the capability for a traveler request for personalized transit services to be made through the Information Service Provider (ISP) Subsystem. The ISP may either be operated by the transit management center or be independently owned and operated by a separate contracted service provider. In the first scenario, the traveler makes a direct request to a specific paratransit service. In the second scenario, a third party service provider determines that the paratransit service is a viable means of satisfying a traveler request and makes a reservation for the traveler.

The GRSM interest in this Market Package would relate to the flexibility of the local transit operators to meet the high demands of travelers during peak periods. The figure below is the Market Package Graphic from the National ITS Architecture.

APTS3 – Demand Response Transit Operations



1. Subsystems

Transit Vehicle - This subsystem resides in the transit vehicle or trolley and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers.

Transit Management – This subsystem manages transit vehicle fleets through a computer-aided dispatch (CAD) system, integrated with an AVL system, and coordinates with other modes and transportation services. It includes the capability to monitor for a transit vehicle being off the assigned route. A separate Transit Management subsystem resides with each of the respective transit agencies.

Information Service Provider (ISP) - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. There are multiple stakeholders who serve as ISPs in this architecture, including the transit agencies themselves and their existing partners, as well as the *GRSM*. The *GRSM* will store the transit vehicle location and other related transit information in a central traveler information database at its Operations Center, and use it to support their ATIS elements in the architecture. Furthermore, the *GRSM* may provide demand responsive transit requests to the local transit operators based on their needs, especially during high demand peak periods.

Traffic Management – This subsystem monitors and controls traffic and the road network. It represents centers that manage a broad range of transportation facilities including Interstate/freeway systems, local/arterial highway systems, and traffic signal control systems. Basically any traffic management agency having roadway jurisdiction in which one of the transit operations utilizes on its fixed-route operations, or may impact the

operations, is included in this Market Package. For the *GRSM*, this information would come from the *Division of Resource and Visitor Protection*.

Maintenance and Construction Management – This subsystem monitors and manages roadway infrastructure construction and maintenance activities. Information of any such activities that are blocking lanes or restricting roadway access is transmitted to the Transit Management Subsystem. Basically any traffic management agency having roadway jurisdiction in which one of the transit operations utilizes on its fixed-route operations, or may impact the operations, is included in this Market Package. For the *GRSM*, this information would come from the *Division of Facility Maintenance*.

2. Terminators

Transit Vehicle/Trolley Operator - This terminator represents the human entity that receives and provides additional information that is specific to operating the ITS functions in all types of transit vehicles.

Transit System Operators - This terminator represents the human entities that are responsible for all aspects of the transit system operation including fleet management, maintenance operations, and scheduling. This entity actively monitors, controls, and modifies the transit fleet routes and schedules on a day to day basis (dynamic scheduling). The modifications will be to take account of abnormal situations such as vehicle breakdown, vehicle delay, detours around work zones or incidents (detour management and service restoration), and other causes of route or schedule deviations.

3. Equipment Packages

Transit Center Paratransit Operations - This equipment package manages demand responsive transit services, including paratransit services. It supports planning and scheduling of these services, allowing paratransit and other demand response transit services to plan efficient routes and better estimate arrival times. This equipment package also supports automated dispatch of paratransit vehicles. Customer service operator systems are updated with the most current schedule information.

Transit Vehicle Operator Scheduling - This equipment package automates and supports the assignment of transit vehicles and operators to enhance the daily operation of a transit service. This operator scheduling function is often performed at a Transit Garage facility.

On-board Paratransit Operations - This on-board equipment package forwards paratransit and flexible-route dispatch requests to the operator and forwards acknowledgements to the center. It coordinates with, and assists the operator in managing multi-stop runs associated with demand responsive transit services including paratransit.

4. Operational and Maintenance

The On-board Paratransit Operations equipment package will reside in the transit agency trolleys used for this type of operation, permitting the trolley service driver to view on-board displays with passenger and performance information. It will also provide this information to the respective agency's Transit Management subsystem based on the demand responsive information sent to the trolley by the Transit Management subsystem.

The Transit Management subsystem will have the Transit Center Paratransit Operations and Transit Vehicle Operator Scheduling equipment packages integrated within it. It will provide route assignments to trolley service drivers upon their providing availability information. It will provide transit operations status information to transit operations center staff based on their request inputs. It will collect road network conditions information from highway Traffic Management systems for the roadways traveled, and workzone related information from the highway agencies' Maintenance and Construction Management (MCM) subsystems.

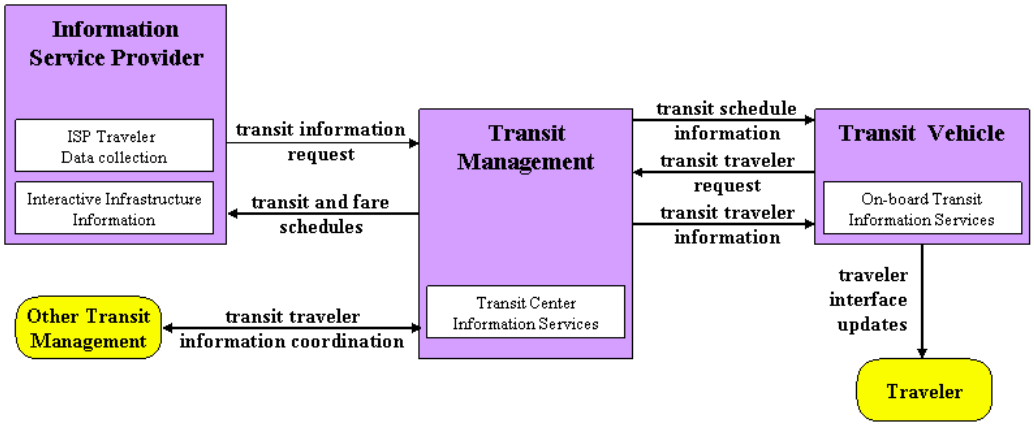
The respective transit agencies will be responsible for the operations and maintenance of all equipment packages and information flows in this Market Package, except for the information flow links between the Transit Management Subsystems and the Traffic Management/Maintenance and Construction Management subsystems, and the ISP subsystems that are operated by the highway based agencies. Interagency agreements between those agencies will determine specific responsibilities.

D. Transit Traveler Information

This market package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this market package.

The *GRSM* will be an ISP and provide support to help improve the dissemination of information to *visitors to the park, and other interested local community organizations*. This is done by collecting transit information from each of the local transit agencies. The figure below is the Market Package Graphic from the National ITS Architecture.

APTS8 - Transit Traveler Information



1. Subsystems

Transit Vehicle - This subsystem resides in the transit vehicle or trolley and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers.

Transit Management – This subsystem manages transit vehicle fleets through a computer-aided dispatch (CAD) system, integrated with an AVL system, and coordinates with other modes and transportation services. It includes the capability to monitor for a transit vehicle being off the assigned route. A separate Transit Management subsystem resides with each of the respective transit agencies.

Information Service Provider (ISP) - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. There are multiple stakeholders who serve as ISPs in this architecture, including the transit agencies themselves and their existing partners, as well as the *GRSM*. The *GRSM* will store the transit vehicle location and other related transit information in a central traveler information database at its Operations Center, and use it to support their ATIS elements in the architecture.

2. Terminators

Traveler – This terminator represents any individual who uses transportation services. The interfaces to the traveler provide general pre-trip and en-route information supporting trip planning, personal guidance, and requests for assistance in an emergency that are relevant to all transportation system users.

Other Transit Management - Representing another Transit Management center, system or subsystem, this terminator is intended to provide a source and destination for ITS data flows between peer (e.g. inter-regional) transit management functions, namely in this architecture between the *Gatlinburg Mass Transit, Pigeon Forge Fun Time Trolley, and Cherokee Transit.*

3. Equipment Packages

Interactive Infrastructure Information - Provides pre-trip and en-route trip planning services for travelers. It receives origin, destination, constraints, and preferences and returns trip plan(s) that meet the supplied criteria. Trip plans may be based on current traffic and road conditions, transit schedule information, and other real-time traveler information. Candidate trip plans are multimodal and may include vehicle, parking and transit segments. This equipment package also confirms the trip plan for the traveler and supports reservations and advanced payment for portions of the trip. The trip plan includes specific routing information and instructions for each segment of the trip and may also include information.

ISP Traveler Data Collection - Collects traveler-related data from other centers, consolidates, verifies, and refines the collected data, and makes this data available in a consistent format to applications that deliver traveler information. A broad range of traveler-related data is collected including traffic and road conditions, transit data, emergency information and advisories, weather data, special event information, traveler services, parking, multimodal data, and toll/pricing data. This equipment package also shares data with other information service providers.

Transit Center Information Services - Collects the latest available information for a transit service and makes it available to transit customers and to Information Service Providers for further distribution. Customers are provided information at transit stops and other public transportation areas before they embark and on-board the transit vehicle once they are enroute. Information provided can include the latest available information on transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, yellow pages, and special events. In addition to general service information, tailored information (e.g., itineraries) are provided to individual transit users.

On-board Transit Information Services - Furnishes en-route transit users with real-time travel-related information on-board a transit vehicle. Current information that can be provided to transit users includes transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, non-motorized transportation services, and special events are provided. In addition to tailored information for individual transit users, this equipment package also supports general annunciation and/or display of general schedule information, imminent arrival information, and other information of general interest to transit users.

4. Operations and Maintenance

Each of the local transit agencies will be responsible for the operations and maintenance of their respective Transit Management subsystems, Transit Vehicle subsystems, the respective equipment packages within those subsystems, and the information flow links between those subsystems. The ISP subsystem used by *GRSM* will be the responsibility of the *GRSM Division of Resource Education* who will have information flow links to all the *local transit agencies* which will be operated and maintained based on agreements between those agencies. The information will be used to support any traveler information services provided by the *GRSM* to provide itinerary planning capabilities.

II. TRAVELER INFORMATION

This Service Area of Market Packages covers all the means to provide travelers with dynamic information. The Market Packages that have been selected for the Regional ITS Architecture include:

- Broadcast Traveler Information;
- Interactive Traveler Information;
- Yellow Pages and Reservation;

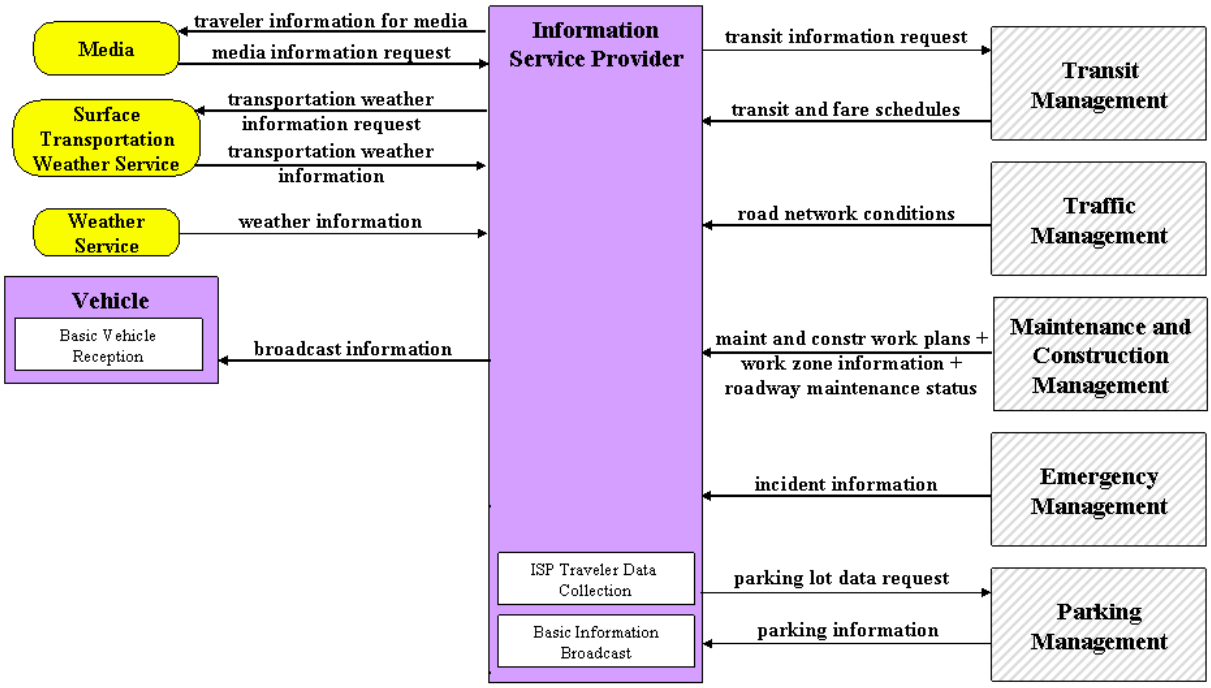
This service area will focus on the provision of information for both the park and in the surrounding communities. The Information Service Providers (ISPs) in each of these Market Packages will be the GRSM, as well as the following stakeholders from the surrounding communities that are interested in providing such services:

- Cherokee Nation
- Gatlinburg Mass Transit
- Knoxville TPO
- Land of Sky Planning Organization
- North Carolina Cities
- North Carolina Counties
- North Carolina DOT
- Pigeon Forge Fun Time Trolley
- Regional ISPs
- Rural Planning Organization – NC
- Tennessee DOT
- Tennessee Localities

A. Broadcast Traveler Information

This market package collects traffic conditions, advisories, general public transportation, parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadly disseminates this information through existing infrastructures and low cost user equipment (e.g., park HAR, Emergency Alert System). The information may be provided directly to travelers or provided to merchants and other traveler service providers so that they can better inform their customers of travel conditions. Different from the market package ATMS6 - Traffic Information Dissemination, which provides localized HAR and DMS information capabilities, ATIS1 provides a wide area digital broadcast service. Successful deployment of this market package relies on availability of real-time traveler information from roadway instrumentation, highway agencies, transit agencies and emergency responders. The figure below is the Market Package Graphic from the National ITS Architecture.

ATIS1 – Broadcast Traveler Information



1. Subsystems

Information Service Provider - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. The information is provided to the traveler through various Vehicle Subsystems through the HAR system or similar technologies. For the *GRSM*, this is the responsibility of the *Division of Resource Education*.

Vehicle – This subsystem provides the audio functions necessary to support efficient, safe, and convenient travel for the personal automobile.

Transit Management – The Transit Management Subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides customer information for the local transit agencies and sends that to the *GRSM*.

Traffic Management – This subsystem monitors and controls traffic and the road network. It represents centers that manage a broad range of transportation facilities including Interstate/freeway systems, local/arterial highway systems, and traffic signal control systems in the surrounding communities, as well as the *GRSM Division of Resource and Visitor Protection.*

Maintenance and Construction Management – This subsystem monitors and manages roadway infrastructure construction and maintenance activities. It includes the same stakeholders as Traffic Management, and the *GRSM Division of Facility Manage*ment.

Emergency Management – This subsystem represents public safety, emergency management, and other allied agency systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications.

Parking Management – This subsystem provides management of parking facilities in the *GRSM* and for parking facilities used by *park visitors in the surrounding communities*. For the *GRSM,* it is the responsibility of the *Division of Resource and Visitor Protection*.

2. Terminators

Media – This terminator represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media.

Weather Service - This terminator provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. It provides atmospheric weather observations and forecasts that are collected and derived by the National Weather Service.

3. Equipment Packages

Basic Information Broadcast - Collects, processes, stores, and disseminates traveler information including traffic and road conditions, incident information, maintenance and construction information, event information, transit information, parking information, and weather information. The same information is broadcast to all equipped traveler interface systems and vehicles, and the park-wide Emergency Alert System.

ISP Traveler Data Collection - Collects traveler-related data from other centers, consolidates, verifies, and refines the collected data, and makes this data available in a consistent format to applications that deliver traveler information. A broad range of traveler-related data is collected including traffic and road conditions, transit data, emergency information and advisories, weather data, special event information, traveler services, parking, multimodal data, and toll/pricing data.

Basic Vehicle Reception – This equipment package provides the capability for drivers to receive basic transportation information including traffic and road conditions, incident information, maintenance and construction information, event information, transit information, parking information, weather information, and broadcast alerts.

4. Operations and Maintenance

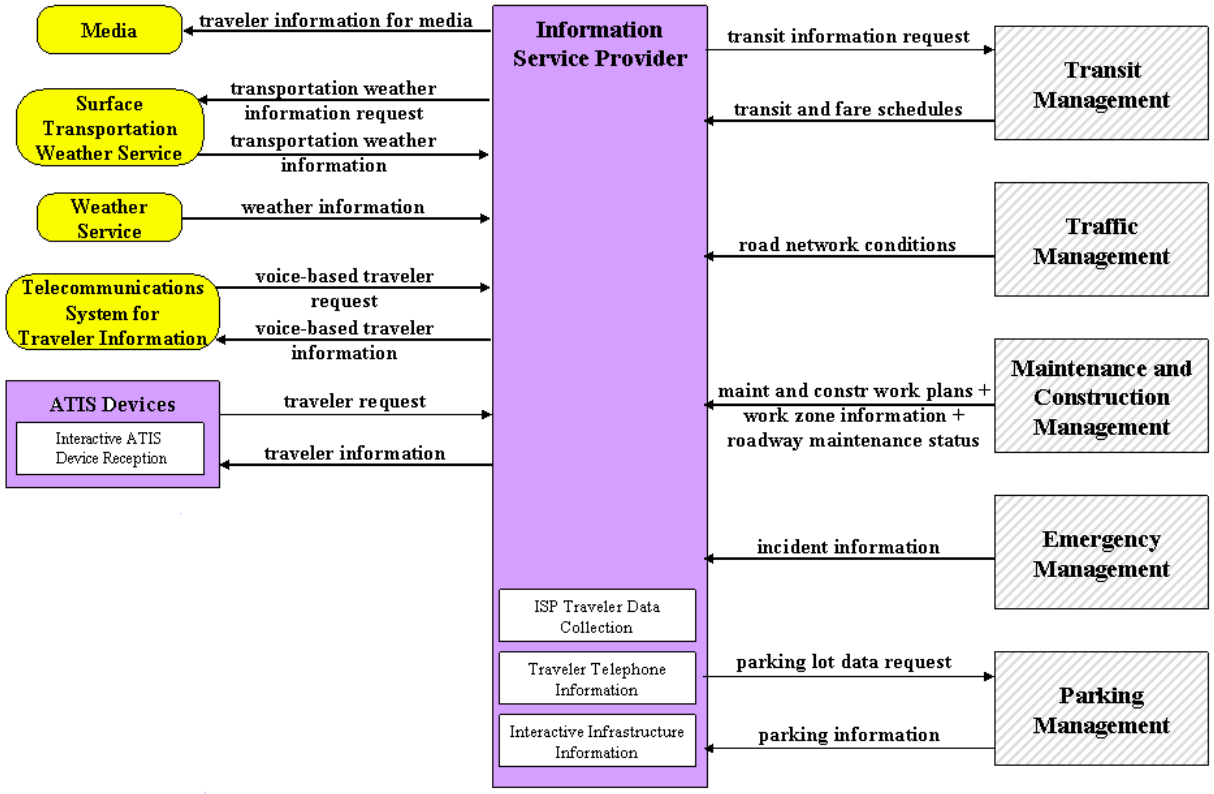
The Information Service Provider ISP will be responsible for the operations and maintenance of the ISP Traveler Data Collection and Basic Information Broadcast equipment packages, and all the information links in this Market Package, except the links with the Media which will be determine upon the agreements between the ISP and the particular Media party.

B. Interactive Traveler Information

This market package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. A range of two-way wide-area wireless and fixed-point to fixed-point communications systems may be used to support the required data communications between the traveler and Information Service Provider. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal, kiosk, Personal Digital Assistant, personal computer, and a variety of in-vehicle devices. This market package also allows value-added resellers to collect transportation information that can be aggregated and be available to their personal devices to better inform their customers of transportation conditions. Successful deployment of this market package relies on availability of real-time transportation data from roadway instrumentation, transit, probe vehicles or other means.

This Market Package builds upon the infrastructure of ATIS-1, by providing more personalized traveler information and trip itinerary planning. The figure below is the Market Package Graphic from the National ITS Architecture.

ATIS2 – Interactive Traveler Information



1. Subsystems

Information Service Provider - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. The information is provided to the traveler through various Vehicle Subsystems through the ATIS Device system or similar technologies. For the *GRSM*, this is the responsibility of the *Division of Resource Education*.

ATIS Devices – This subsystem provides the visual and interactive functions necessary to support efficient, safe, and convenient travel.

Transit Management – The Transit Management Subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides customer information for the local transit agencies and sends that to the *GRSM*.

Traffic Management – This subsystem monitors and controls traffic and the road network. It represents centers that manage a broad range of transportation facilities including Interstate/freeway systems, local/arterial highway systems, and traffic signal control systems in the surrounding communities, as well as the *GRSM Division of Resource and Visitor Protection.*

Maintenance and Construction Management – This subsystem monitors and manages roadway infrastructure construction and maintenance activities. It includes the same stakeholders as Traffic Management, and *the GRSM Division of Facility Management*.

Emergency Management – This subsystem represents public safety, emergency management, and other allied agency systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications.

Parking Management – This subsystem provides management of parking facilities in the *GRSM* and for parking facilities used by *park visitors in the surrounding communities*. For the *GRSM*, it is the responsibility of the *Division of Resource and Visitor Protection*.

2. Terminators

Media – This terminator represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media.

Weather Service - This terminator provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. It provides atmospheric weather observations and forecasts that are collected and derived by the National Weather Service.

3. Equipment Packages

Interactive Infrastructure Information - This equipment package collects, processes, stores, and disseminates personalized traveler information including traffic and road conditions, transit information, maintenance and construction information, event information, and weather information. Tailored information is provided based on the traveler's request in this interactive equipment package.

Traveler Telephone Information - This equipment package services voice-based traveler requests for information that supports traveler telephone information systems like 511 and the GRSM telephone number for park information. The equipment package takes requests for traveler information, and returns the requested traveler information in the proper format. In addition to servicing requests for traveler information, this equipment package also collects and forwards alerts and advisories to traveler telephone information systems.

ISP Traveler Data Collection - This equipment package collects traveler-related data from other centers, consolidates, verifies, and refines the collected data, and makes this data available in a consistent format to applications that deliver traveler information. A broad range of traveler-related data is collected including traffic and road conditions, transit data, emergency information and advisories, weather data, special event information, traveler services, parking, multimodal data, and toll/pricing data. This equipment package also shares data with other information service providers.

Interactive ATIS Devices Reception - This equipment package provides travelers with personalized traveler information including traffic and road conditions, transit information, maintenance and construction information, multimodal information, event information, and weather information. The provided information is tailored based on traveler requests. Both one-time requests for information and on-going information streams based on a submitted traveler profile and preferences are supported.

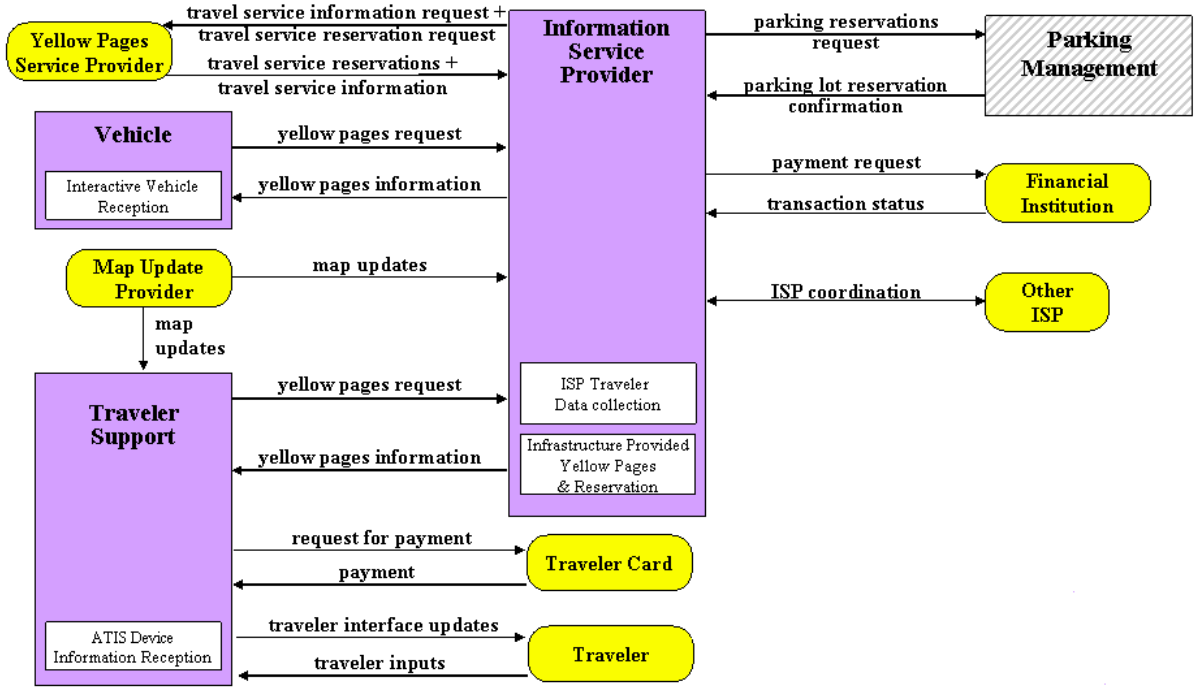
4. Operations and Maintenance

The Information Service Provider ISP will be responsible for the operations and maintenance of the ISP Traveler Data Collection and Basic Information Broadcast equipment packages, and all the information links in this Market Package, except the links with the Media which will be determine upon the agreements between the ISP and the particular Media party.

C. Yellow Pages and Reservation

This market package provides yellow pages and reservation services to the user. These additional tourism and traveler services may be provided using the same basic user equipment used for Interactive Traveler Information. This market package provides multiple ways for accessing information either while en route in a vehicle using wide-area wireless communications or pre-trip via fixed-point to fixed-point connections. The figure below is the Market Package Graphic from the National ITS Architecture.

ATIS7 - Yellow Pages and Reservation



1. Subsystems

Information Service Provider - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. The information is provided to the traveler through various Vehicle Subsystems through the ATIS Device system or similar technologies. For the *GRSM*, this is the responsibility of the *Division of Resource Education*.

Traveler Support – This subsystem provides the visual and interactive functions necessary to support efficient, safe, and convenient travel through ATIS devices.

Vehicle – This subsystem provides the sensory, processing, storage, and communications functions necessary to support efficient, safe, and convenient travel for the personal automobile.

Parking Management – This subsystem provides management of parking facilities in the *GRSM* and for parking facilities used by *park visitors in the surrounding communities*. For the *GRSM*, it is the responsibility of the *Division of Resource and Visitor Protection*.

2. Terminators

Yellow Pages Service Provider – This terminator represents the individual organizations that provide any service oriented towards the Traveler, such as the *Visitor Welcome Centers.*

Map Update Provider – Represents a third-party developer and provider of digitized map databases used to support the Traveler Information Systems. It supports the provision of the databases that are required for displays to the traveler and the ISP operator.

Financial Institution – This terminator represents the organization that handles all electronic fund transfer requests to enable the transfer of funds from the user of the service to the provider of the service if fees are required.

Other ISP - Representing other distinct Information Service Providers, this terminator is intended to provide a source and destination for ITS data flows between peer information and service provider functions. It enables cooperative information sharing between providers as conditions warrant.

3. Equipment Packages

Infrastructure Provided Yellow Pages & Reservation – Collects, processes, stores, and disseminates information about traveler services such as lodging, restaurants, and service stations. Tailored traveler service information is provided on request that meets the constraints and preferences specified by the traveler. The equipment package also supports reservations and advanced payment for traveler services.

ISP Traveler Data Collection - Collects traveler-related data from other centers, consolidates, verifies, and refines the collected data, and makes this data available in a consistent format to applications that deliver traveler information. A broad range of traveler-related data is collected including traffic and road conditions, transit data, emergency information and advisories, weather data, special event information, traveler services, parking, and pricing data. This equipment package also shares data with other information service providers.

Personal Interactive Information Reception - Provides traffic information, road conditions, transit information, yellow pages (traveler services) information, special event information, and other traveler information that is specifically tailored based on the traveler's request and/or previously submitted traveler profile information. The interactive traveler information capability is provided by personal devices including personal computers and personal portable devices such as personal digital assistants (PDAs).

4. Operations and Maintenance

The Information Service Provider ISP will be responsible for the operations and maintenance of the ISP Traveler Data Collection and Infrastructure Provided Yellow Pages & reservations equipment packages, and all the information links in this Market Package, except the links with the Traveler Support which will be determined upon the agreements between the ISP and the owners of the particular ATIS Devices.

III. TRAFFIC MANAGEMENT

This Service Area of Market Packages relate to various means to monitor and control roadway traffic. The Market Packages that have been selected for the Regional ITS Architecture include:

- Network Surveillance;
- Traffic Information Dissemination;
- Traffic Incident Management System;
- Emissions Monitoring and Management;
- Parking Facility Management;
- Regional Parking Management;
- Speed Monitoring;
- Roadway Closure Management

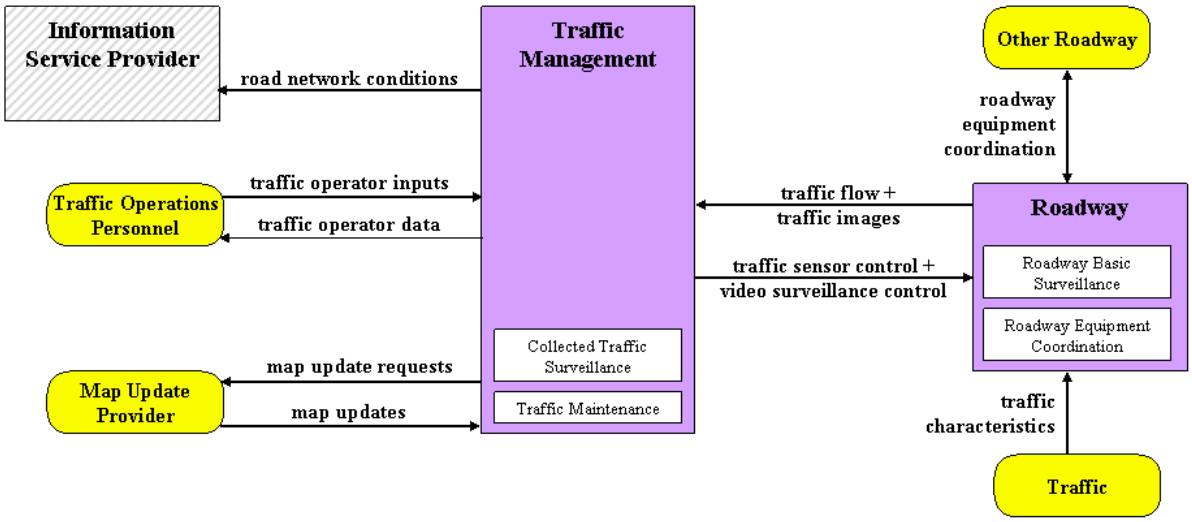
In this Service Area, the Traffic Management, Roadway, and Maintenance and Construction subsystems belong to each highway agency stakeholder and the GRSM. The GRSM Division of Resource and Visitor Protection is responsible for Traffic Management, Parking Management, and the Roadway, except for Emissions Monitoring where the Division of Resource Management and Science is responsible. The Division of Facility Maintenance is responsible for Maintenance and Construction. All the GRSM Divisions have a role in incident detection and management.

A. Network Surveillance

This market package includes traffic counters/detectors, other surveillance equipment, the supporting field equipment, and fixed-point to fixed-point communications to transmit the collected data back to the Operations Center. The data generated by this market package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Information Service Provider Subsystem.

This Market Package addresses the surveillance network to include all key *park roads and also key roads in surrounding communities that affect park travelers*. The figure below is the Market Package Graphic from the National ITS Architecture.

ATMS01 – Network Surveillance



1. Subsystems

Traffic Management – This subsystem monitors and controls traffic and the road network. It represents centers that manage a broad range of transportation facilities including Interstate/freeway systems, local/arterial highway systems, and traffic signal control systems both on *park roads and those in surrounding communities*.

Roadway – This subsystem includes the equipment distributed on and along the roadway that monitors and controls traffic and monitors and manages the roadway itself.

Information Service Provider - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. The *GRSM Division of Resource and Visitor Protection* will serve as the ISP collecting information from both *park roads and those in surrounding communities*.

2. Terminators

Traffic Operations Personnel – This terminator represents the human entity that directly interfaces with vehicle traffic operations.

Map Update Provider – Represents a third-party developer and provider of digitized map databases used to support the Traffic Management System. It supports the provision of the databases that are required for display by traffic management operators.

Traffic – This terminator represents the collective body of vehicles that travel on roadways.

Other Roadway - Representing another roadway system or subsystem, this terminator provides a source and destination for information that may be exchanged between peer roadway subsystems. *This includes roadways in the surrounding Gateway Communities and major highways leading into and out of the park.*

3. Equipment Packages

Roadway Basic Surveillance - Monitors traffic conditions using fixed equipment such as loop detectors and CCTV cameras.

Roadway Equipment Coordination - Supports direct communications between field equipment. This includes coordination between remote sensors and field devices (e.g., Dynamic Message Signs) and coordination between the field detector devices themselves (e.g., detectors on *park roads and those in surrounding communities*).

Colleted Traffic Surveillance - Remotely monitors and controls traffic sensors and surveillance equipment, and collects, processes and stores the collected traffic data. The collected information is provided to traffic operations personnel and made available to other centers.

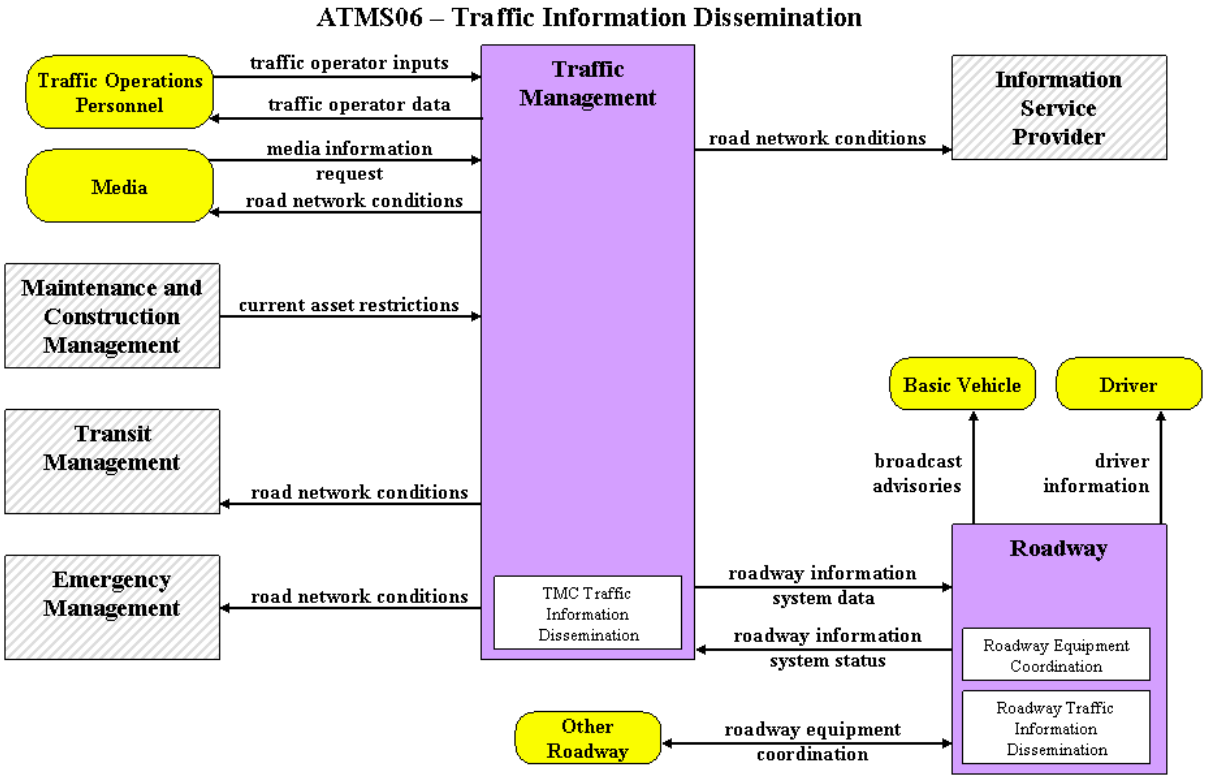
Traffic Maintenance - Monitors the operational status of field equipment and detects failures. It presents field equipment status to Traffic Operations Personnel and reports failures to the Maintenance and Construction Management Subsystem. The equipment package tracks the repair or replacement of the failed equipment.

4. Operations and Maintenance

The *GRSM* will be responsible for all subsystems, equipment packages and information flow links in this Market Package, except for roadway equipment on Other Roadways (*Surrounding communities*). These will be the responsibility of the agency whose roadway jurisdiction contains the surveillance equipment, and the information flow link of such data will be addressed through agreements with the *GRSM*.

B. Traffic Information Dissemination

This market package provides driver information using roadway equipment such as dynamic message signs (DMS) or highway advisory radio (HAR). A wide range of information can be disseminated including traffic and road conditions, closure and detour information, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Information Service Providers. A link to the Maintenance and Construction Management subsystem allows real time information on road closures due to maintenance and construction activities to be disseminated. The figure below is the Market Package Graphic from the National ITS Architecture.



1. Subsystems

Traffic Management – This subsystem monitors and controls traffic and the road network. It represents centers that manage a broad range of transportation facilities including

Interstate/freeway systems, local/arterial highway systems, and traffic signal control systems.

Roadway – This subsystem includes the equipment distributed on and along the roadway that monitors and controls traffic and monitors and manages the roadway itself.

Information Service Provider - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public.

Transit Management – The Transit Management Subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, planning and management functions for the transit property.

Maintenance and Construction Management – This subsystem monitors and manages roadway infrastructure construction and maintenance activities.

Emergency Management – This subsystem represents public safety, emergency management, and other allied agency systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications.

2. Terminators

Traffic Operations Personnel - This terminator represents the human entity that directly interfaces with vehicle traffic operations.

Media – This terminator represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media.

Other Roadway - Representing another roadway system or subsystem, this terminator provides a source and destination for information that may be exchanged between peer roadway subsystems. *This includes roadways in the surrounding Gateway Communities and major highways leading into and out of the park.*

Basic Vehicle – This terminator represents the basic vehicle platform that interfaces with and hosts ITS electronics.

Driver - This terminator represents the human entity that operates a licensed vehicle on the roadway.

3. Equipment Packages

Roadway Equipment Coordination - Supports direct communications between field equipment. It includes field elements that control and send data to other field elements. This includes coordination between remote sensors and field devices (e.g., Dynamic

Message Signs) and coordination between the field devices themselves (e.g., direct coordination between traffic controllers that are controlling adjacent intersections.).

Roadway Traffic Information Dissemination - Includes field elements that provide information to drivers, including dynamic message signs and highway advisory radio.

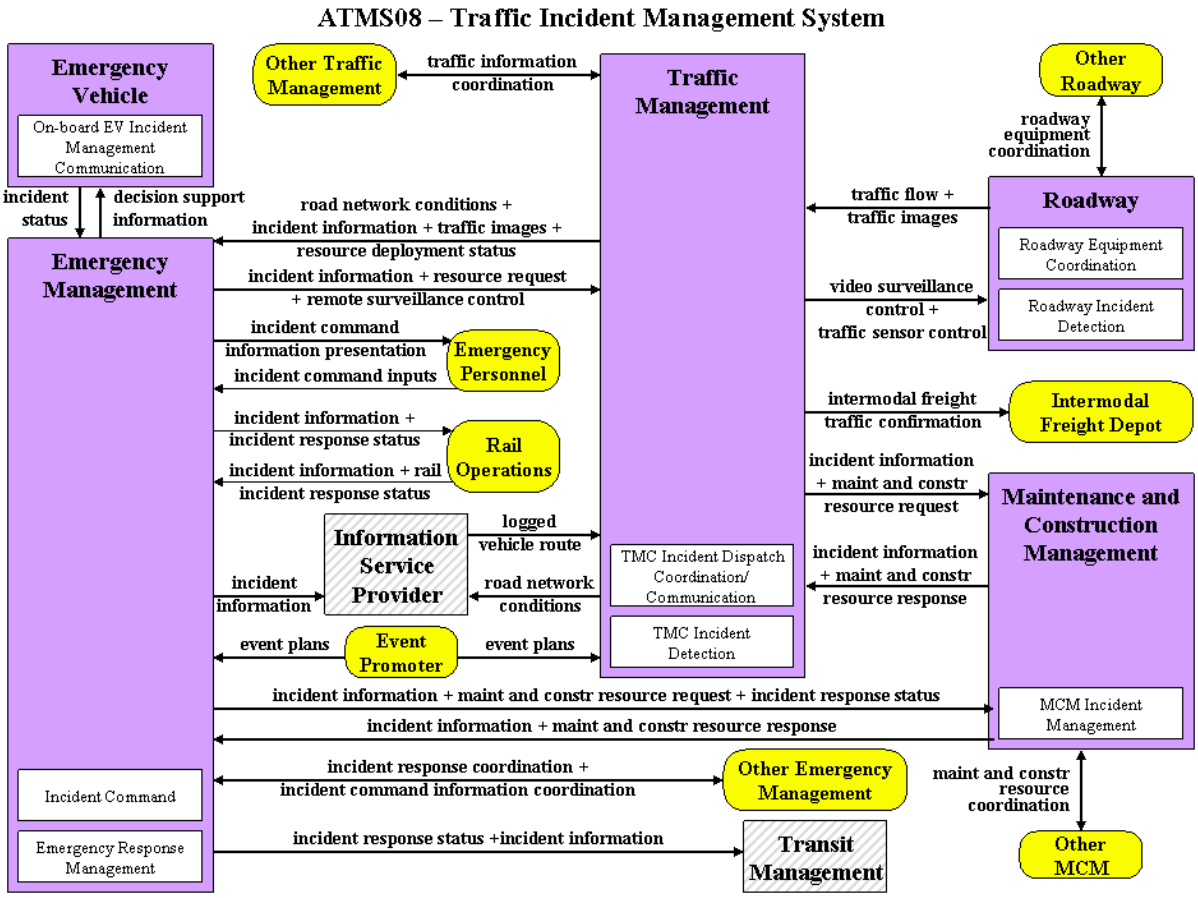
TMC Traffic Information Dissemination - Disseminates traffic and road conditions, closure and detour information, incident information, driver advisories, and other traffic-related data to other centers, the media, and driver information systems. It monitors and controls driver information system field equipment including dynamic message signs and highway advisory radio, managing dissemination of driver information through these systems.

4. Operations and Maintenance

The *GRSM* will be responsible for all subsystems, equipment packages and information flow links in this Market Package, except for roadway equipment on Other Roadways (*Surrounding communities*) and information flow links with the Transit Management and Emergency Management subsystems. The Other Roadways will be the responsibility of the *agency* whose roadway jurisdiction contains the surveillance equipment, and the information flow links will be addressed through agreements with the *GRSM*.

C. Traffic Incident Management System

This market package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The market package includes incident detection capabilities through roadside surveillance devices and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as event promoters. Information from these diverse sources is collected and correlated by this market package to detect and verify incidents and implement an appropriate response. This market package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between center subsystems. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination market package and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information market packages. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel. The figure below is the Market Package Graphic from the National ITS Architecture.



1. Subsystems

Emergency Management – This subsystem represents public safety, emergency management, and other allied agency systems that support incident management.

Emergency Vehicle – This subsystem resides in an emergency vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient incident response. The subsystem represents a range of vehicles including those operated by police, fire, and emergency medical services. In addition, this subsystem represents other incident response vehicles including towing and recovery vehicles and freeway service patrols.

Traffic Management – This subsystem monitors and controls traffic and the road network. It represents centers that manage a broad range of transportation facilities including Interstate/freeway systems, local/arterial highway systems, and traffic signal control systems.

Roadway – This subsystem includes the equipment distributed on and along the roadway that monitors and controls traffic and monitors and manages the roadway itself.

Maintenance and Construction Management (MCM) - This subsystem monitors and manages roadway infrastructure construction and maintenance activities.

2. Terminators

Emergency Personnel – This terminator represents personnel that are responsible for police, fire, emergency medical services, towing, service patrols, and other special response team (e.g., hazardous material clean-up) activities at an incident site. These personnel are associated with the Emergency Vehicle Subsystem during dispatch to the incident site, but often work independently of the Emergency Vehicle Subsystem while providing their incident response services. Emergency personnel may include an Officer in Charge (OIC) and a crew. When managing an incident following standard Incident Command System practices, the on-site emergency personnel form an organizational structure under the auspices of an Incident Commander.

Other Emergency Personnel – Representing other Emergency Management centers, systems or subsystems, this terminator provides a source and destination for ITS data flows between various communications centers operated by public safety agencies, emergency management agencies, other allied agencies, and private companies that participate in coordinated management of highway-related incidents.

Other Traffic Management – Representing another Traffic Management center, system or subsystem, this terminator is intended to provide a source and destination for ITS data flows between peer (e.g. inter-regional) traffic management functions. It enables traffic management activities to be coordinated across different jurisdictional areas.

Event Promoter – This terminator represents Special Event Sponsors that have knowledge of events that may impact travel on roadways or other modal means. These promoters interface to the ITS to provide event information such as date, time, estimated duration, location, and any other information pertinent to traffic movement in the surrounding area.

Other Roadway – Representing another roadway system or subsystem, this terminator provides a source and destination for information that may be exchanged between peer roadway subsystems.

Other MCM - Representing another Maintenance and Construction Management center or subsystem, this terminator is intended to provide a source and destination for ITS information flows between maintenance and construction management functions. It enables maintenance and construction operations to be coordinated across jurisdictions or between public and private sectors.

3. Equipment Packages

Emergency Response Management – Provides the strategic emergency response capabilities and broad inter-agency interfaces that are implemented for extraordinary incidents and disasters that require response from outside the local community. It provides the functional capabilities and interfaces commonly associated with Emergency Operations Centers. This equipment package develops and stores emergency response plans and

manages overall coordinated response to emergencies. It tracks the availability of resources and assists in the appropriate allocation of these resources for a particular emergency response. This equipment package provides coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident.

Incident Command – Provides tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders at or near the incident scene to support local management of an incident. The equipment package supports communications with public safety, emergency management, transportation, and other allied response agency centers, tracks and maintains resource information, action plans, and the incident command organization itself. Information is shared with agency centers including resource deployment status, hazardous material information, traffic, road, and weather conditions, evacuation advice, and other information that enables emergency or maintenance personnel in the field to implement an effective, safe incident response. This equipment package supports the functions and interfaces commonly supported by a mobile command center.

On-board EV Incident Management Communication – Provides communications support to first responders. Information about the incident, information on dispatched resources, and ancillary information such as road and weather conditions are provided to emergency personnel. Emergency personnel transmit information about the incident such as identification of vehicles and people involved, the extent of injuries, hazardous material, resources on site, site management strategies in effect, and current clearance status.

MCM Incident Management – Supports maintenance and construction participation in coordinated incident response. Incident notifications are shared, incident response resources are managed, and the overall incident situation and incident response status is coordinated among allied response organizations.

Roadway Equipment Coordination – Supports direct communications between field equipment. It includes field elements that control and send data to other field elements. This includes coordination between remote sensors and field devices (e.g., Dynamic Message Signs) and coordination between the field devices themselves (e.g., direct coordination between traffic controllers that are controlling adjacent intersections.).

Roadway Incident Detection – Provides incident detection using traffic detectors and surveillance equipment. It monitors for unusual traffic conditions that may indicate an incident or processes surveillance images, watching for potential incidents. This equipment package provides potential incident information as well as traffic flow and images to the center for processing and presentation to traffic operations personnel.

TMC Incident Detection – Identifies and reports incidents to Traffic Operations Personnel. It remotely monitors and controls traffic sensor and surveillance systems that support incident detection and verification. It analyzes and reduces the collected sensor and surveillance data, external alerting and advisory and incident reporting systems, special event information, and identifies and reports incidents and hazardous conditions.

TMC Incident Dispatch Coordination/Communication - Formulates and manages an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management including proposing and facilitating the dispatch of emergency response and service vehicles as well as coordinating response with all appropriate cooperating agencies.

4. Operations and Maintenance

The operations and maintenance of Traffic Management/Roadway/MCM system equipment packages will be the responsibility of the *GRSM Division in charge of the respective system.*

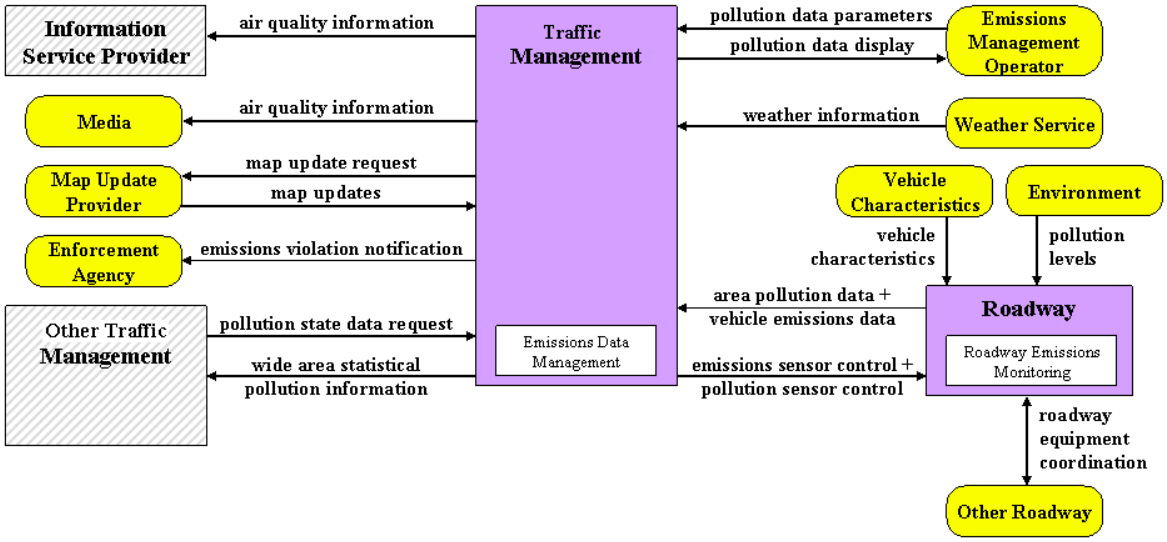
The operations and maintenance of Emergency Management and Emergency Vehicle system equipment packages will be the responsibility of the *agency in charge of the respective system, GRSM or emergency responder from the surrounding community*.

The operations and maintenance of all information flow links between the systems will be addressed through interagency agreements.

D. Emissions Monitoring Management

This market package monitors vehicle emissions by providing general air quality monitoring using distributed sensors to collect the data. The collected information is transmitted to the traffic management subsystem at the *GRSM* "command center" for processing. Area wide air quality monitoring is supported by this market package. This market package measures air quality, identifies sectors that are non-compliant with air quality standards, and collects, stores and reports supporting statistical data. Summary emissions information or warnings can also be displayed to drivers. The gathered information can be used to implement environmentally sensitive TDM programs, policies, and regulations. The figure below is the Market Package Graphic from the National ITS Architecture.

ATMS11 – Emissions Monitoring and Management



1. Subsystems

Traffic Management - This subsystem operates at the GRSM command center and co-resides with the rest of the Traffic Management Subsystem. This subsystem provides the capabilities for air quality managers to monitor and manage air quality. These capabilities include collecting emissions data from distributed emissions sensors within the roadway subsystem. These sensors monitor general air quality within each sector of the area. The sector emissions measures are collected, processed, and used to identify sectors exceeding safe pollution levels. This information is provided to traffic management to implement strategies intended to reduce emissions in and around the problem areas.

Roadway – This subsystem includes the environmental sensors distributed throughout the *park* that monitors air quality/emissions.

Information Service Provider – This subsystem collects, processes, stores, and disseminates transportation information to *GRSM staff and the traveling public* through a park-wide alert/advisory system.

Other Traffic Management - Representing the respective state air quality agency reporting systems, this terminator is intended to provide a source and destination for statistical pollution data flows.

2. Terminators

Other Roadway – Representing another Traffic Management center, system or subsystem, this terminator is intended to provide a source and destination for ITS data flows between peer (e.g. inter-regional) traffic management functions.

Environment – This terminator represents the natural surroundings in which the ITS operates.

Weather Service – This terminator provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. It provides atmospheric weather observations and forecasts that are collected and derived by the National Weather Service.

Emissions Management Operator – This terminator represents personnel that monitor, operate, and manage emissions monitoring and management systems.

Media - This terminator represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media.

3. Equipment Packages

Emissions Data Management - This equipment package collects and stores air quality and vehicle emissions information by remotely monitoring and controlling area wide and point sensors. General air quality measures are distributed as general traveler information and

also may be used for in demand management programs. Collected roadside emissions are analyzed and used to detect, identify, and notify concerned parties regarding vehicles that exceed emissions standards.

Roadway Emissions Monitoring - This equipment package monitors emissions and general air quality and communicates the collected information back to the emissions management subsystem where it can be monitored, analyzed, and used. This equipment package supports point monitoring of individual vehicle emissions as well as general monitoring of standard air quality measures.

4. Operations and Maintenance

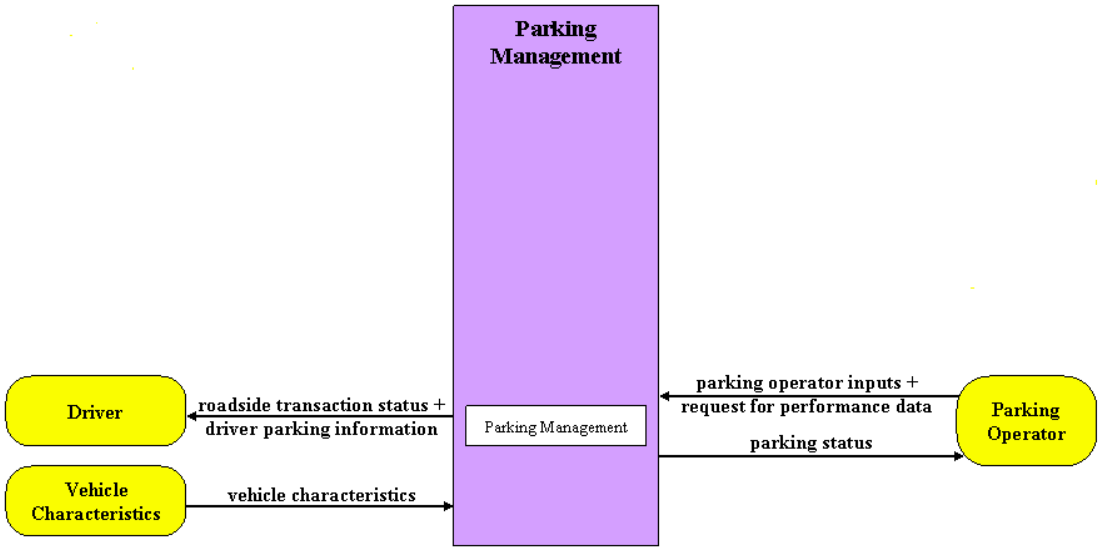
The *GRSM* will be responsible for all subsystems, equipment packages and information flow links in this Market Package, except for Other Traffic Management subsystems (*Surrounding communities*). These will be the responsibility of the agency whose roadway jurisdiction contains the air quality monitoring equipment, and the information flow link of such data will be addressed through agreements with the *GRSM*.

E. Parking Facility Management

This market package provides enhanced monitoring and management of *GRSM parking facilities*. It assists in the management of parking operations, and coordinates with *GRSM Divisions*. This market package collects current parking status, and shares this data with *GRSM* Information Service Providers and Traffic Management subsystems.

The figure below is the Market Package Graphic from the National ITS Architecture.

ATMS16 – Parking Facility Management



1. Subsystems

Parking Management – The Parking Management Subsystem provides management of parking facilities in the *park*. It also includes the instrumentation, signs, and other infrastructure that monitors parking lot usage and provides local information about parking availability and other general parking information. This portion of the subsystem functionality must be located in the parking facility where it can monitor, classify, and share information with customers and their vehicles. The subsystem also broadly disseminates parking information to other operational centers in the region.

Vehicle - This subsystem provides the sensory, processing, storage, and communications functions necessary to support efficient, safe, and convenient travel. Information services provide the driver with current availability of parking services along the route and throughout the *park*.

2. Terminators

Parking Operator – This terminator is the human entity that may be physically present at the parking lot facility to monitor the operational status of the facility.

Vehicle Characteristics – This terminator represents the external view of an individual vehicle, namely size to help quantify customer demand for parking.

Driver - This terminator represents the human entity that operates a licensed vehicle on the roadway.

3. Equipment Packages

Parking Management - This equipment package detects and classifies vehicles at parking facility entrances, exits, and other designated locations within the facility. Current parking availability is monitored and used to inform drivers through dynamic message signs/displays so that vehicles are efficiently routed to available spaces. Parking facility information, including current parking rates and directions to entrances and available exits, is also provided to drivers. Coordination with traffic management supports local traffic control coordination in and around the parking facility.

4. Operations and Maintenance

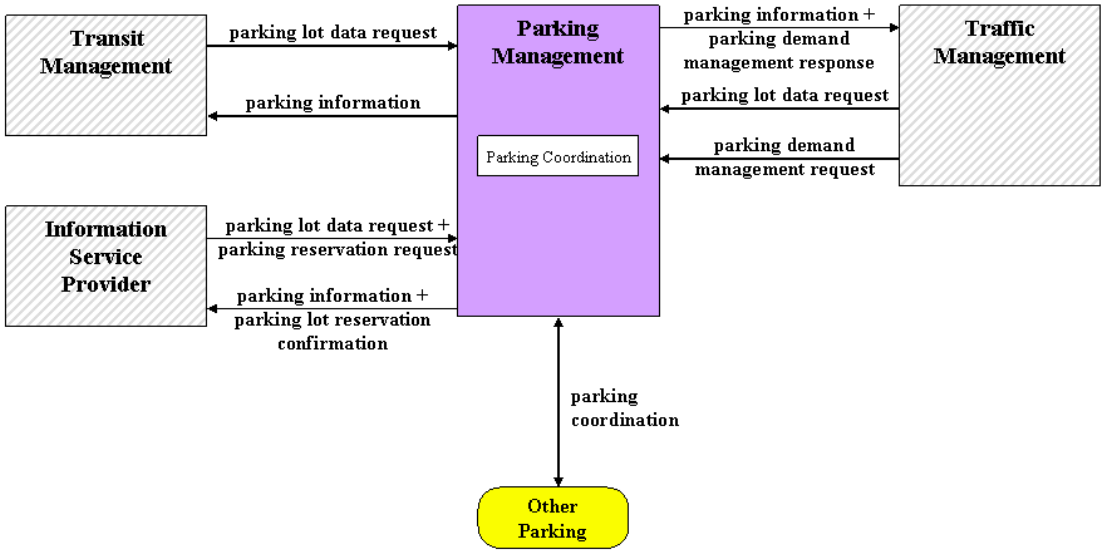
The *GRSM* will be responsible for all subsystems, equipment packages and information flow links in this Market Package

F. Regional Parking Management

This market package supports coordination between parking facilities within the *park and outside in surrounding communities*, to enable regional parking management strategies.

The figure below is the Market Package Graphic from the National ITS Architecture.

ATMS17 – Regional Parking Management



1. Subsystems

Parking Management - The Parking Management Subsystem provides management of parking facilities inside and in the surrounding communities of the park. It also includes the instrumentation, signs, and other infrastructure that monitors parking lot usage and provides local information about parking availability and other general parking information. This portion of the subsystem functionality must be located in the parking facility where it can monitor, classify, and share information with customers and their vehicles. The subsystem also broadly disseminates parking information to other operational centers in the region.

Traffic Management – The Traffic Management Subsystem monitors and controls traffic and the road network. This represents all traffic management in the region.

Transit Management – The Transit Management Subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, planning and management functions for the transit property. This represents the regional transit agencies.

Information Service Provider - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. This represents all ISPs in the region.

2. Terminators

Other Parking - Representing another parking facility outside the *park*, this terminator provides a source and destination for information that may be exchanged between peer parking systems. This terminator enables parking management activities to be coordinated between different parking operators or systems in a region.

3. Equipment Packages

Parking Coordination - This equipment package supports communication and coordination between equipped parking facilities and also supports regional coordination between parking facilities and traffic and transit management systems. This equipment package also shares information with transit management systems and information service providers to support multimodal travel planning, including parking reservations capabilities. Information including current parking availability, system status, and operating strategies are shared through this equipment package to enable local parking facility management that supports regional transportation strategies.

4. Operations and Maintenance

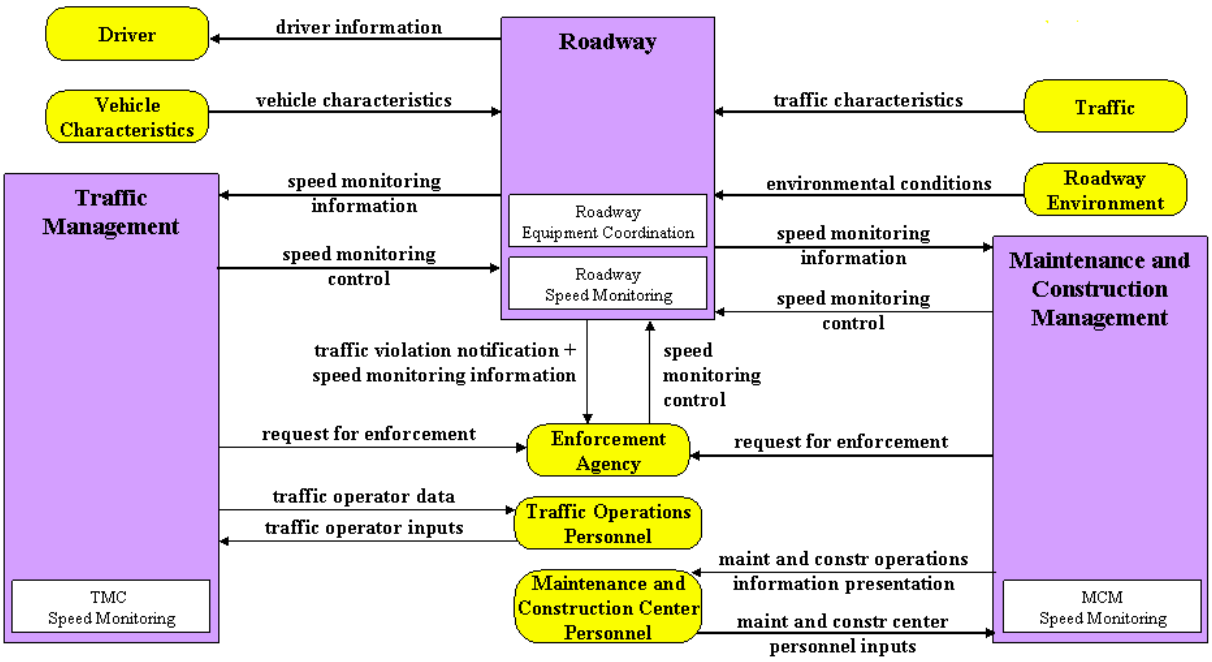
The *GRSM* will be responsible for all subsystems, equipment packages and information flow links in this Market Package, except for information links with other Parking Management and Traffic Management subsystems in the region. These will be the responsibility of the agency whose jurisdiction contains the parking management systems, and the information flow link of such data will be addressed through agreements with the *GRSM*.

G. Speed Monitoring

This market package monitors the speeds of vehicles traveling through the *park roadway system.* If the speed is determine to be excessive, roadside equipment can suggest a safe driving speed. Environmental conditions may be monitored and factored into the safe speed advisories that are provided to the motorist. This service can also support notifications to an the GRSM law enforcement park rangers to enforce the speed limit on a roadway system.

The figure below is the Market Package Graphic from the National ITS Architecture.

ATMS19 – Speed Monitoring



1. Subsystems

Roadway – This subsystem includes the equipment distributed on and along the roadway that monitors vehicle speeds.

Traffic Management – The Traffic Management Subsystem monitors traffic and the road network in the park.

Maintenance and Construction Management - The Maintenance and Construction Management Subsystem monitors and manages roadway infrastructure construction and maintenance activities. It manages traffic in the vicinity of the work zone.

2. Terminators

Enforcement Agency – This terminator represents the systems that receive reports of speeding violations detected by various ITS facilities.

Traffic Operations Personnel – This terminator represents the human entity that directly interfaces with vehicle traffic operations.

Maintenance and Construction Center Personnel – This terminator represents the people that directly interface with the systems in the Maintenance and Construction Management subsystem.

Driver – This terminator represents the human entity that operates a licensed vehicle on the roadway.

Vehicle Characteristics – This terminator represents the external view of an individual vehicle. It includes vehicle characteristics such as height, width, length, weight, and other properties (e.g., magnetic properties, number of axles) that allow an individual vehicle to be detected and measured.

Roadway Environment – This terminator represents the physical condition and geometry of the road surface and the conditions surrounding the roadway. The geometry of the roadway and the road surface characteristics must be sensed and interpreted to support the speed monitoring services. Surrounding conditions may include fog, ice, snow, rain, wind, etc. which will influence the way in which a vehicle can be safely operated on the roadway. The condition of the roadway must be monitored by the architecture to enable corrective action and information dissemination regarding roadway conditions which may adversely affect travel.

Traffic – The Traffic terminator represents the collective body of vehicles that travel on roadways.

3. Equipment Packages

MCM Speed Monitoring - This equipment package remotely monitors and controls devices that monitor vehicle speeds and optionally provide safe speed advisories to the motorist. If excessive speeds are detected, this equipment package also includes the capability to notify an enforcement agency and request traffic enforcement in work zones or other areas where excessive speeds are identified.

Roadway Equipment Coordination - This equipment package supports direct communications between field equipment. It includes field elements that control and send data to other field elements. This includes coordination between remote sensors and field devices (e.g., Dynamic Message Signs) and coordination between the field devices themselves (e.g., direct coordination between traffic controllers that are controlling adjacent intersections.).

Roadway Speed Monitoring - This equipment package includes the field elements that monitor vehicle speeds. If the speed is determined to be excessive, then roadside equipment can suggest a safe driving speed. Environmental conditions may be monitored and factored into the safe speed advisories that are provided to the motorist. The operational status (state of the device, configuration, and fault data) is provided to the center. This equipment package can also provide an enforcement function, reporting speed violations to an enforcement agency.

TMC Speed Monitoring - This equipment package remotely monitors and controls speed monitoring and speed warning systems. It remotely monitors vehicle speeds and presents this information to traffic operations personnel. It configures and controls the speed monitoring and warning equipment that provides safe speed advisories to the motorist. This equipment package can also notify an enforcement agency if excessive speeds are identified.

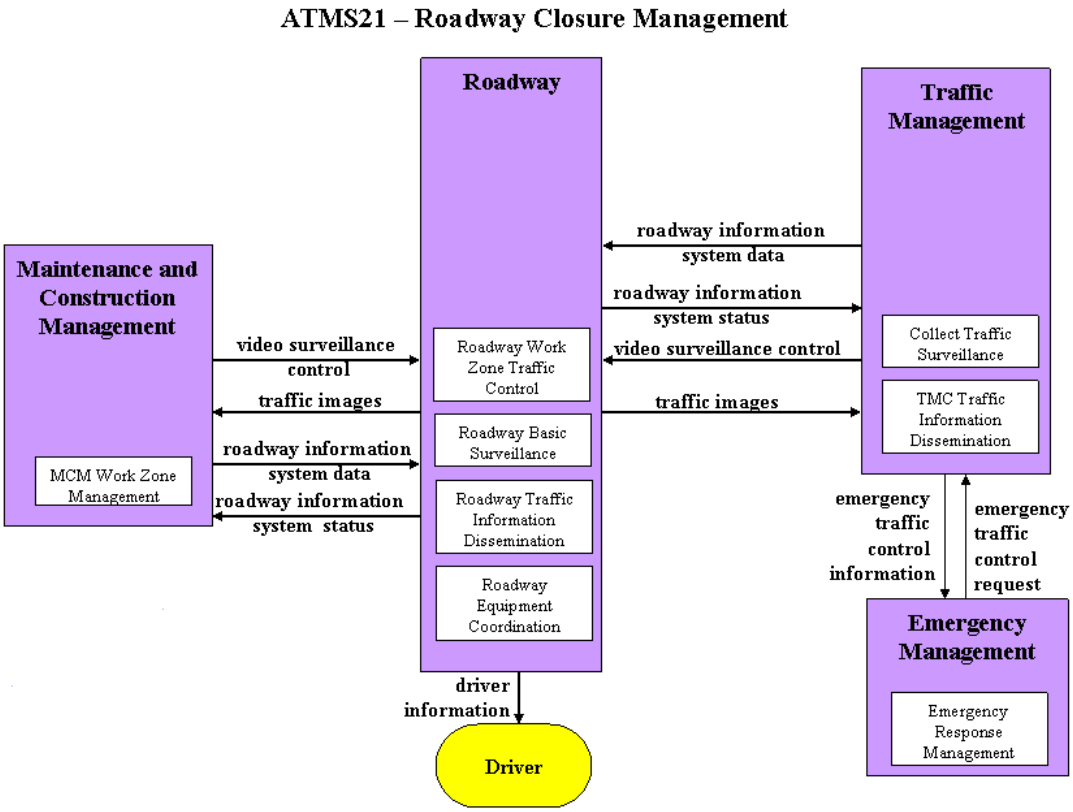
4. Operations and Maintenance

The *GRSM* will be responsible for all subsystems, equipment packages and information flow links in this Market Package.

H. Roadway Closure Management

This market package closes roadways to vehicular traffic when driving conditions are unsafe, maintenance must be performed, and other scenarios where access to the roadway must be prohibited. The market package includes automatic or remotely controlled gates or barriers that control access to roadway segments including ramps and traffic lanes. Remote control systems allow the gates to be controlled from a central location or from a vehicle at the gate/barrier location, improving system efficiency and reducing personnel exposure to unsafe conditions during severe weather and other situations where roads must be closed. Surveillance systems allow operating personnel to visually verify the safe activation of the closure system and driver information systems (e.g., DMS) provide closure information to motorists in the vicinity of the closure. The equipment managed by this market package includes the control and monitoring systems, the field devices (e.g., gates, warning lights, DMS, CCTV cameras) at the closure location(s), and the information systems that notify other systems of a closure.

The figure below is the Market Package Graphic from the National ITS Architecture.



1. Subsystems

Roadway – This subsystem includes the equipment distributed on and along the roadway that monitors and controls traffic and monitors and manages the roadway itself.

Maintenance and Construction Management – This Subsystem monitors and manages roadway infrastructure construction and maintenance activities.

Traffic Management – This Subsystem monitors and controls traffic and the road network.

Emergency Management – This subsystem represents public safety, emergency management, and other allied agency systems that support incident management.

2. Terminators

Driver - This terminator represents the human entity that operates a licensed vehicle on the roadway.

3. Equipment Packages

Emergency Response Management - This equipment package provides the strategic emergency response capabilities and broad inter-agency interfaces that are implemented for extraordinary incidents and disasters that require response from outside the local community. It provides the functional capabilities and interfaces commonly associated with Emergency Operations Centers. This equipment package develops and stores emergency response plans and manages overall coordinated response to emergencies. It tracks the availability of resources and assists in the appropriate allocation of these resources for a particular emergency response. This equipment package provides coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident.

MCM Work Zone Management - This equipment package remotely monitors and supports work zone activities, controlling traffic through dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers, and informing other groups of activity (e.g., ISP, TM, other maintenance and construction centers) for better coordination management. Work zone speeds, and delays, and closures are provided to the motorist prior to the work zones. This equipment package provides control of field equipment in all maintenance areas, including fixed and portable field equipment supporting both stationary and mobile work zones.

Roadway Basic Surveillance - This equipment package monitors traffic conditions using fixed equipment such as loop detectors and CCTV cameras.

Roadway Equipment Coordination - This equipment package supports direct communications between field equipment. It includes field elements that control and send data to other field elements. This includes coordination between remote sensors and field devices (e.g., Dynamic Message Signs) and coordination between the field devices

themselves (e.g., direct coordination between traffic controllers that are controlling adjacent intersections.).

Roadway Traffic Information Dissemination - This equipment package includes field elements that provides information to drivers, including dynamic message signs and highway advisory radio.

Roadway Work Zone Traffic Control - This equipment package controls traffic in areas of the roadway where maintenance and construction activities are underway, monitoring and controlling traffic using field equipment such as CCTV cameras, dynamic messages signs, and gates/barriers. Work zone speeds and delays are provided to the motorist prior to the work zones.

Collect Traffic Surveillance - This equipment package remotely monitors and controls traffic sensors and surveillance (e.g., CCTV) equipment, and collects, processes and stores the collected traffic data. The collected information is provided to traffic operations personnel and made available to other centers.

TMC Traffic Information Dissemination - This equipment package disseminates traffic and road conditions, closure and detour information, incident information, driver advisories, and other traffic-related data to other centers, the media, and driver information systems. It monitors and controls driver information system field equipment including dynamic message signs and highway advisory radio, managing dissemination of driver information through these systems.

4. Operations and Maintenance

The *GRSM* will be responsible for all subsystems, equipment packages and information flow links in this Market Package, except for roadway equipment on Other Roadways (*Surrounding communities*). These will be the responsibility of the *agency* whose roadway jurisdiction contains the surveillance equipment, and the information flow link of such data will be addressed through agreements with the *GRSM*.

IV. EMERGENCY MANAGEMENT

This Service Area of Market Packages relates to the types of emergency management that affects transportation management. The Market Packages that have been selected for the Regional ITS Architecture include:

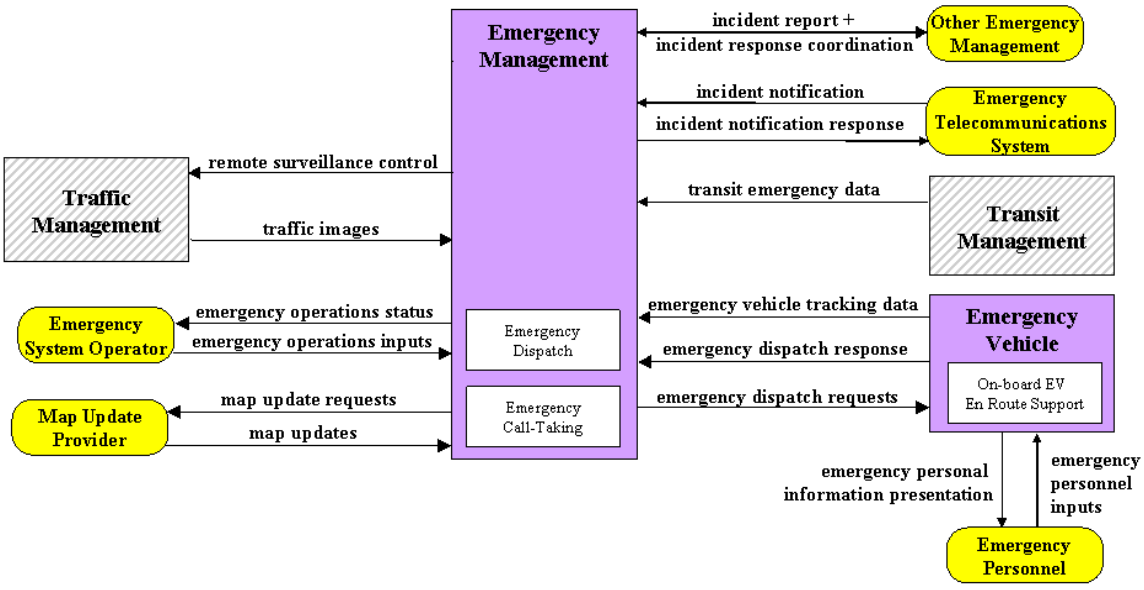
- Emergency Call-taking and Dispatch;
- Emergency Routing;

This Service Area will cover the GRSM emergency response services, as well as emergency service responders in the surrounding communities which support incident response in the park.

A. Emergency Call-taking and Dispatch

This market package provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Subsystem and an Emergency Vehicle supports dispatch and provision of information to responding personnel. The figure below is the Market Package Graphic from the National ITS Architecture.

EM01 – Emergency Call-Taking and Dispatch



1. Subsystems

Emergency Management – The Emergency Management Subsystem represents public safety, emergency management, and other allied agency systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications. The subsystem includes the functions associated with fixed and mobile public safety communications centers including public safety call taker and dispatch centers operated by police, fire, and emergency medical services.

Emergency Vehicle – This subsystem resides in an emergency vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient incident response. The subsystem represents a range of vehicles including those operated by police, fire, and emergency medical services. In addition, this subsystem represents other incident response vehicles including towing and recovery vehicles and freeway service patrols. The Emergency Vehicle Subsystem includes two-way communications to support coordinated response to emergencies in accordance with an associated Emergency Management Subsystem. Emergency vehicles are equipped with automated vehicle location capability for monitoring by vehicle tracking and fleet management functions in the Emergency Management Subsystem. Using these capabilities, the appropriate emergency vehicle to respond to each emergency is determined.

Traffic Management – The Traffic Management Subsystem monitors and controls traffic and the road network.

Transit Management - The Transit Management Subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, planning and management functions for the transit property.

2. Terminators

Emergency System Operator – This terminator represents the human entity that monitors all ITS emergency requests, (including those from the E911 Operator) and sets up pre-defined responses to be executed by an emergency management system.

Map Update Provider – This terminator represents the provider of digitized map databases used to support ITS services. It supports the provision of the databases that are required exclusively for route guidance (navigable maps).

Emergency Personnel – This terminator represents personnel that are responsible for police, fire, emergency medical services, towing, service patrols, and other special response team (e.g., hazardous material clean-up) activities at an incident site. These personnel are associated with the Emergency Vehicle Subsystem during dispatch to the incident site.

Emergency Telecommunications System – This terminator represents the telecommunications systems that connect a caller with a Public Safety Answering Point (PSAP). These systems transparently support priority wireline and wireless caller access to the PSAP through 9-1-1. The calls are routed to the appropriate PSAP, based on caller location when this information is available.

Other Emergency Management - Representing other Emergency Management centers, systems or subsystems outside of the *park*, this terminator provides a source and destination for ITS data flows between various communications centers operated by public safety agencies, emergency management agencies, other allied agencies, and private companies that participate in coordinated management of highway-related incidents. The interface represented by this terminator enables emergency management activities to be coordinated across jurisdictional boundaries and between functional areas.

3. Equipment Packages

Emergency Call-Taking - Supports the emergency call-taker, collecting available information about the caller and the reported emergency, and forwarding this information to other equipment packages that formulate and manage the emergency response. This equipment package receives 9-1-1, 7-digit local access, and motorist call-box calls and interfaces to other agencies to assist in the verification and assessment of the emergency and to forward the emergency information to the appropriate response agency.

Emergency Dispatch - Tracks the location and status of emergency vehicles and dispatches these vehicles to incidents. Pertinent incident information is gathered from the public and other public safety agencies (see the Emergency Call-Taking equipment package) and relayed to the responding units. Incident status and the status of the responding units are tracked so that additional units can be dispatched and/or unit status can be returned to available when the incident is cleared and closed.

On-board EV En Route Support - Supports dispatch, routing, and tracking of an emergency vehicle. Dispatch and routing information are received and presented to the driver and vehicle location and status are tracked and provided back to the dispatcher. This equipment package supports traffic signal preemption via short range communication directly with signal control equipment. It also supports communications with care facilities, sharing patient status and care facility status between the en route emergency vehicle and the care facility.

4. Operations and Maintenance

All Emergency Call-Taking and Dispatch are handled by the *park* or the County 911 centers, depending on the location and source of the call. Notification of an incident that is on the highway is made to the *GRSM* if the incident is in the *park*. These relationships are ongoing and need to be maintained through efforts of the Regional Traffic Incident Management Committee.

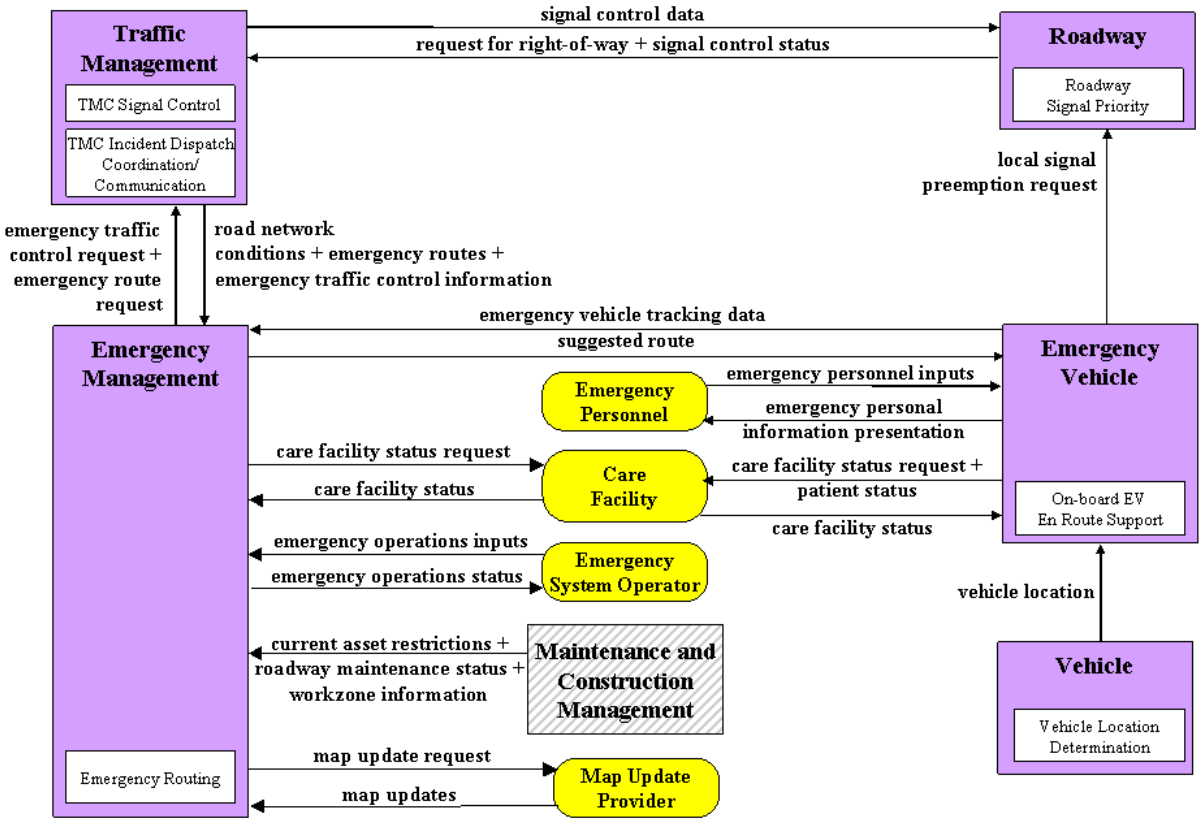
Each agency which has emergency call-taking and dispatch responsibilities in the region, will be responsible for the operations and maintenance of their respective Emergency Call-

taking and Emergency Dispatch equipment packages, as well as all the information flow links interfacing with their respective Emergency Management Systems in this Market Package. The agency responsible for the Emergency Vehicle in use is responsible for the operations and maintenance of the On-Board EV En Route Support equipment package, and the information flow links with Emergency Personnel.

B. Emergency Routing

This market package supports automated vehicle location and dynamic routing of emergency vehicles. Traffic information, road conditions, and suggested routing information are provided to enhance emergency vehicle routing. Special priority or other specific emergency traffic control strategies can be coordinated to improve the safety and time-efficiency of responding vehicle travel on the selected route(s). The Emergency Management Subsystem provides the routing for the emergency fleet based on real-time conditions and has the option of requesting a route from the Traffic Management subsystem. The Emergency Vehicle may also be equipped with dedicated short range communications for local signal preemption in the surrounding communities. The service provides for information exchange between care facilities and both the Emergency Management Subsystem and emergency vehicles. The figure below is the Market Package Graphic from the National ITS Architecture.

EM02 – Emergency Routing



1. Subsystems

Emergency Management – The Emergency Management Subsystem represents public safety, emergency management, and other allied agency systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications. The subsystem includes the functions associated with fixed and mobile public safety communications centers including public safety call taker and dispatch centers operated by police, fire, and emergency medical services.

The subsystem tracks and manages emergency vehicle fleets using real-time road network status and routing information from the other center subsystems to aide in selecting the emergency vehicle(s) and routes that will provide the most timely response. Interface with the Traffic Management Subsystem allows strategic coordination in tailoring traffic control to support emergency vehicle ingress and egress, implementation of special traffic restrictions and closures, evacuation traffic control plans, and other special strategies that adapt the transportation system to better meet the unique demands of an emergency.

Emergency Vehicle – This subsystem resides in an emergency vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient incident response. The subsystem represents a range of vehicles including those operated by police, fire, and emergency medical services. In addition, this subsystem represents other incident response vehicles including towing and recovery vehicles and freeway service patrols. The Emergency Vehicle Subsystem includes two-way communications to support coordinated response to emergencies in accordance with an associated Emergency Management Subsystem. Emergency vehicles are equipped with automated vehicle location capability for monitoring by vehicle tracking and fleet management functions in the Emergency Management Subsystem. Using these capabilities, the appropriate emergency vehicle to respond to each emergency is determined. Route guidance capabilities within the vehicle enable safe and efficient routing to the emergency. In addition, the emergency vehicle may be equipped to support signal preemption through communications with the Roadway Subsystem.

Vehicle - This subsystem provides the sensory, processing, storage, and communications functions necessary to support efficient, safe, and convenient travel for Emergency Vehicles. Route guidance capabilities assist in formulation of an optimal route and step by step guidance along the travel route.

Traffic Management – The Traffic Management Subsystem monitors and controls traffic signals and the road network.

Roadway - This subsystem includes the traffic signal equipment distributed on and along the roadway that controls traffic.

Maintenance and Construction Management - The Maintenance and Construction Management Subsystem monitors and manages roadway infrastructure construction and maintenance activities.

2. Terminators

Emergency System Operator – This terminator represents the human entity that monitors all ITS emergency requests, (including those from the E911 Operator) and sets up pre-defined responses to be executed by an emergency management system.

Map Update Provider – This terminator represents the provider of digitized map databases used to support ITS services. It supports the provision of the databases that are required exclusively for route guidance (navigable maps).

Emergency Personnel – This terminator represents personnel that are responsible for police, fire, emergency medical services, towing, service patrols, and other special response team (e.g., hazardous material clean-up) activities at an incident site. These personnel are associated with the Emergency Vehicle Subsystem during dispatch to the incident site.

Care Facility - This terminator represents a hospital or another emergency care facility.

3. Equipment Packages

Emergency Routing - Supports routing of emergency vehicles and enlists support from the Traffic Management Subsystem to facilitate travel along these routes. Routes may be determined by this equipment package based on real-time traffic information and road conditions or routes may be provided by the Traffic Management Subsystem on request. Vehicles are tracked and routes are based on current vehicle location. This equipment package may coordinate with the Traffic Management Subsystem to provide preemption or otherwise adapt the traffic control strategy along the selected route.

On-board EV En Route Support - Supports dispatch, routing, and tracking of an emergency vehicle. Dispatch and routing information are received and presented to the driver and vehicle location and status are tracked and provided back to the dispatcher. This equipment package supports traffic signal preemption via short range communication directly with signal control equipment. It also supports communications with care facilities, sharing patient status and care facility status between the en route emergency vehicle and the care facility.

Roadway Signal Priority - Includes the field elements that receive signal priority and/or signal preemption requests from vehicles approaching a signalized intersection and controls traffic signals accordingly. Depending on the type of request and implementation, this equipment package may override (preempt) current signal timing or delay phase transition. In signal priority systems, the request for priority may or may not be granted, based on the overall traffic situation at the intersection.

TMC Incident Dispatch Coordination/Communication - Formulates and manages an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management including proposing and facilitating the dispatch of emergency response and service vehicles as well as coordinating response with all appropriate cooperating agencies.

TMC Signal Control - Provides the capability for traffic managers to monitor and manage the traffic flow at signalized intersections. This capability includes analyzing and reducing the collected data from traffic surveillance equipment and developing and implementing control plans for signalized intersections. Control plans may be developed and implemented that coordinate signals at many intersections under the domain of a single traffic management subsystem and are responsive to traffic conditions and adapt to support incidents, preemption and priority requests, pedestrian crossing calls, etc.

Vehicle Location Determination - Determines current location of the vehicle using GPS or similar location referencing capability and provides this information to other equipment packages that use the location information to provide various ITS services.

4. Operations and Maintenance

Emergency Routing to be coordinated and developed amongst stakeholders through Regional Traffic Incident Management Committee. Plans should be developed amongst the applicable stakeholders. Plans should be based on incidents occurring at specific highway directional segment locations. For each directional highway segment, emergency responders and their respective routes can be identified. The mechanisms to trigger when such routing is implemented should be developed through the Regional Traffic Incident Management Committee. Routing is generated by the Traffic Management System based on signal control data, and confirmed by the Emergency Management System. Care Facility represents a hospital or another emergency care facility.

The operations and maintenance of Traffic Management/Roadway/MCM system equipment packages will be the responsibility of the *GRSM*, and the agency whose jurisdiction is utilized for emergency responses leading into and out of the park.

The operations and maintenance of Emergency Management and Emergency Vehicle system equipment packages will be the responsibility of the agency in charge of the respective system.

The operations and maintenance of all information flow links between the systems will be addressed through interagency agreements. Any additional information flow links not between the identified stakeholders groups will be the responsibility of the stakeholder whose system it does interface.

V. MAINTENANCE AND CONSTRUCTION MANAGEMENT

This Service Area of Market Packages relates to maintenance and construction roadway activities. The Market Packages that have been selected for the Regional ITS Architecture include:

- Maintenance and Construction Vehicle and Equipment Tracking;
- Road Weather Data Collection;
- Roadway Automated Treatment;
- Roadway Maintenance and Construction;
- Work Zone Management; and
- Maintenance and Construction Activity Coordination.

The Maintenance and Construction Management (MCM) Subsystem monitors and manages roadway infrastructure construction and maintenance activities. Representing the GRSM Facility Maintenance Division which provides these functions, this subsystem manages fleets of maintenance vehicles (Maintenance and Construction Vehicles or MCV). The subsystem receives a wide range of status information from these vehicles and performs vehicle dispatch, routing, and resource management for the vehicle fleets and associated equipment. The subsystem participates in incident response by deploying maintenance and construction resources to an incident scene, in coordination with other center subsystems. The subsystem manages equipment at the roadside, including environmental sensors and automated systems that monitor and mitigate adverse road and surface weather conditions. The subsystem manages the repair and maintenance of both non-ITS and ITS equipment including the traffic controllers, detectors, dynamic message signs, signals, and other equipment associated with the roadway infrastructure. Additional interfaces to weather information providers (the weather service and surface transportation weather service providers) provide current and forecast weather information that can be fused with other data sources and used to support advanced decision support systems that increase the efficiency and effectiveness of maintenance and construction operations.

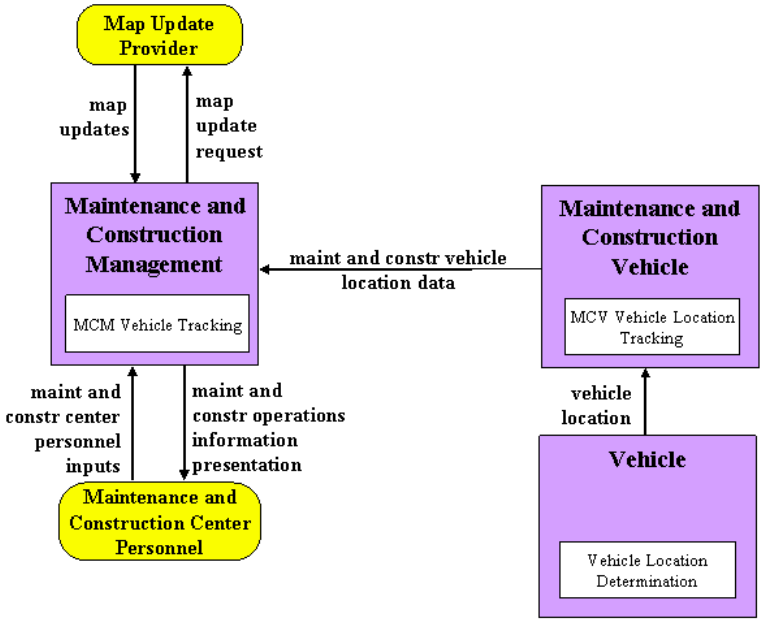
The subsystem remotely monitors and manages ITS capabilities in work zones, gathering, storing, and disseminating work zone information to other systems. It manages traffic in the vicinity of the work zone and advises drivers of work zone status (either directly at the roadside or through an interface with the Information Service Provider or Traffic Management subsystems.) It schedules and manages the location and usage of maintenance assets (such as portable dynamic message signs).

Construction and maintenance activities are tracked and coordinated with other systems, improving the quality and accuracy of information available regarding closures and other roadway construction and maintenance activities.

E. Maintenance and Construction Vehicle (MCV) and Equipment Tracking

This market package will track the location of MCVs and other equipment to ascertain the progress of their activities and possible support during incidents. This Market Package supports other MCM Market Packages. These activities can include ensuring that work activity is being performed at the correct locations, and the proximity of resources for incident management support. The figure below is the Market Package Graphic from the National ITS Architecture.

MC01 - Maintenance and Construction Vehicle and Equipment Tracking



1. Subsystems

Maintenance and Construction Management – The Maintenance and Construction Management Subsystem monitors and manages roadway infrastructure construction and maintenance activities. Representing the *GRSM Facility Maintenance Division* which provides these functions, this subsystem manages fleets of maintenance vehicles (e.g., snow and ice control equipment). The subsystem receives a wide range of status information from these vehicles and performs vehicle dispatch, routing, and resource management for the vehicle fleets and associated equipment.

Maintenance and Construction Vehicle – This subsystem resides in a maintenance, construction, or other specialized service vehicle or equipment and provides the sensory, processing, storage, and communications functions necessary to support highway maintenance and construction. The subsystem provides two-way communications between

drivers/operators and dispatchers and maintains and communicates current location and status information.

Vehicle - This subsystem provides the sensory, processing, storage, and communications functions necessary to support efficient, safe, and convenient travel of Maintenance and Construction Vehicles.

2. Terminators

Maintenance and Construction Center Personnel – This terminator represents the people that directly interface with the systems in the Maintenance and Construction Management subsystem. These personnel interact with fleet dispatch and management systems.

Map Update Provider - This terminator represents a third-party developer and provider of digitized map databases used to support ITS services. It supports the provision of the databases that are used exclusively for display by operators.

3. Equipment Packages

MCM Vehicle Tracking - Tracks the location of maintenance and construction vehicles and other equipment. Vehicle location and associated information is presented to the operator.

MCV Vehicle Location Tracking - Tracks vehicle location and reports the position and timestamp information to a dispatch center.

Vehicle Location Determination - Determines current location of the vehicle using GPS or similar location referencing capability and provides this information to other equipment packages that use the location information to provide various ITS services.

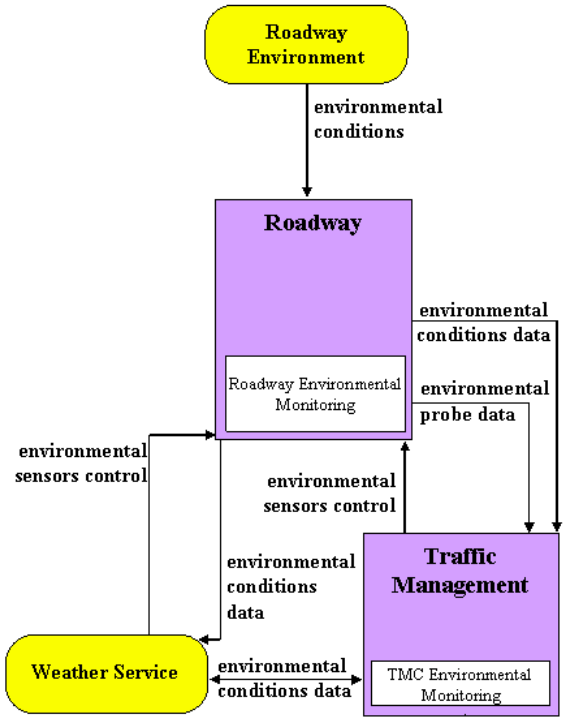
4 . Operations and Maintenance

The responsibility for operations and maintenance of all the identified equipment packages and information flows in this market package are with the *GRSM*.

F. Road Weather Data Collection

This market package collects current road and weather conditions using data collected from environmental sensors deployed throughout the *park*. In addition to fixed sensor stations at the roadside, sensing of the roadway environment can also occur from sensor systems located on MCVs. The figure below is the Market Package Graphic from the National ITS Architecture.

MC03 – Road Weather Data Collection



1. Subsystems

Roadway – This subsystem includes the equipment distributed throughout the *park* that monitors environmental weather conditions.

Traffic Management – The Traffic Management Subsystem monitors and controls traffic and the road network.

2. Terminators

Weather Service – This terminator provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. It provides atmospheric weather observations and forecasts that are collected and derived by the National Weather Service.

Roadway Environment - This terminator represents the physical condition and geometry of the road surface and the conditions surrounding the roadway. The geometry of the roadway and the road surface characteristics must be sensed and interpreted to support ITS services. Surrounding conditions may include fog, ice, snow, rain, wind, etc. which will influence the way in which a vehicle can be safely operated on the roadway.

3. Equipment Packages

Roadway Environmental Monitoring - Measures environmental conditions and communicates the collected information back to a center where it can be monitored and analyzed. A broad array of general weather and road surface information may be collected. Weather conditions that may be measured include temperature, wind, humidity, precipitation, and visibility. Surface and sub-surface sensors can measure road surface temperature, moisture, icing, salinity, and other measures.

TMC Environmental Monitoring - Assimilates current and forecast road conditions and surface weather information using a combination of weather service provider information, information collected by other centers such as the Maintenance and Construction Management Subsystem, and data collected from environmental sensors deployed on and about the roadway. The collected environmental information is monitored and presented to the operator. This information can be used to issue general traveler advisories and support location specific warnings to drivers. Other equipment packages process the collected information and provide decision support.

4. Operations and Maintenance

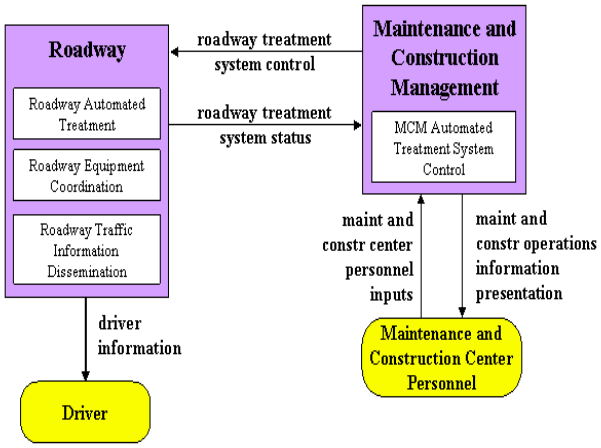
The responsibility for operations and maintenance of all the identified equipment packages and information flows in this market package are with the GRSM.

G. Roadway Automated Treatment

This market package collects current road and weather conditions using data collected from environmental sensors deployed throughout the *park.* In addition to fixed sensor stations at the roadside, sensing of the roadway environment can also occur from sensor systems located on Maintenance and Construction Vehicles. The collected environmental data is used by the Weather Information Processing and Distribution Market Package to process the information and make decisions on operations.

The figure below is the Market Package Graphic from the National ITS Architecture.

MC05 - Roadway Automated Treatment



1. Subsystems

Roadway – This subsystem includes the equipment distributed throughout the park that monitors environmental weather conditions.

Maintenance and Construction Management - The Maintenance and Construction Management Subsystem monitors and manages roadway infrastructure construction and maintenance activities. Representing the *GRSM Facility Maintenance Division* which provides these functions, this subsystem manages fleets of maintenance vehicles. The subsystem manages equipment at the roadside, including environmental sensors and automated systems that monitor and mitigate adverse road and surface weather conditions.

2. Terminators

Maintenance and Construction Personnel - This terminator represents the people that directly interface with the systems in the Maintenance and Construction Management subsystem.

Driver - This terminator represents the human entity that operates a licensed vehicle on the roadway.

3. Equipment Packages

MCM Automated Treatment System Control - This equipment package remotely monitors and controls automated road treatment systems that disperse anti-icing chemicals or otherwise treat a road segment. The automated treatment system may be remotely activated by this equipment package or it may include environmental sensors that activate the system automatically based on sensed environmental conditions. This equipment package monitors treatment system operation, sets operating parameters, and directly controls system activation if necessary.

Roadway Automated Treatment - This equipment package automatically treats a roadway section based on environmental or atmospheric conditions or under center control.

Roadway Equipment Coordination - This equipment package supports direct communications between field equipment. It includes field elements that control and send data to other field elements.

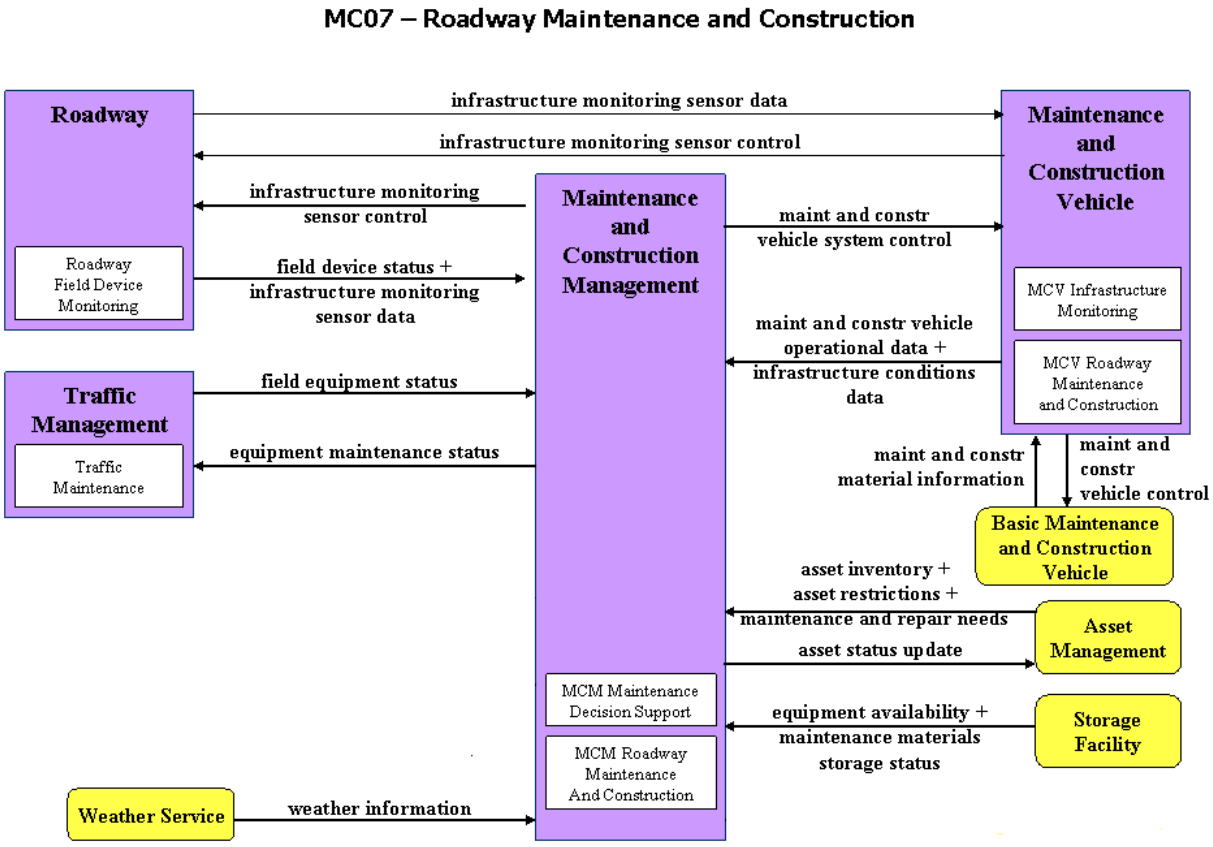
Roadway Traffic Information Dissemination - This equipment package includes field elements that provide information to drivers, including dynamic message signs and highway advisory radio.

4. Operations and Maintenance

The responsibility for operations and maintenance of all the identified equipment packages and information flows in this market package are with the *GRSM*.

H. Roadway Maintenance and Construction

This market package supports numerous services for scheduled and unscheduled maintenance and construction on the park roadway system or right-of-way. Maintenance services would include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic detectors, dynamic message signs, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities. The figure below is the Market Package Graphic from the National ITS Architecture.



1. Subsystems

Maintenance and Construction Management – The Maintenance and Construction Management Subsystem monitors and manages roadway infrastructure construction and maintenance activities. This subsystem manages fleets of maintenance, construction, or special service vehicles (e.g., snow and ice control equipment). The subsystem manages the repair and maintenance of both non-ITS and ITS equipment. Construction and maintenance activities are tracked and coordinated with other systems, improving the

quality and accuracy of information available regarding closures and other roadway construction and maintenance activities.

Maintenance and Construction Vehicle – This subsystem resides in a maintenance, construction, or other specialized service vehicle or equipment and provides the sensory, processing, storage, and communications functions necessary to support highway maintenance and construction. The subsystem provides two-way communications between drivers/operators and dispatchers and maintains and communicates current location and status information.

Traffic Management - The Traffic Management Subsystem monitors and controls traffic and the road network. This subsystem communicates with the Roadway Subsystem to monitor and manage field equipment status. This subsystem coordinates with the Maintenance and Construction Management Subsystem to maintain the road network and coordinate and adapt to maintenance activities, closures, and detours.

Roadway - This subsystem includes the equipment distributed on and along the roadway that monitors and controls traffic and monitors and manages the roadway itself.

2. Terminators

Basic Maintenance and Construction Vehicle – This terminator represents a specialized form of the Basic Vehicle used by maintenance fleets. The monitoring of the Basic Maintenance and Construction Vehicle mechanical condition and mileage provides the major inputs for maintenance vehicle activity scheduling.

Weather Service – This terminator provides weather, hydrologic, and climate information and warnings of hazardous weather including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. It provides atmospheric weather observations and forecasts that are collected and derived by the National Weather Service.

Asset Management – This terminator represents the systems that support decision-making for maintenance, upgrade, and operation of physical transportation assets.

Storage Facility - This terminator represents the facilities that provide storage and forward staging for equipment and materials used in maintenance and construction operations. It provides status information on the types and quantities of materials and equipment that are available at the facility.

3. Equipment Packages

MCM Maintenance Decision Support - Recommends maintenance courses of action based on current and forecast environmental and road conditions and additional application specific information. Decisions are supported through understandable presentation of filtered and fused environmental and road condition information for specific time horizons as well as specific maintenance recommendations that are generated by the system based on this integrated information. The recommended courses of action are supported by information on the anticipated consequences of action or inaction, when available.

MCM Roadway Maintenance and Construction - Provides overall management and support for routine maintenance on a roadway system or right-of-way. Services managed include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, dynamic message signs, traffic signals, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling routine maintenance activities.

MCV Infrastructure Monitoring - Monitors the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure (e.g., culverts). It includes vehicle-based sensors that directly monitor the infrastructure, communications that allow roadway-based infrastructure monitoring sensors to be controlled and read, and data communications that allows collected infrastructure condition information to be reported back to a center.

MCV Roadway Maintenance and Construction - Includes the on-board systems that support routine non-winter maintenance on a roadway system or right-of-way. Routine maintenance includes landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic detectors, dynamic message signs, etc.).

Roadway Field Device Monitoring - Monitors the operational status of field devices and detects and reports fault conditions. Consolidated operational status (device status, configuration, and fault information) are reported to the Maintenance and Construction Management Subsystem for resolution and repair. A local interface is provided to field personnel for local monitoring and diagnostics, supporting field maintenance, repair, and replacement of field devices.

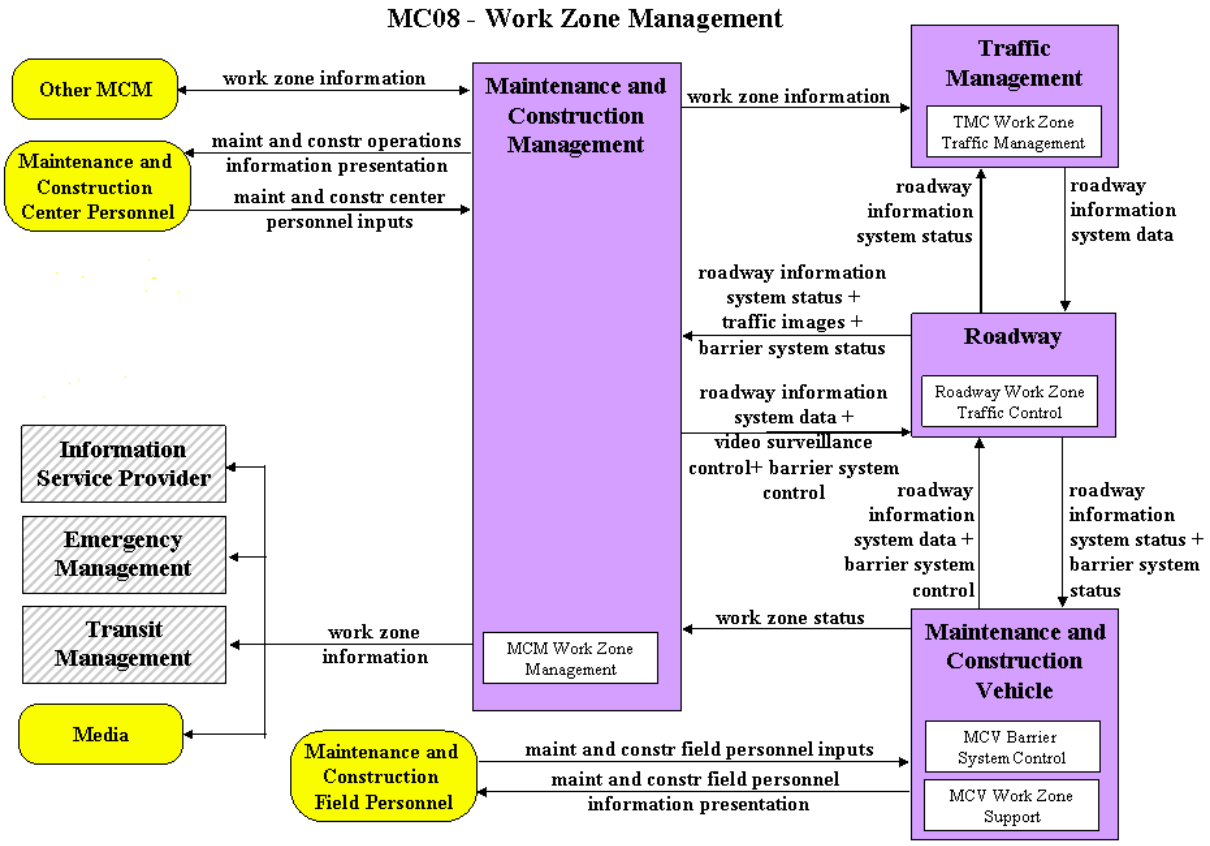
Traffic Maintenance - Monitors the operational status of field equipment and detects failures. It presents field equipment status to Traffic Operations Personnel and reports failures to the Maintenance and Construction Management Subsystem. The equipment package tracks the repair or replacement of the failed equipment. The entire range of ITS field equipment may be monitored by this equipment package including sensors (traffic, infrastructure, environmental, security, speed, etc.) and devices (highway advisory radio, dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, etc.).

4. Operations and Maintenance

The responsibility for operations and maintenance of all the identified equipment packages and information flows in this market package are with the *GRSM*.

I. Work Zone Management

This market package manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Traffic conditions are monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information is coordinated with other groups (e.g., ISP, traffic management, other maintenance and construction centers). Work zone speeds and delays are provided to the motorist prior to the work zones. This market package provides control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones. The figure below is the Market Package Graphic from the National ITS Architecture.



1. Subsystems

Maintenance and Construction Management – The Maintenance and Construction Management Subsystem monitors and manages roadway infrastructure construction and maintenance activities. The subsystem remotely monitors and manages ITS capabilities in work zones, gathering, storing, and disseminating work zone information to other systems. It manages traffic in the vicinity of the work zone and advises drivers of work zone status (either directly at the roadside or through an interface with the Information Service Provider or Traffic Management subsystems.) It schedules and manages the

location and usage of maintenance assets (such as portable dynamic message signs). Construction and maintenance activities are tracked and coordinated with other systems, improving the quality and accuracy of information available regarding closures and other roadway construction and maintenance activities.

Maintenance and Construction Vehicle – This subsystem resides in a maintenance, construction, or other specialized service vehicle or equipment and provides the sensory, processing, storage, and communications functions necessary to support highway maintenance and construction.

Traffic Management - The Traffic Management Subsystem monitors and controls traffic and the road network. This subsystem coordinates with the Maintenance and Construction Management Subsystem to maintain the road network and coordinate and adapt to maintenance activities, closures, and detours.

Roadway – This subsystem includes the equipment distributed on and along the roadway that monitors and controls traffic and monitors and manages the roadway itself. Work zone systems including work zone surveillance, traffic control, driver warning, and work crew safety systems are also included.

Information Service Provider – This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public.

Emergency Management – The Emergency Management Subsystem represents public safety, emergency management, and other allied agency systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications.

Transit Management - The Transit Management Subsystem manages transit vehicle fleets and coordinates with other modes and transportation services.

2. Terminators

Maintenance and Construction Center Personnel – This terminator represents the people that directly interface with the systems in the Maintenance and Construction Management subsystem.

Other MCM – Representing another Maintenance and Construction Management center or subsystem, this terminator is intended to provide a source and destination for ITS information flows between maintenance and construction management functions. It enables maintenance and construction operations to be coordinated across jurisdictions.

Maintenance and Construction Field Personnel – This terminator represents the people that perform maintenance and construction field activities including vehicle and equipment operators, field supervisory personnel, field crews, and work zone safety personnel. Information flowing from the Maintenance and Construction Field Personnel terminator will include those system inputs specific to maintenance and construction operations, such

as information regarding work zone status. The field personnel are also monitored within the work zone to enhance work zone safety.

Media - This terminator represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media.

3. Equipment Packages

MCM Work Zone Management - Remotely monitors and supports work zone activities, controlling traffic through dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers, and informing other groups of activity (e.g., ISP, TM, other maintenance and construction centers) for better coordination management. Work zone speeds, and delays, and closures are provided to the motorist prior to the work zones. This equipment package provides control of field equipment in all maintenance areas, including fixed and portable field equipment supporting both stationary and mobile work zones.

MCV Work Zone Support – On-board device provides communications and support for local management of a work zone. It supports communications between field personnel and the managing center to keep the center appraised of current work zone status. It controls vehicle-mounted driver information systems (e.g., dynamic message signs) and uses short range communications to monitor and control other fixed or portable driver information systems in the work zone.

Roadway Work Zone Traffic Control - Controls traffic in areas of the roadway where maintenance and construction activities are underway, monitoring and controlling traffic using field equipment such as CCTV cameras, dynamic messages signs, and gates/barriers. Work zone speeds and delays are provided to the motorist prior to the work zones.

TMC Work Zone Traffic Management - Coordinates work plans with maintenance systems so that work zones are established that have minimum traffic impact. Traffic control strategies are implemented to further mitigate traffic impacts associated with work zones that are established, providing work zone information on driver information systems such as dynamic message signs.

4. Operations and Maintenance

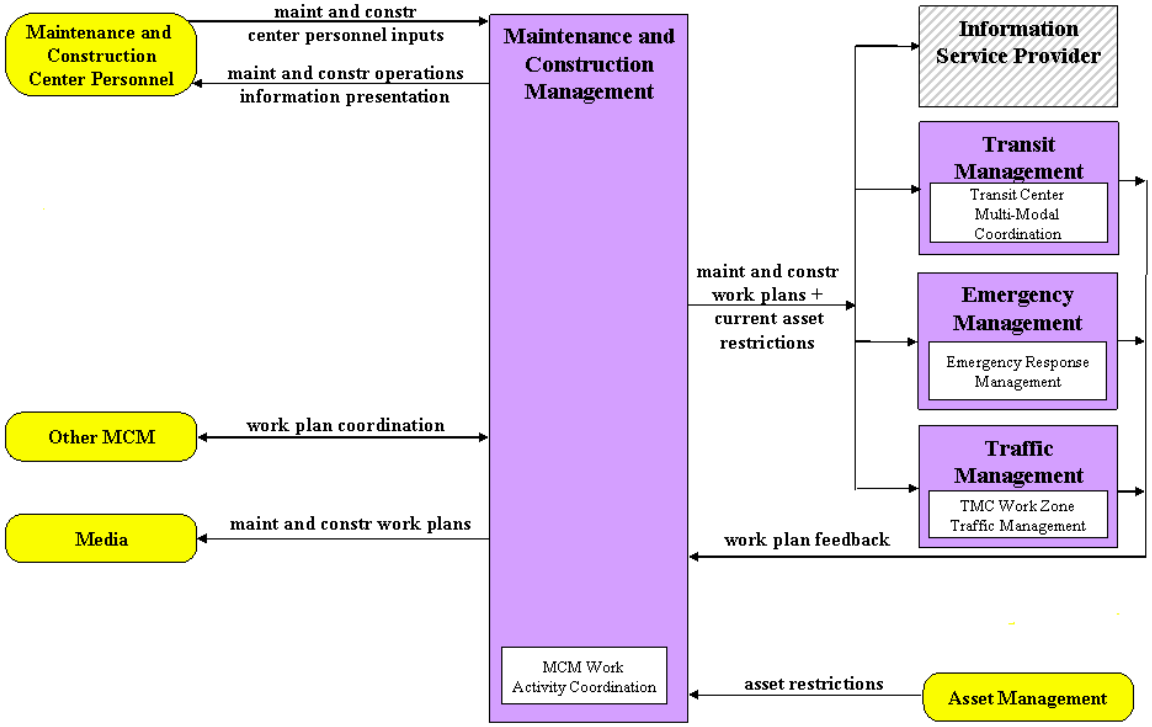
All of the identified systems in this Market Package are expected to be within individual jurisdictional agencies (GRSM and agencies in surrounding communities) that perform roadway maintenance and construction in the region.

The operations and maintenance of all equipment packages and information flow links between systems are the responsibility of each highway agency with jurisdictions in the region, except the information flow links to ISP/Emergency Management/Transit Management to be addressed through multi-agency agreements.

J. Maintenance and Construction Activity Coordination

This market package supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to the Information Service Providers who can provide the information to travelers. The figure below is the Market Package Graphic from the National ITS Architecture.

MC10 - Maintenance and Construction Activity Coordination



1. Subsystems

Maintenance and Construction Management – The Maintenance and Construction Management Subsystem monitors and manages roadway infrastructure construction and maintenance activities. The subsystem remotely monitors and manages ITS capabilities in work zones, gathering, storing, and disseminating work zone information to other systems. Construction and maintenance activities are tracked and coordinated with other systems, improving the quality and accuracy of information available regarding closures and other roadway construction and maintenance activities.

Traffic Management – The Traffic Management Subsystem monitors and controls traffic and the road network. This subsystem coordinates with the Maintenance and Construction Management Subsystem to maintain the road network and coordinate and adapt to maintenance activities, closures, and detours.

Emergency Management – The Emergency Management Subsystem represents public safety, emergency management, and other allied agency systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications.

Transit Management – The Transit Management Subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, planning and management functions for the transit property.

Information Service Provider - This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public.

2. Terminators

Maintenance and Construction Personnel – This terminator represents the people that directly interface with the systems in the Maintenance and Construction Management subsystem.

Asset Management – This terminator represents the systems that support decision-making for maintenance, upgrade, and operation of physical transportation assets.

Other MCM – Representing another Maintenance and Construction Management center or subsystem, this terminator is intended to provide a source and destination for ITS information flows between maintenance and construction management functions.

Media - This terminator represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media.

3. Equipment Packages

Emergency Response Management - Provides the strategic emergency response capabilities and broad inter-agency interfaces that are implemented for extraordinary incidents and disasters that require response from outside the local community. It provides the functional capabilities and interfaces commonly associated with Emergency Operations Centers. This equipment package develops and stores emergency response plans and manages overall coordinated response to emergencies. It tracks the availability of resources and assists in the appropriate allocation of these resources for a particular emergency response. This equipment package provides coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident.

MCM Work Activity Coordination - Disseminates work activity schedules and current asset restrictions to other agencies. Work schedules are coordinated with operating agencies, factoring in the needs and activities of other agencies and adjacent jurisdictions. Work schedules are also distributed to Information Service Providers for dissemination to the traveling public.

TMC Work Zone Traffic Management - Coordinates work plans with maintenance systems so that work zones are established that have minimum traffic impact. Traffic control strategies are implemented to further mitigate traffic impacts associated with work zones that are established, providing work zone information on driver information systems such as dynamic message signs.

Transit Center Multi-Modal Coordination - Determines the need for transit priority on routes and at certain intersections and requests transit vehicle priority at these locations. The equipment package also supports schedule coordination between transit properties and coordinates with other surface and air transportation modes. As part of schedule coordination, this equipment package shares transit transfer cluster (a collection of stops, stations, or terminals where transfers can be made conveniently) and transfer point information between Multimodal Transportation Service Providers, Transit Agencies, and ISPs. An interface to Traffic Management also supports demand management strategies.

4. Operations and Maintenance

All of the identified systems in this Market Package are expected to be within individual jurisdictional agencies (*GRSM and agencies in surrounding communities*) that perform roadway maintenance and construction in the region.

The operations and maintenance of all equipment packages and information flow links between systems are the responsibility of each highway agency with jurisdictions in the region, except the information flow links to ISP/Emergency Management/Transit Management to be addressed through multi-agency agreements.

Appendix B: ITS Interconnect Diagrams

This appendix presents the more detailed interconnect diagrams that represent the data and information flows between various entities * and stakeholders that will participate in the GRSM ITS implementation. In effect, the present diagrams are "drill-downs" of the Section C, Figure 6, high-level interconnect diagram. Because the GRSM ITS Architecture by definition is "GRSM-centric", only the key internal stakeholders, namely the five main park divisions are represented as connecting to all other internal and external stakeholders. The five park divisions at the core of the architecture are:

- GRSM Division of Administration (connects to 11 other entities)
- GRSM Division of Facility Management (connects to 10 other entities)
- GRSM Division of Resource and Visitor Protection (connects to 21 other entities)
- GRSM Division of Resource Management & Science (connects to 5 other entities)
- GRSM Division of Resource Education (connects to 10 other entities)

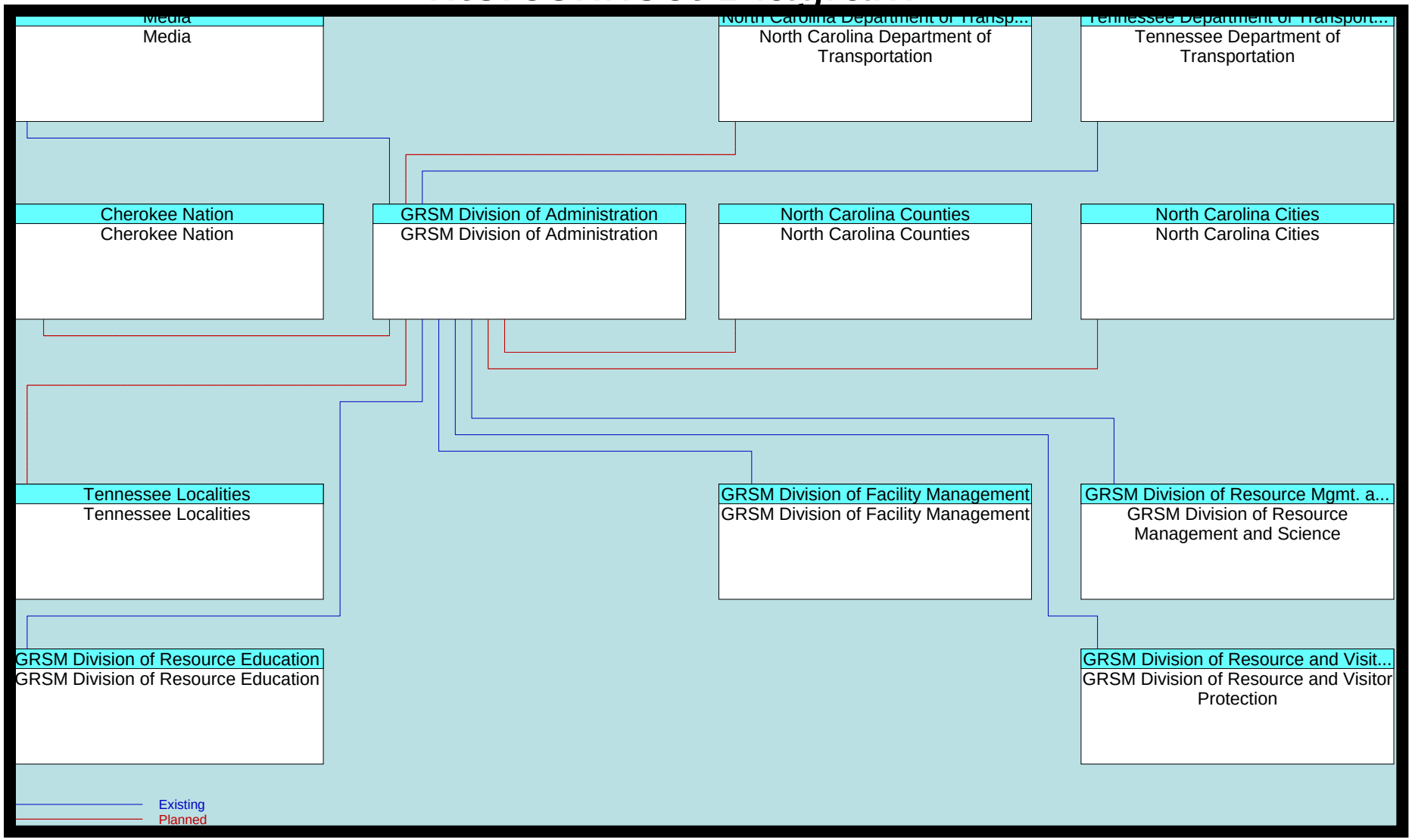
The following diagrams thus are presented organized around these five. For each, first a mid-level interconnect diagram is presented illustrating all of the other entities with which the Division connects. Following this diagram are individual diagrams showing the detailed data and information flows by name between the Division and the interconnected entities.

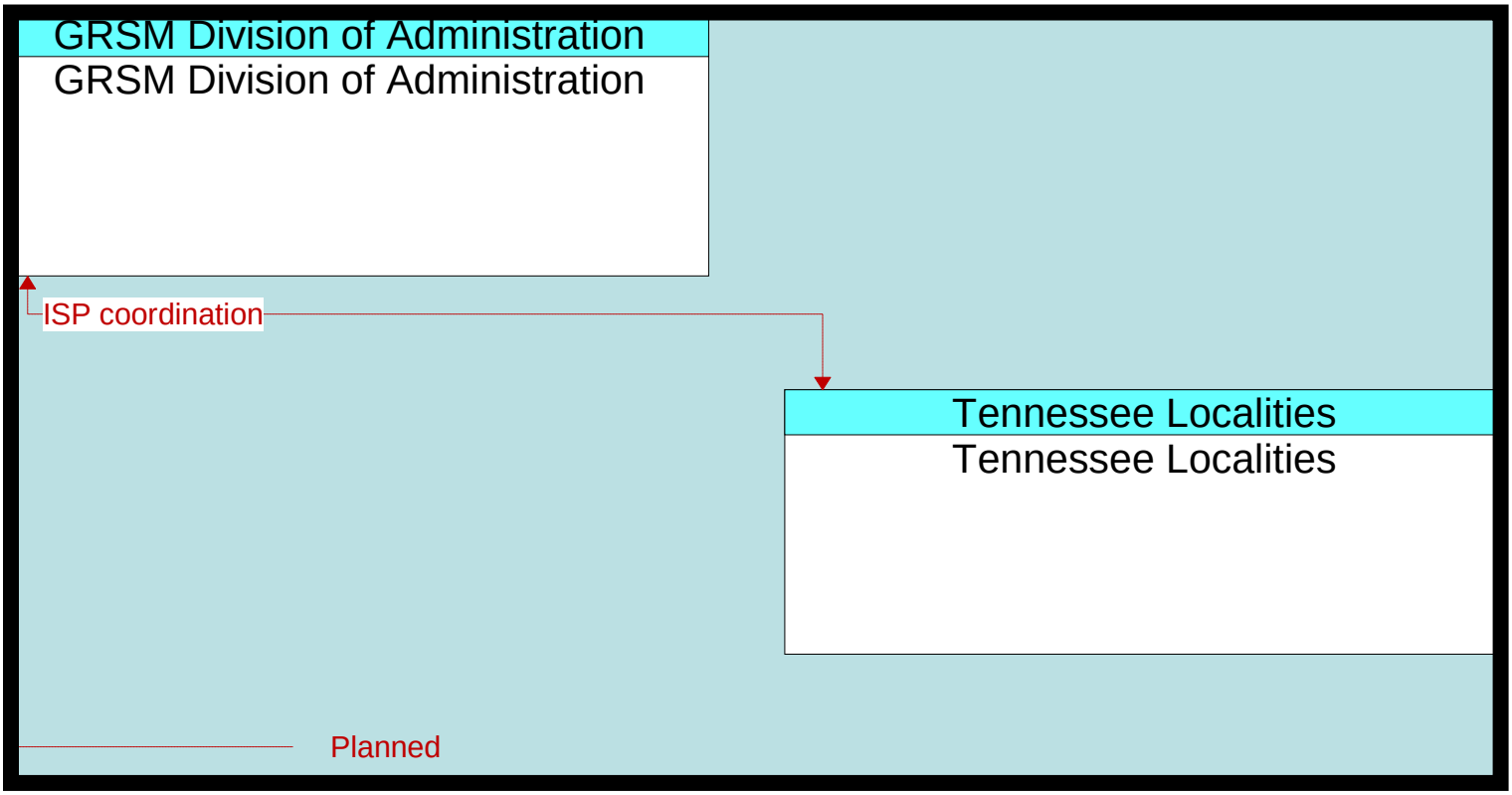
** " North Carolina Cities" are the various gateway cities on the North Caroline side of the GRSM Park. These cities are responsible for transportation planning, traffic management and roadway maintenance within their jurisdiction. The North Carolina cities include: Bryson City, Maggie Valley, and City of Waynesville.*

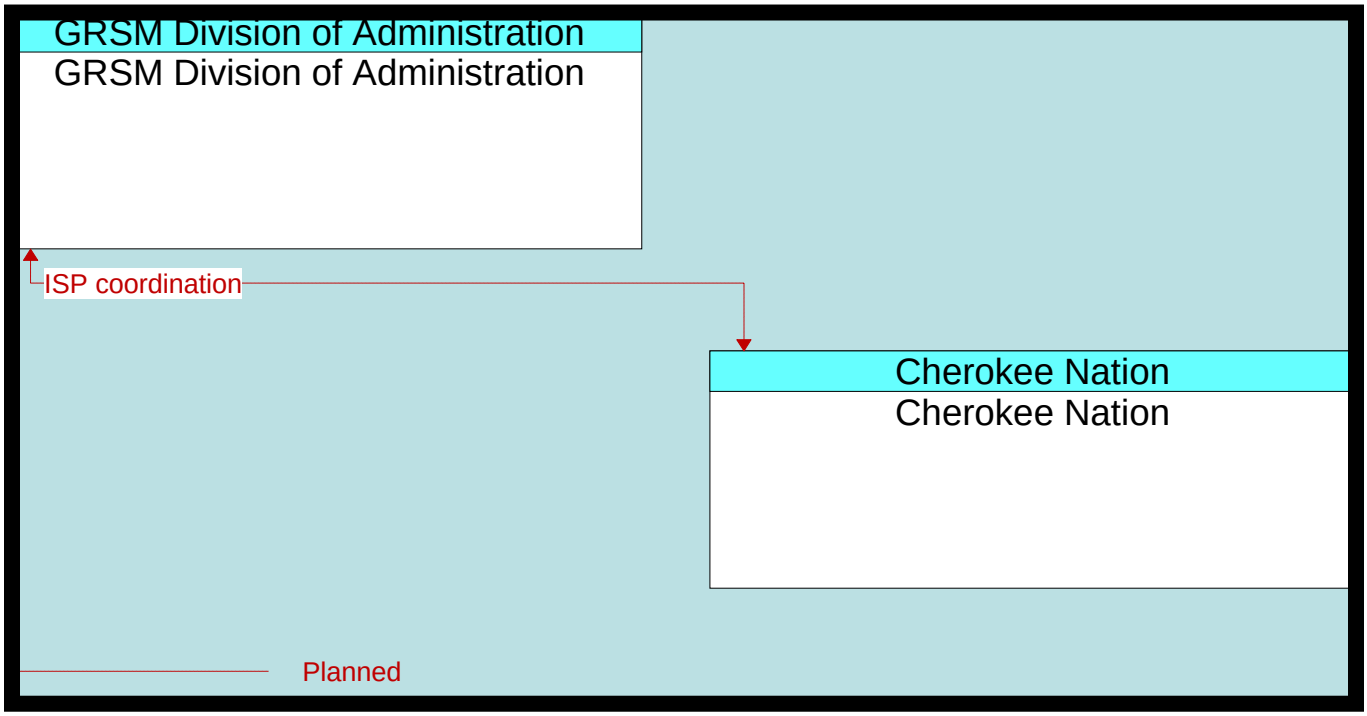
** "North Carolina Counties" are the various gateway counties on the North Carolina side of the GRSM Park. These counties are responsible for transportation planning and emergency management within their jurisdiction. The North Carolina Counties include: Haywood County, Swain County, and Graham County.*

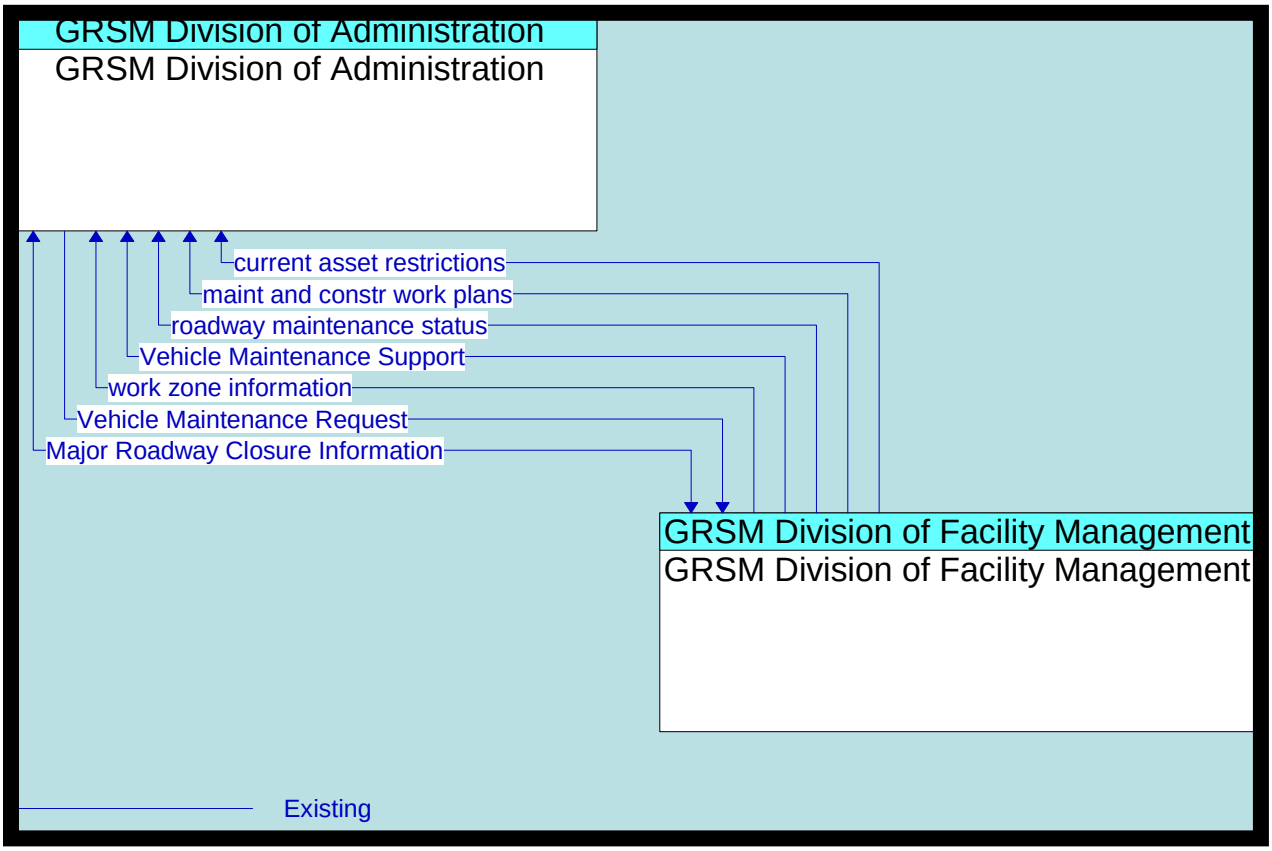
** "Tennessee Localities" are the various cities and gateway communities on the Tennessee side of the GRSM Park. These localities are responsible for transportation planning, traffic management, and road maintenance within their jurisdiction. The Tennessee Localities include: City of Gatlinburg, City of Pigeon Forge, City of Sevierville, City of Townsend, Sevier County, Bount County, and Cocke County*

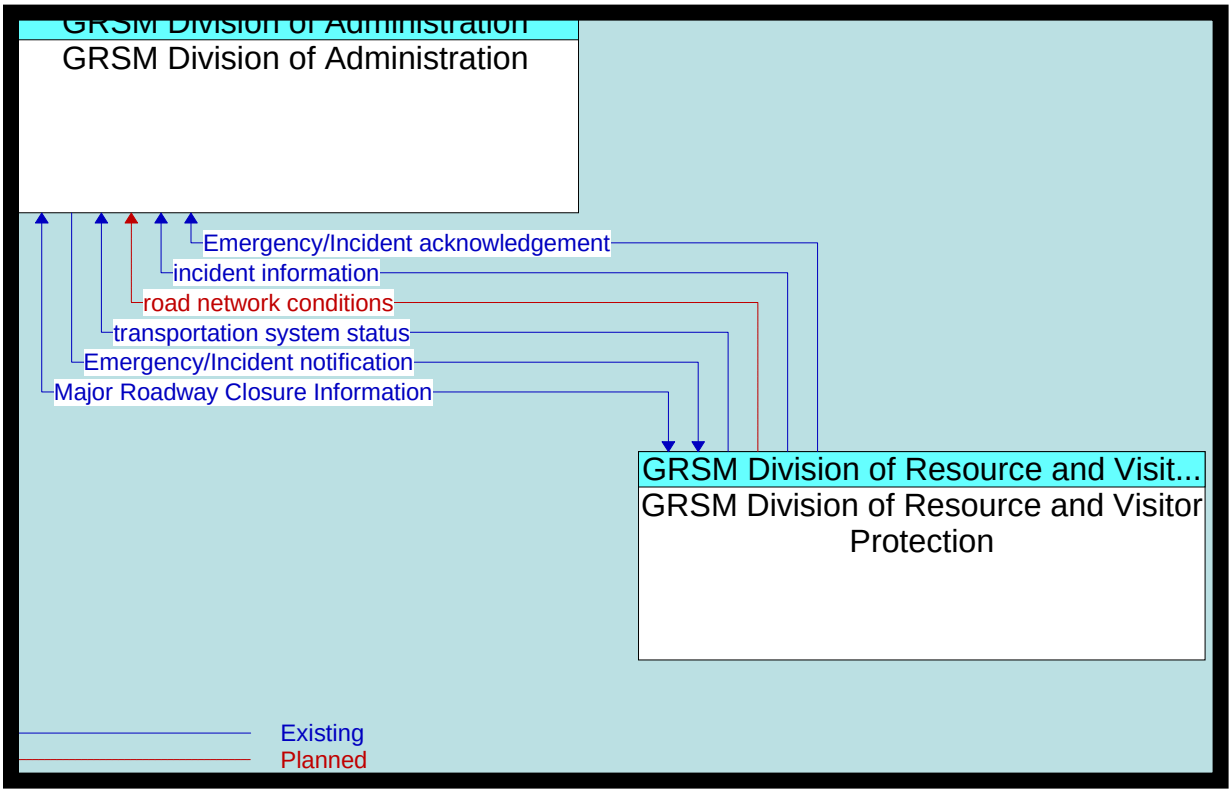
GRSM Division of Administration Interconnect Diagram

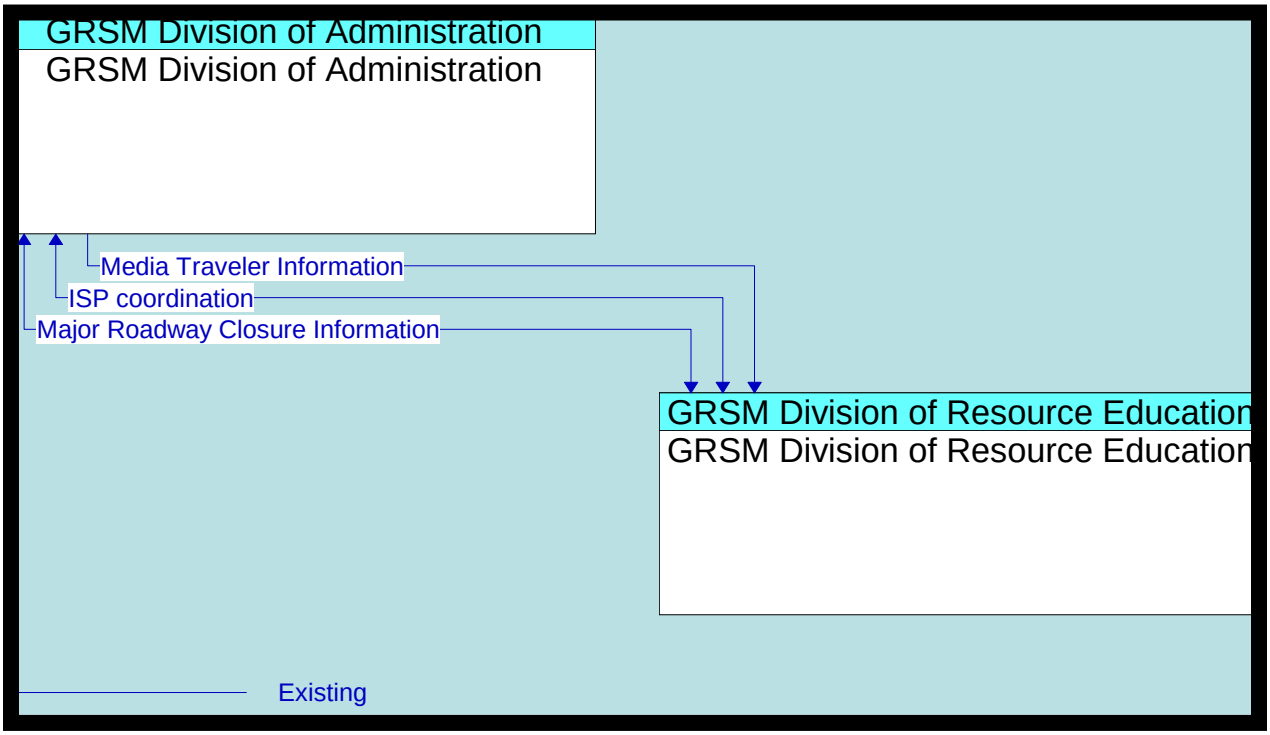



GRSM Division of Administration
GRSM Division of Administration
ISP coordination
Tennessee Localities
Tennessee Localities
Planned


GRSM Division of Administration
GRSM Division of Administration
ISP coordination
Cherokee Nation
Cherokee Nation
Planned


GRSM Division of Administration
GRSM Division of Administration
current asset restrictions
maint and constr work plans
roadway maintenance status
Vehicle Maintenance Support
work zone information
Vehicle Maintenance Request
Major Roadway Closure Information
GRSM Division of Facility Management
GRSM Division of Facility Management
Existing


GRSM Division of Administration
GRSM Division of Administration
Emergency/Incident acknowledgement
incident information
road network conditions
transportation system status
Emergency/Incident notification
Major Roadway Closure Information
GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
Existing
Planned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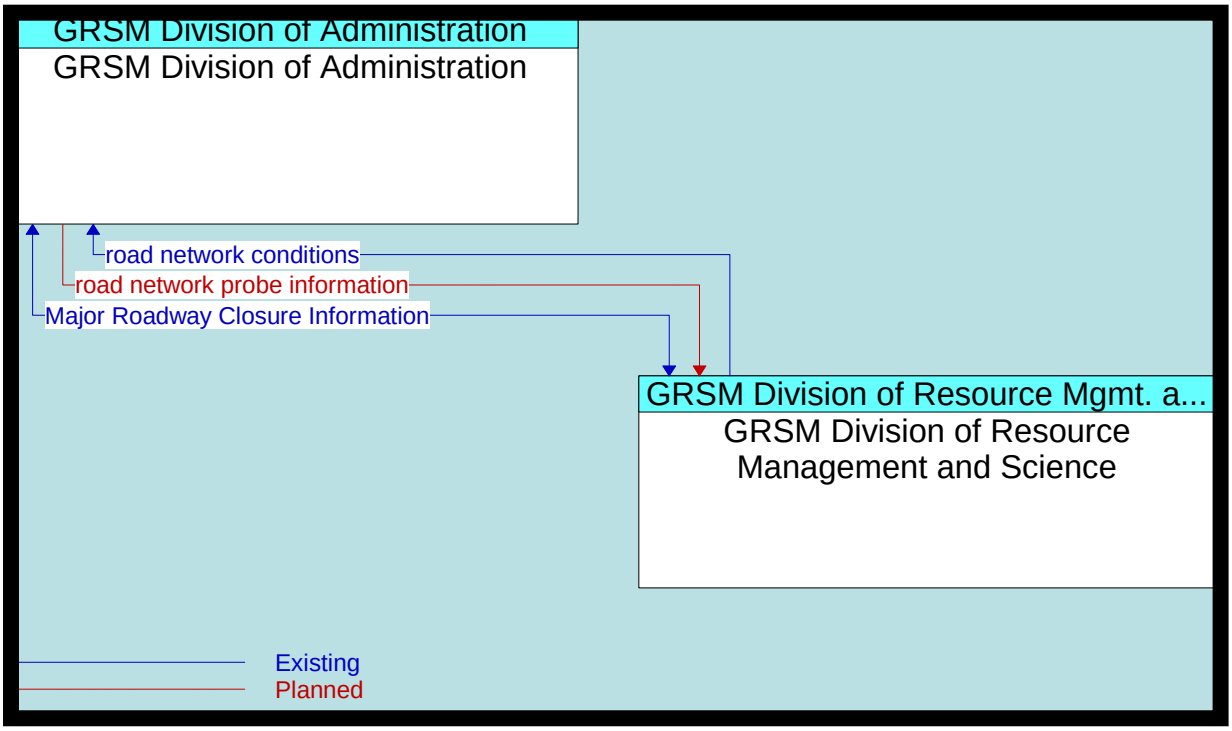
GRSM Division of Administration
Media Traveler Information
ISP coordination
Major Roadway Closure Information
GRSM Division of Resource Education
GRSM Division of Resource Education
Existing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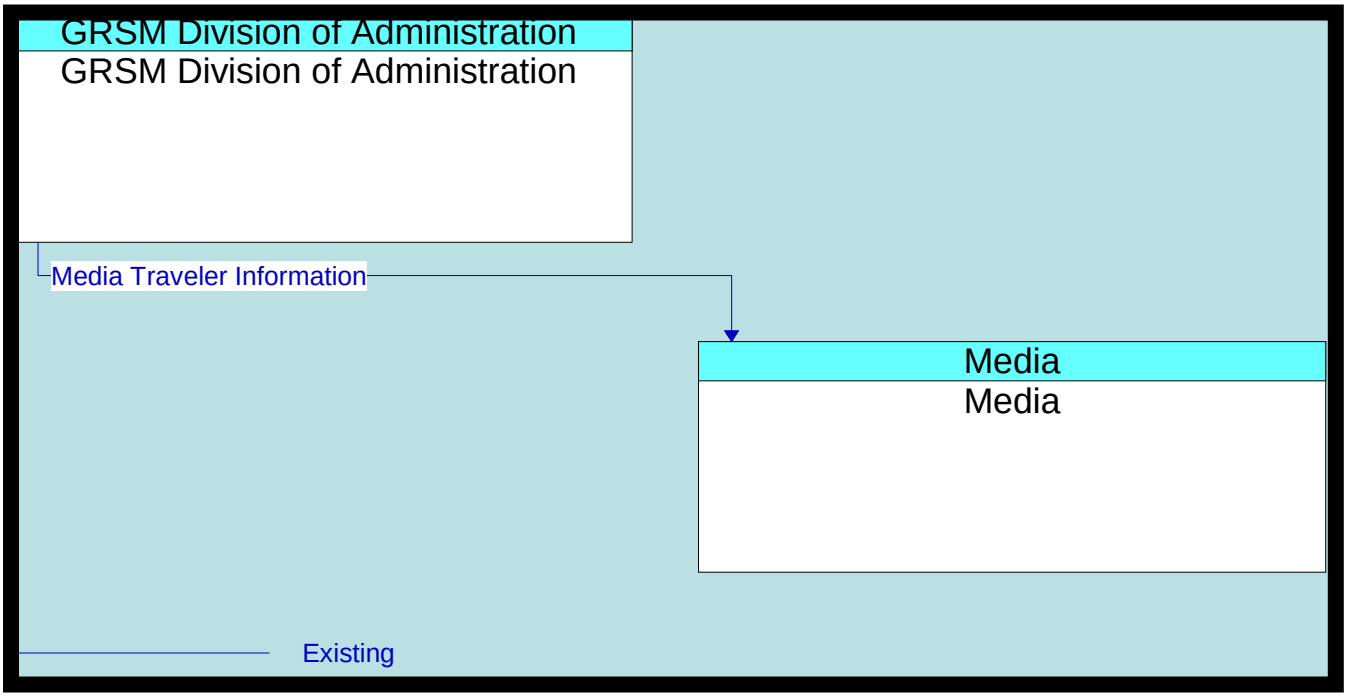
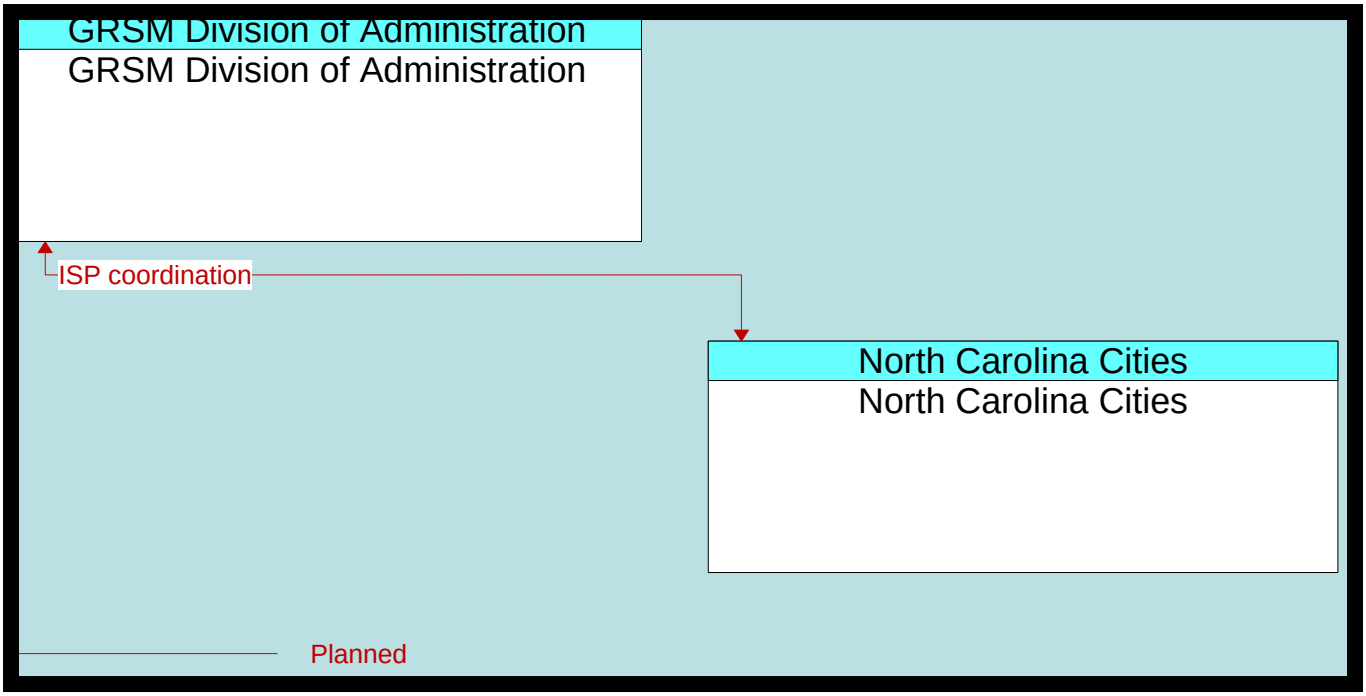
GRSM Division of Administration
road network conditions
road network probe information
Major Roadway Closure Information
GRSM Division of Resource Mgmt. a...
GRSM Division of Resource Management and Science
Existing
Planned


GRSM Division of Administration
GRSM Division of Administration
Media Traveler Information
Media
Media
Existing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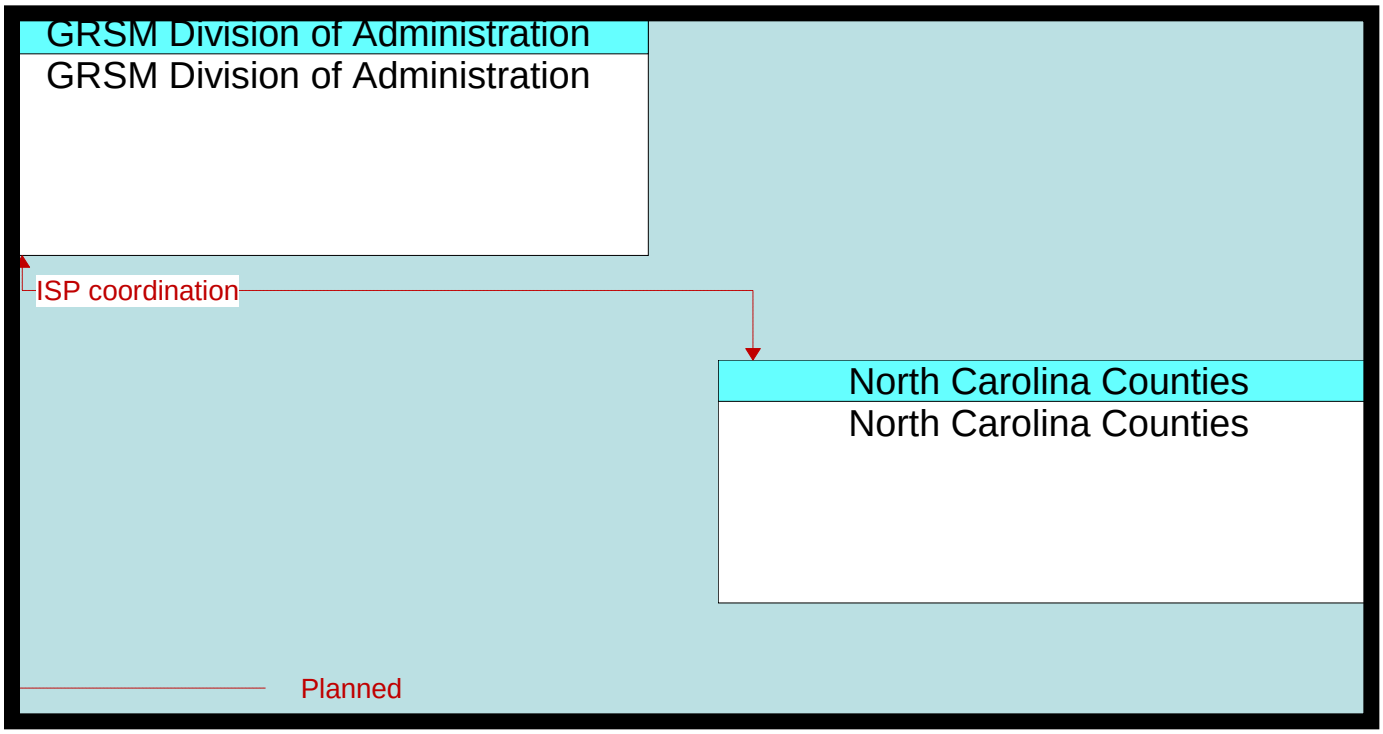
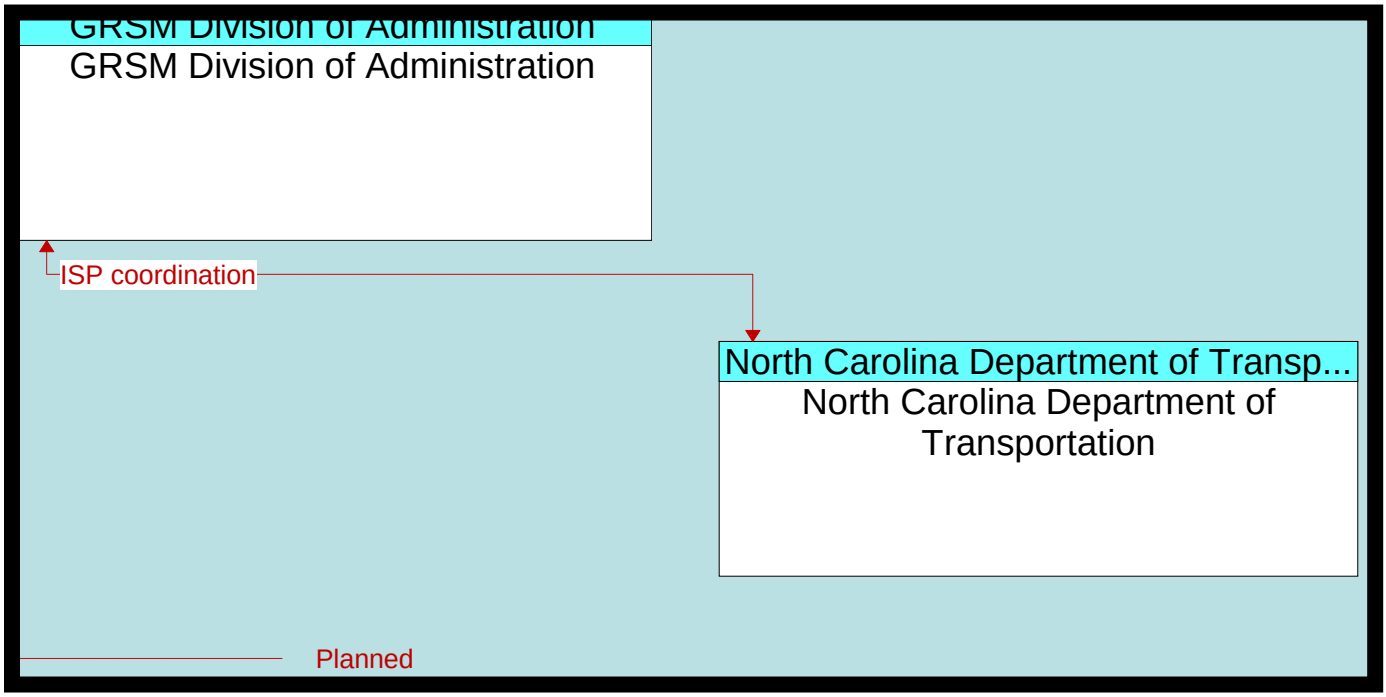
GRSM Division of Administration
ISP coordination
North Carolina Cities
North Carolina Cities
Planned


GRSM Division of Administration
GRSM Division of Administration
ISP coordination
North Carolina Counties
North Carolina Counties
Planned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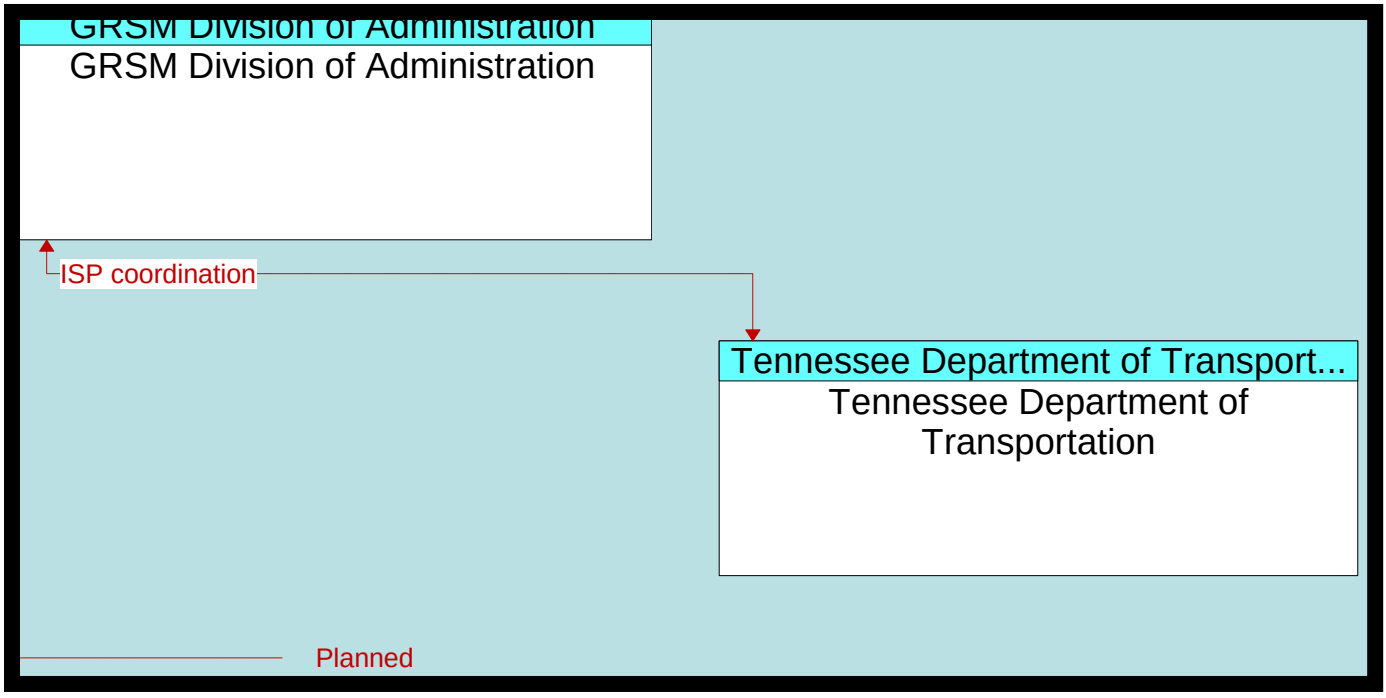
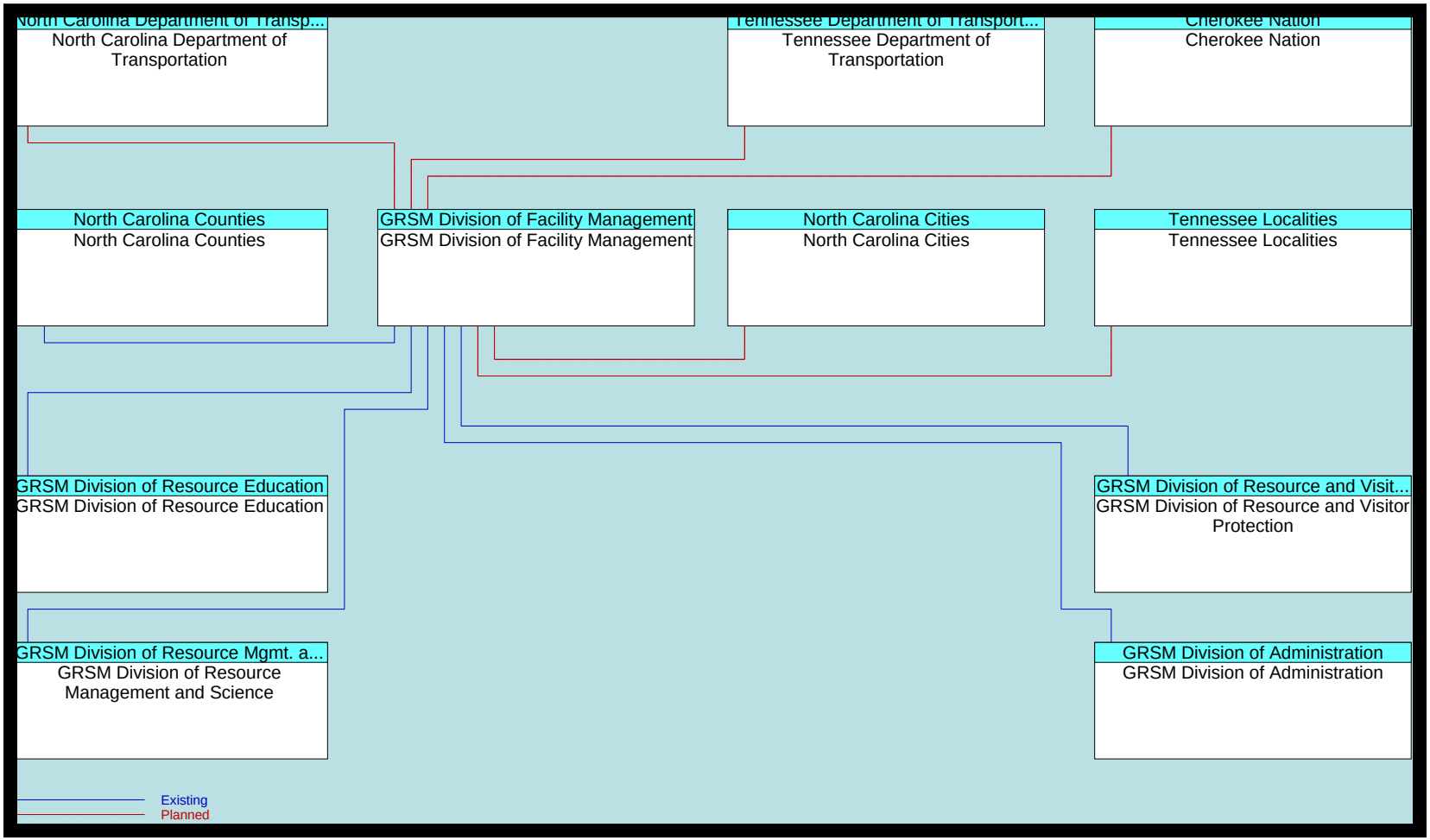
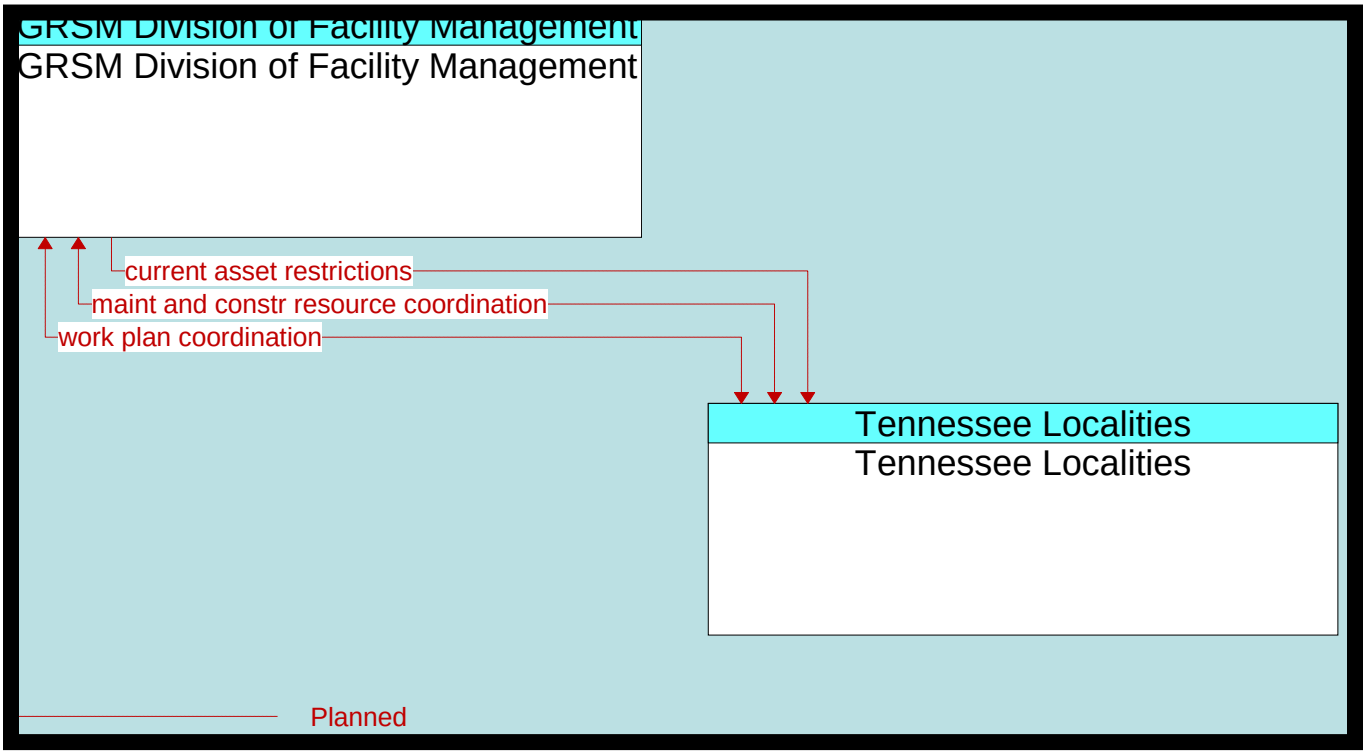
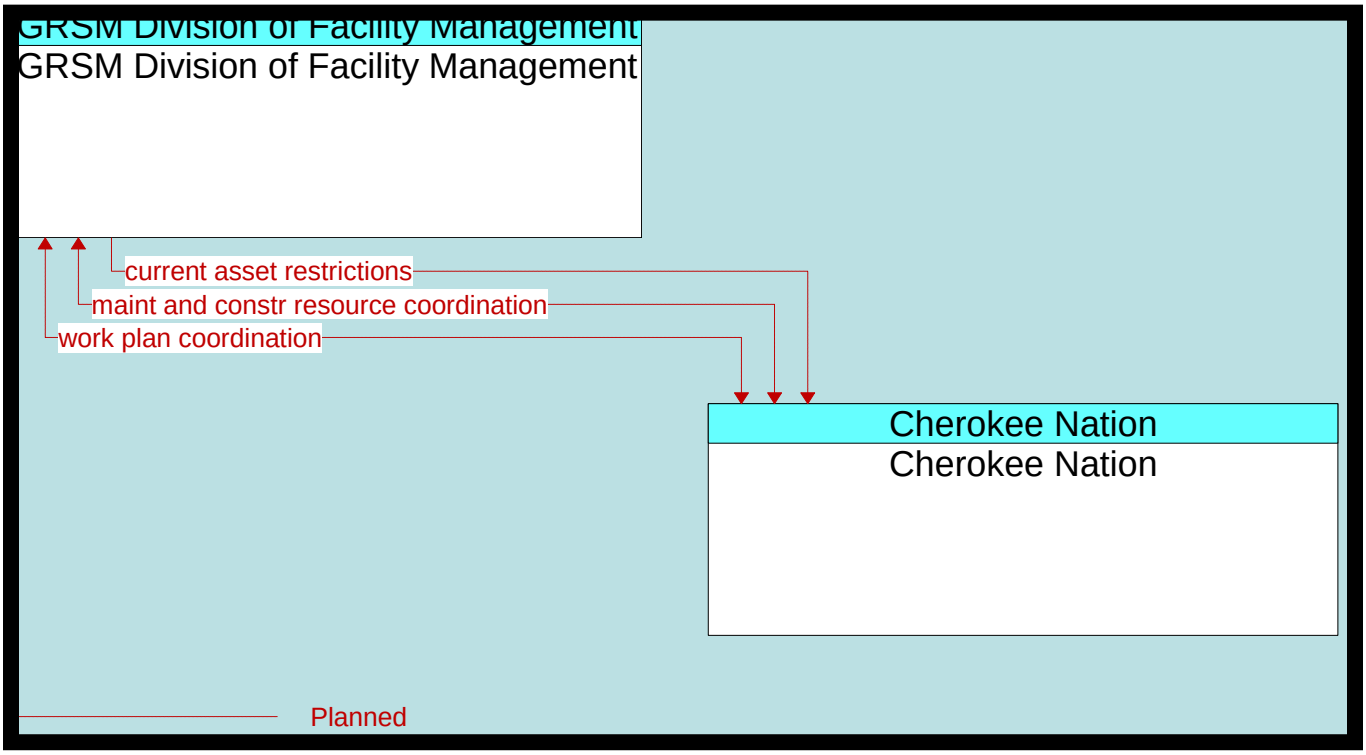
GRSM Division of Administration
ISP coordination
North Carolina Department of Transp...
North Carolina Department of Transportation
Planned

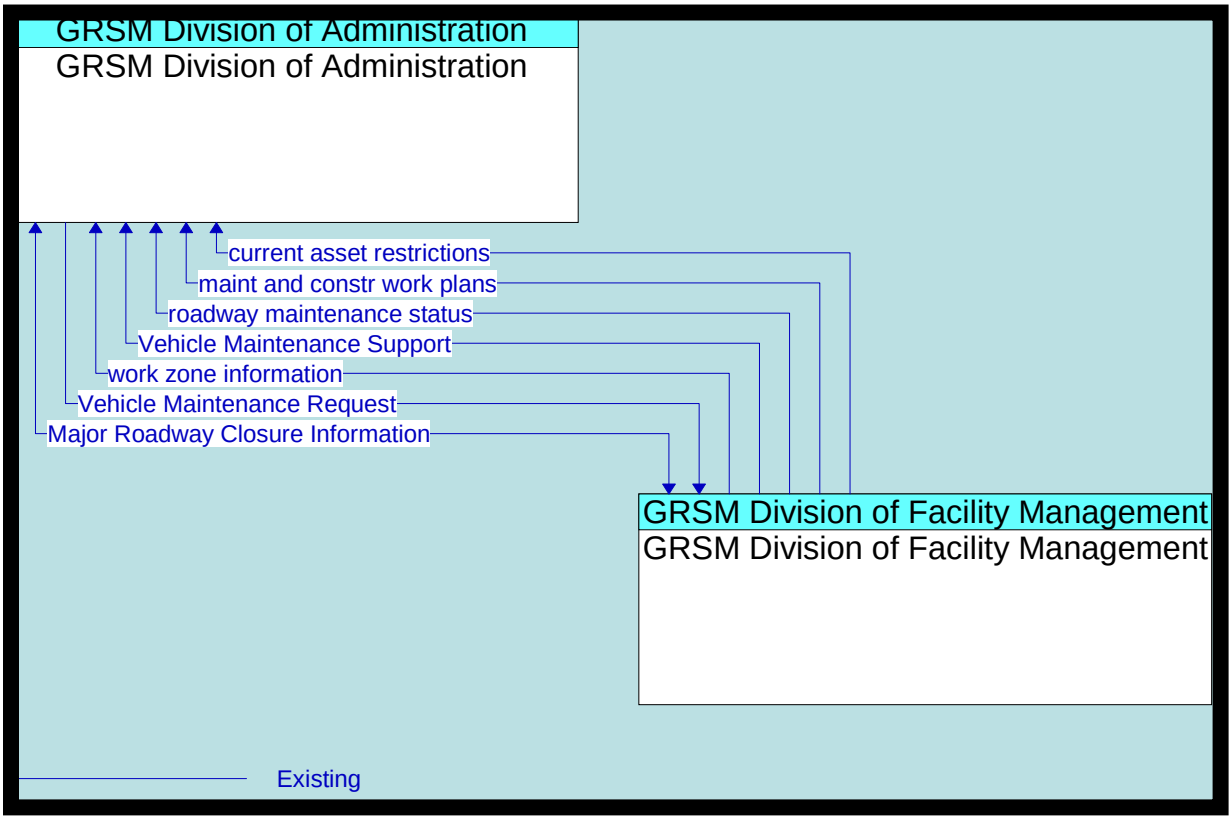

GRSM Division of Administration
GRSM Division of Administration
ISP coordination
Tennessee Department of Transport...
Tennessee Department of Transportation
Planned

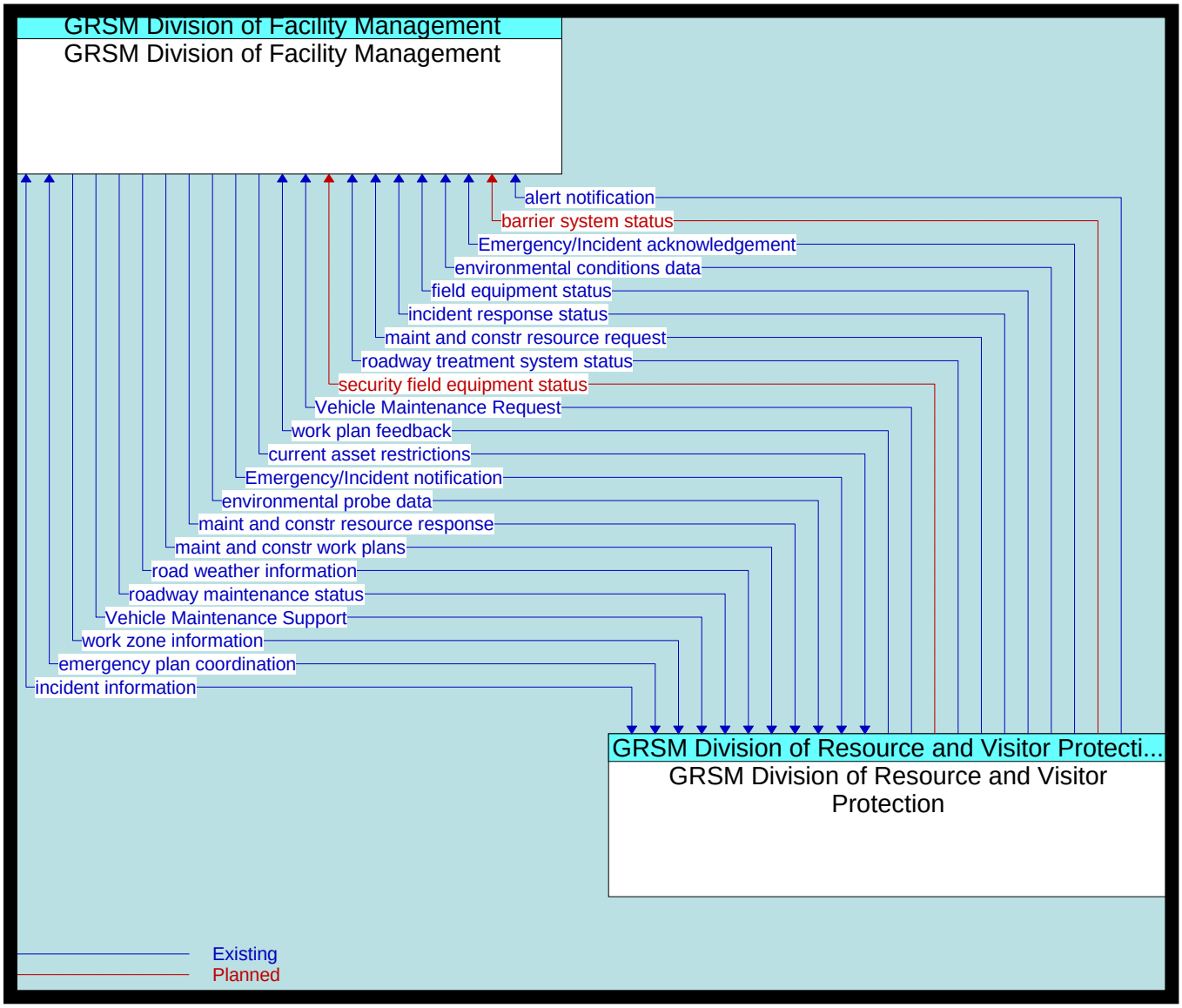
GRSM Division of Facility Management Interconnect Diagram

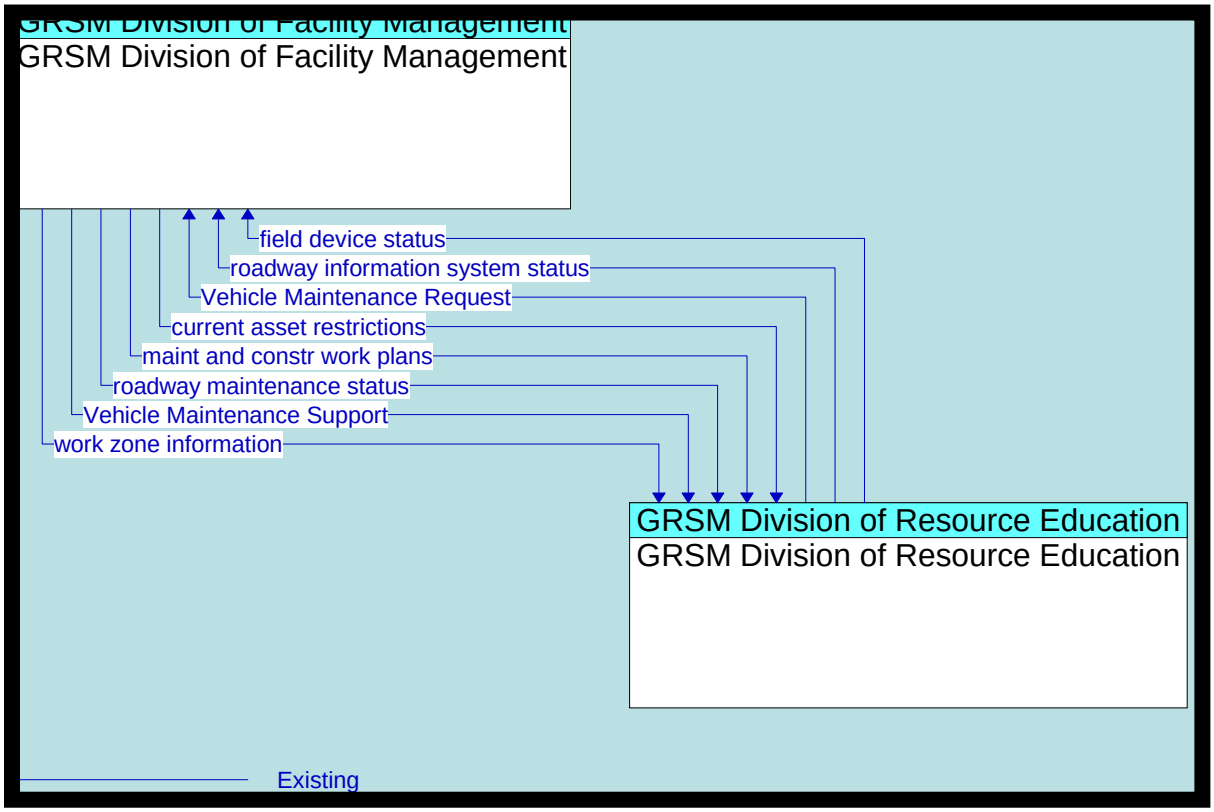


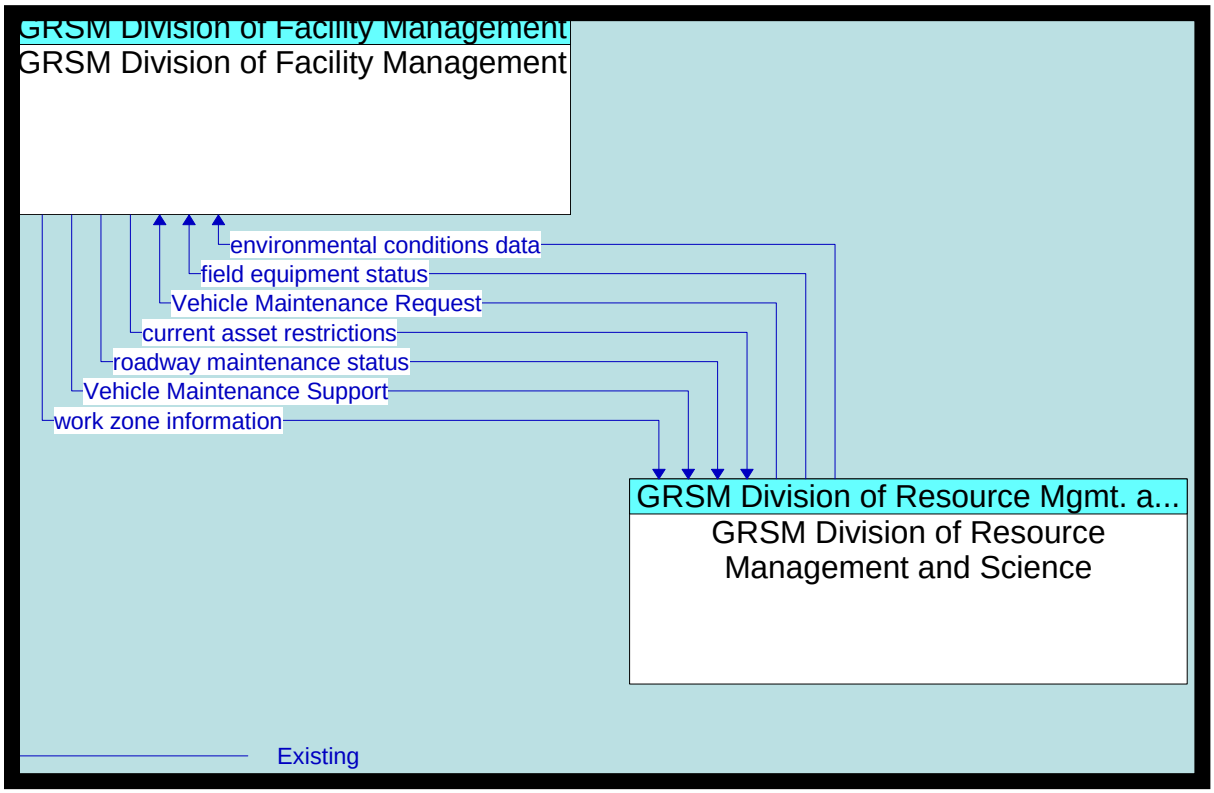

GRSM Division of Facility Management
GRSM Division of Facility Management
current asset restrictions
maint and constr resource coordination
work plan coordination
Tennessee Localities
Tennessee Localities
Planned

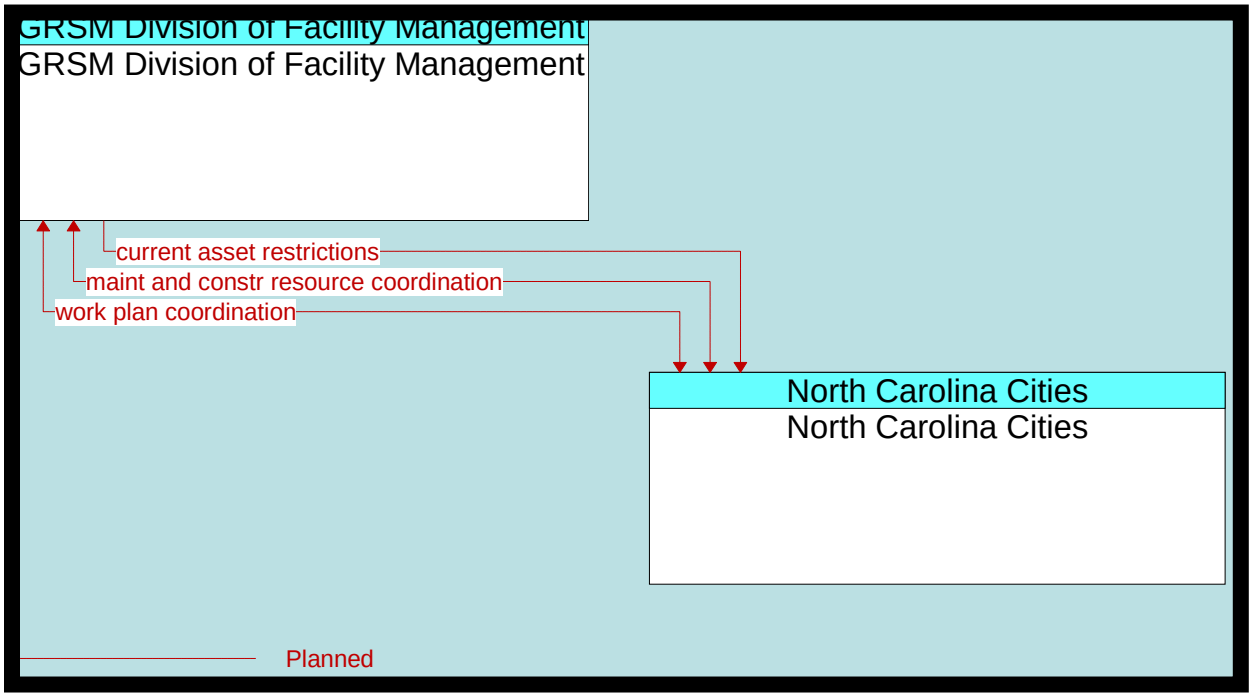

GRSM Division of Facility Management
GRSM Division of Facility Management
current asset restrictions
maint and constr resource coordination
work plan coordination
Cherokee Nation
Cherokee Nation
Planned

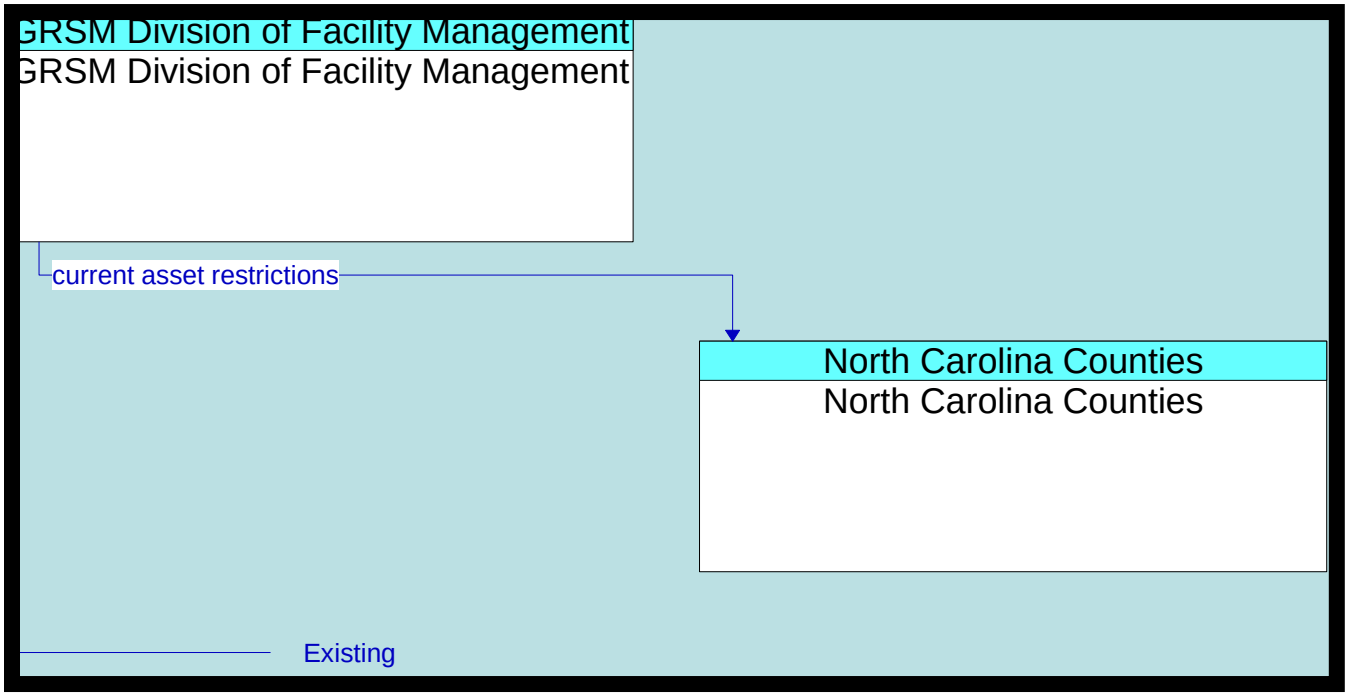

GRSM Division of Administration
GRSM Division of Administration
current asset restrictions
maint and constr work plans
roadway maintenance status
Vehicle Maintenance Support
work zone information
Vehicle Maintenance Request
Major Roadway Closure Information
GRSM Division of Facility Management
GRSM Division of Facility Management
Existing

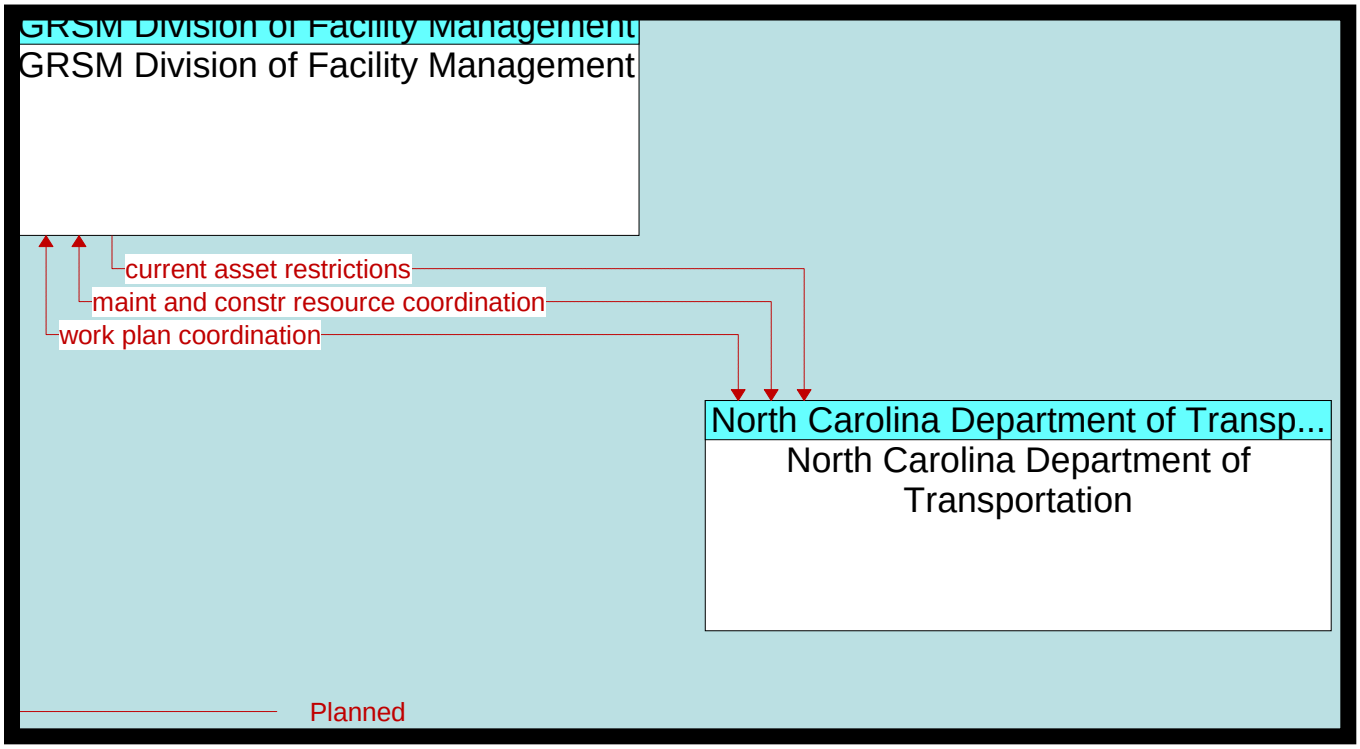

GRSM Division of Facility Management
GRSM Division of Facility Management
alert notification
barrier system status
Emergency/Incident acknowledgement
environmental conditions data
field equipment status
incident response status
maint and constr resource request
roadway treatment system status
security field equipment status
Vehicle Maintenance Request
work plan feedback
current asset restrictions
Emergency/Incident notification
environmental probe data
maint and constr resource response
maint and constr work plans
road weather information
roadway maintenance status
Vehicle Maintenance Support
work zone information
emergency plan coordination
incident information
GRSM Division of Resource and Visitor Protecti...
GRSM Division of Resource and Visitor Protection
Existing
Planned

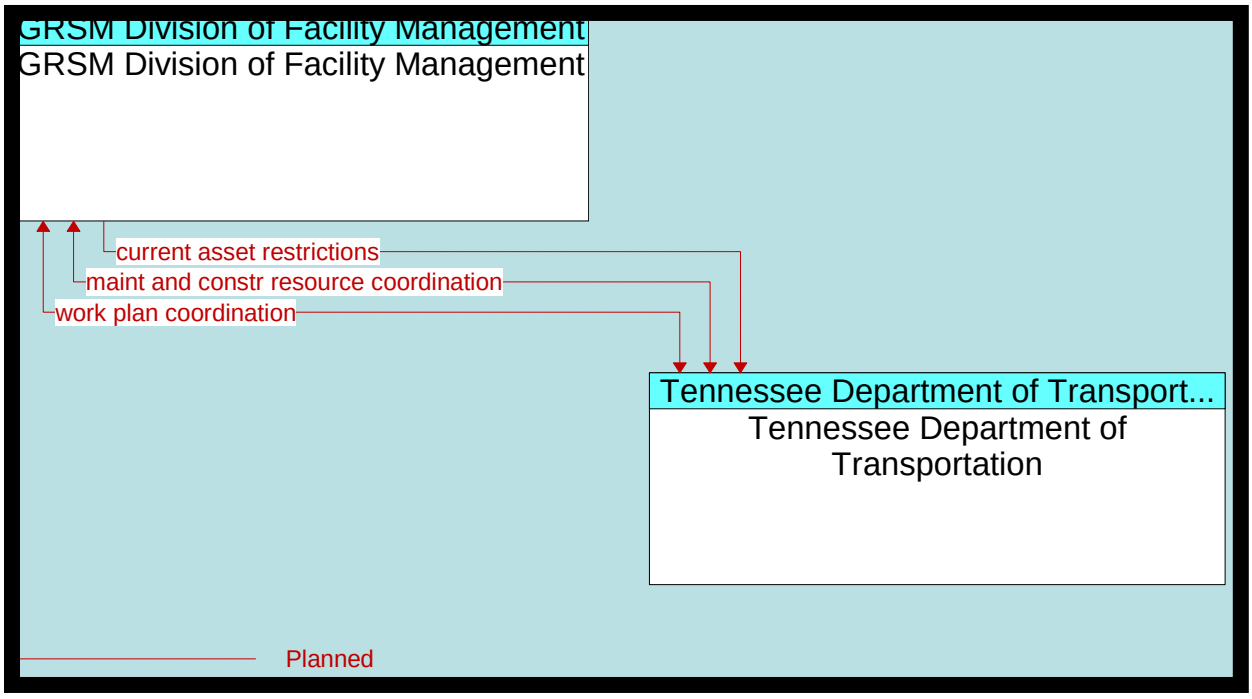

GRSM Division of Facility Management
GRSM Division of Facility Management
field device status
roadway information system status
Vehicle Maintenance Request
current asset restrictions
maint and constr work plans
roadway maintenance status
Vehicle Maintenance Support
work zone information
GRSM Division of Resource Education
GRSM Division of Resource Education
Existing


GRSM Division of Facility Management
GRSM Division of Facility Management
environmental conditions data
field equipment status
Vehicle Maintenance Request
current asset restrictions
roadway maintenance status
Vehicle Maintenance Support
work zone information
GRSM Division of Resource Mgmt. a...
GRSM Division of Resource Management and Science
Existing

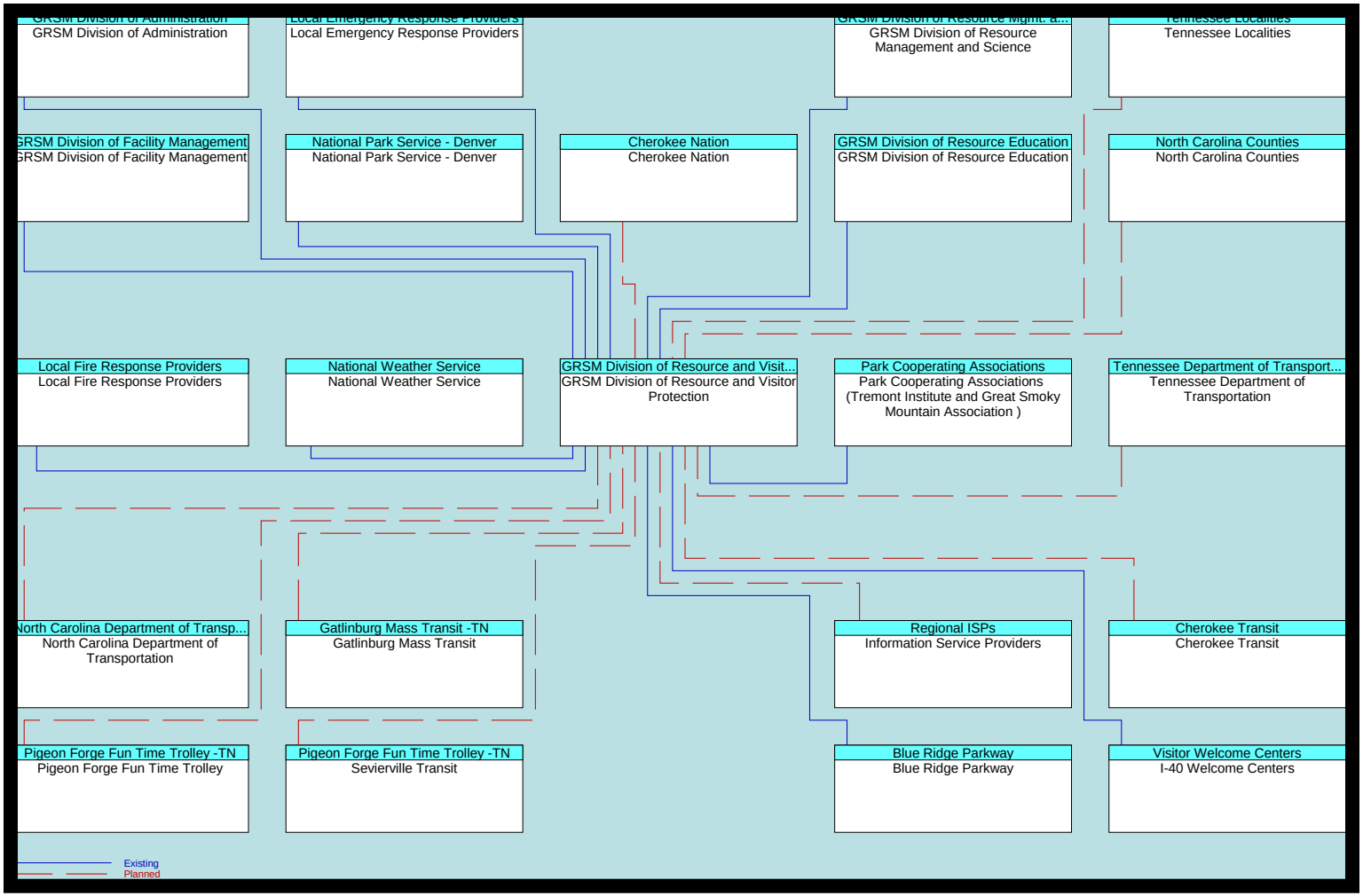

GRSM Division of Facility Management
GRSM Division of Facility Management
current asset restrictions
maint and constr resource coordination
work plan coordination
North Carolina Cities
North Carolina Cities
Planned

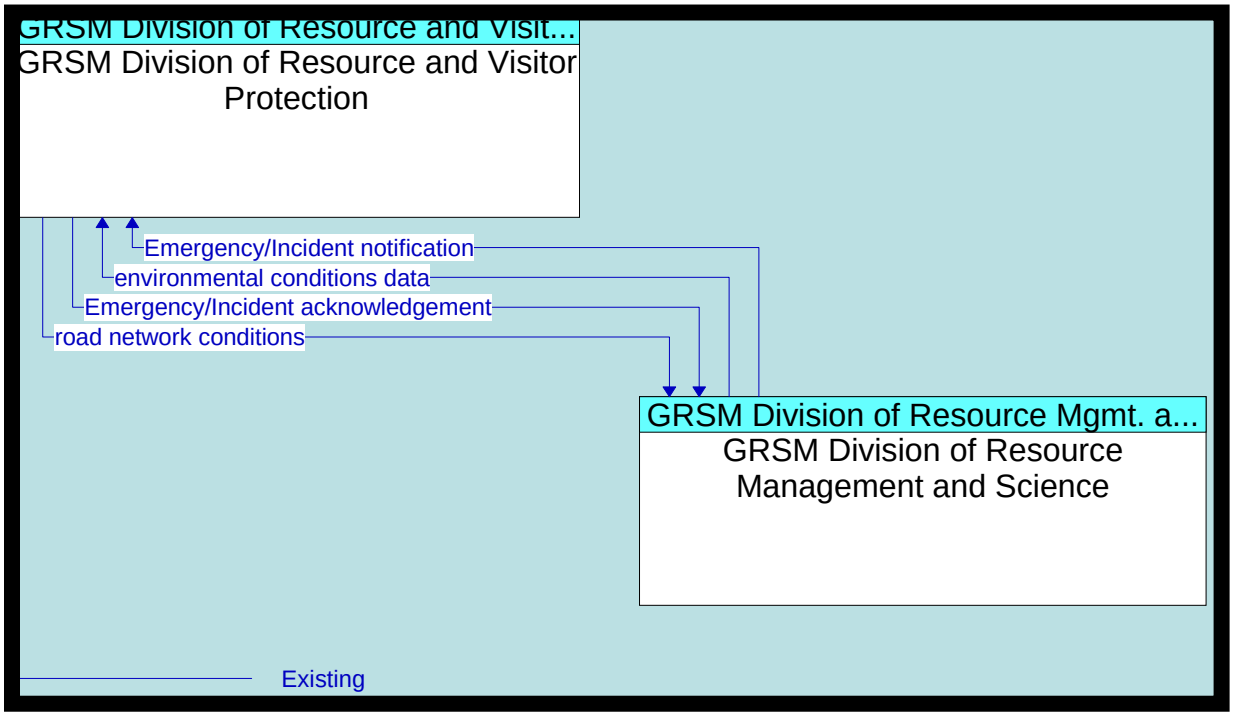

GRSM Division of Facility Management
GRSM Division of Facility Management
current asset restrictions
North Carolina Counties
North Carolina Counties
Existing

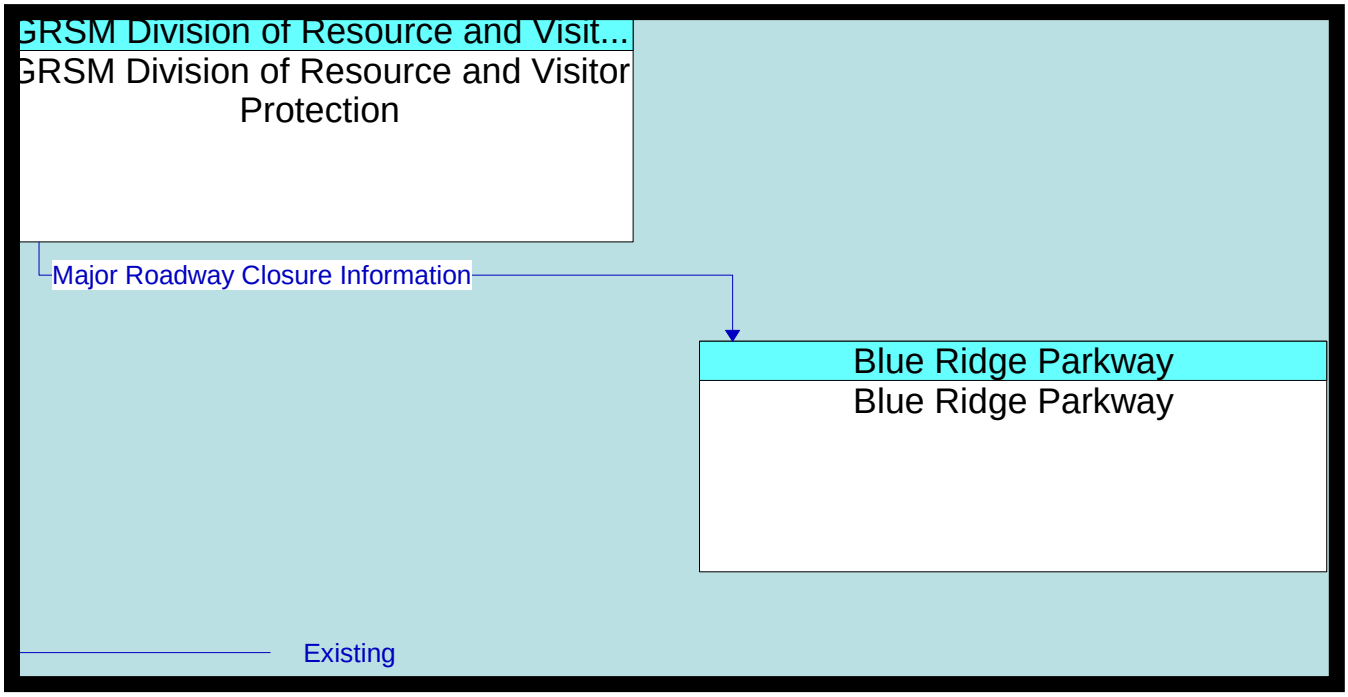

GRSM Division of Facility Management
GRSM Division of Facility Management
current asset restrictions
maint and constr resource coordination
work plan coordination
North Carolina Department of Transp...
North Carolina Department of Transportation
Planned

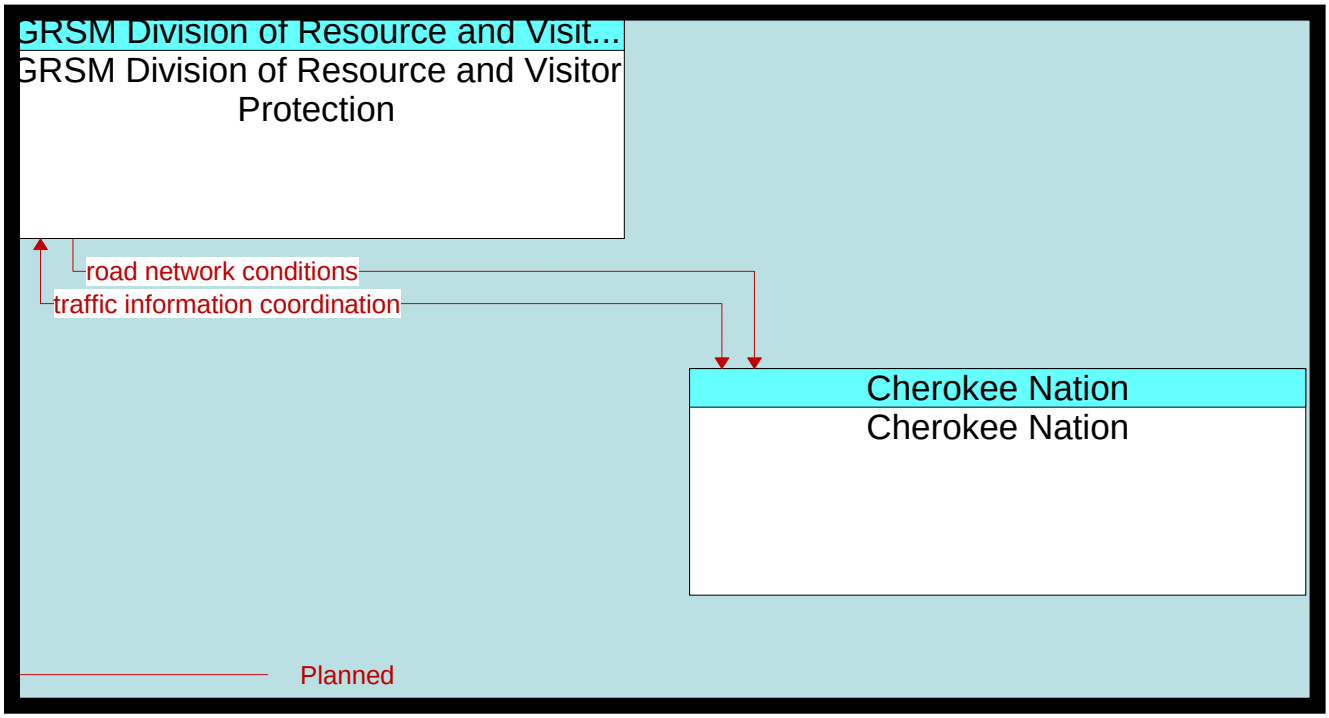

GRSM Division of Facility Management
GRSM Division of Facility Management
current asset restrictions
maint and constr resource coordination
work plan coordination
Tennessee Department of Transport...
Tennessee Department of Transportation
Planned

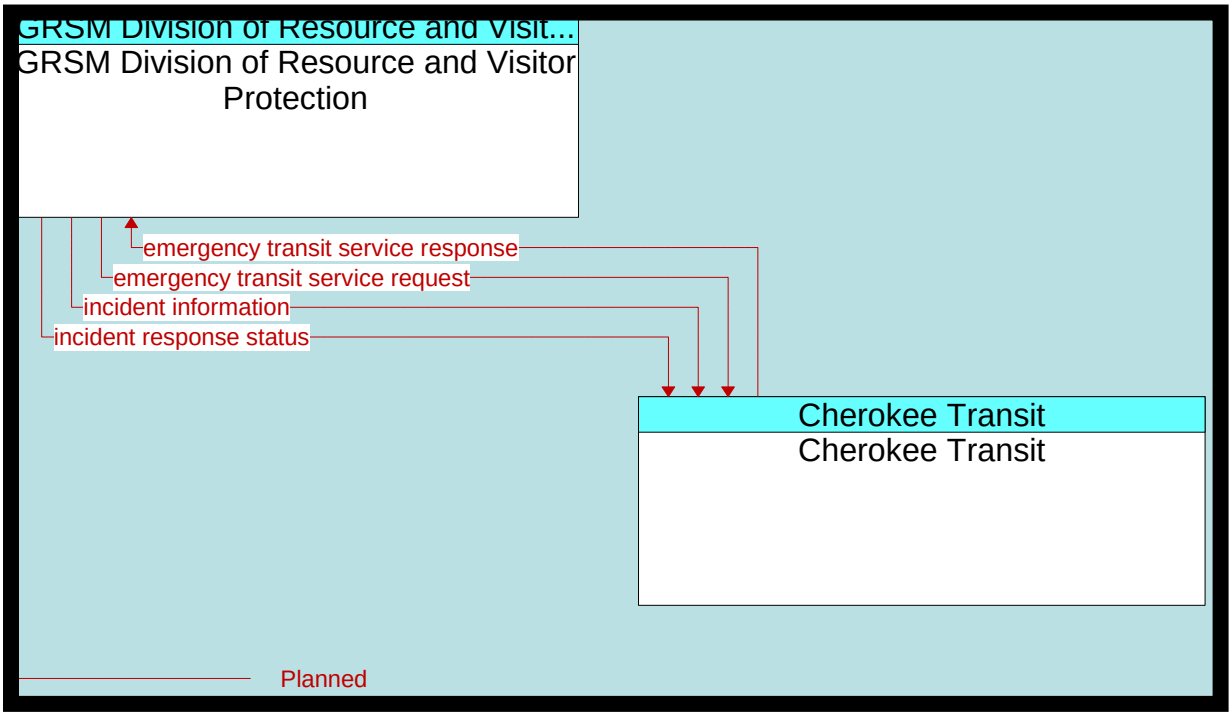
GRSM Division of Resource and Visitor Protection Interconnect Diagram

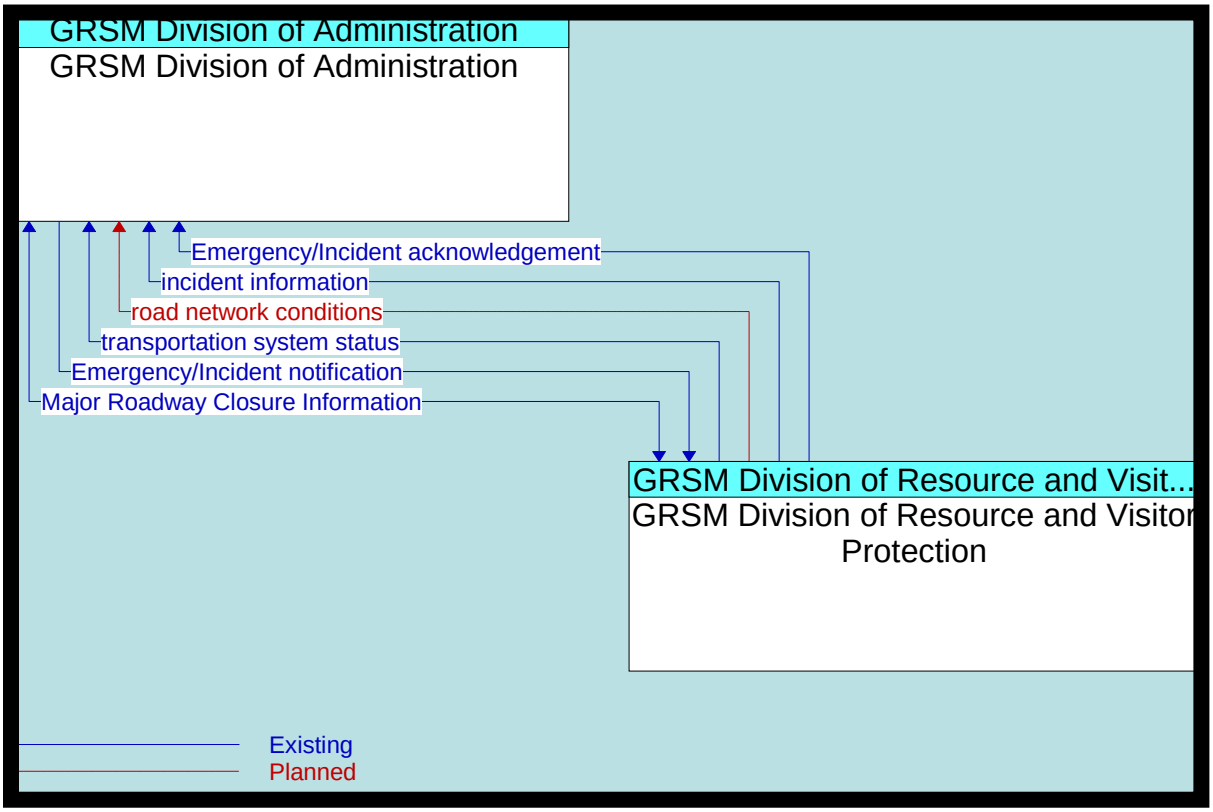


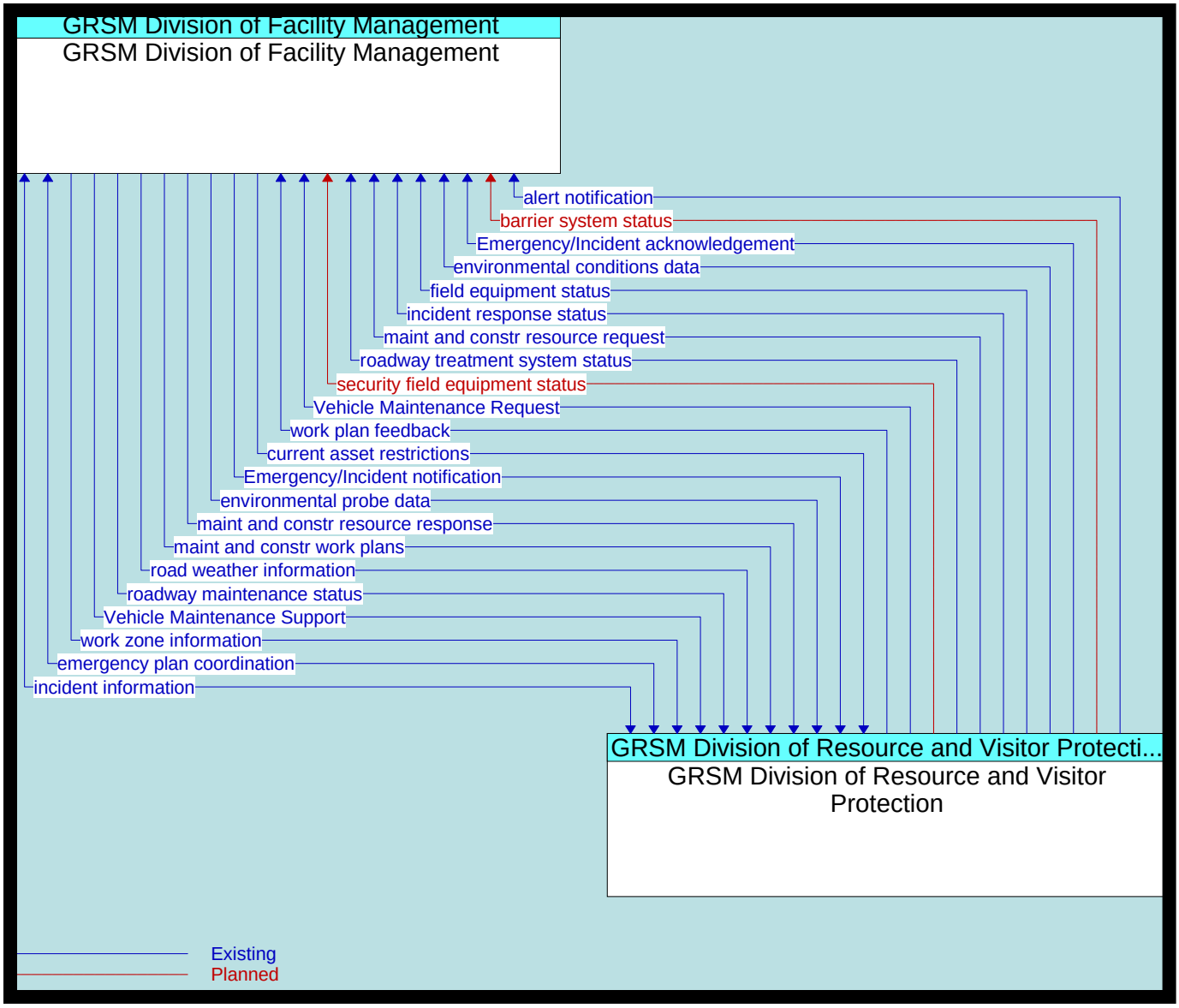

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
Emergency/Incident notification
environmental conditions data
Emergency/Incident acknowledgement
road network conditions
GRSM Division of Resource Mgmt. a...
GRSM Division of Resource Management and Science
Existing

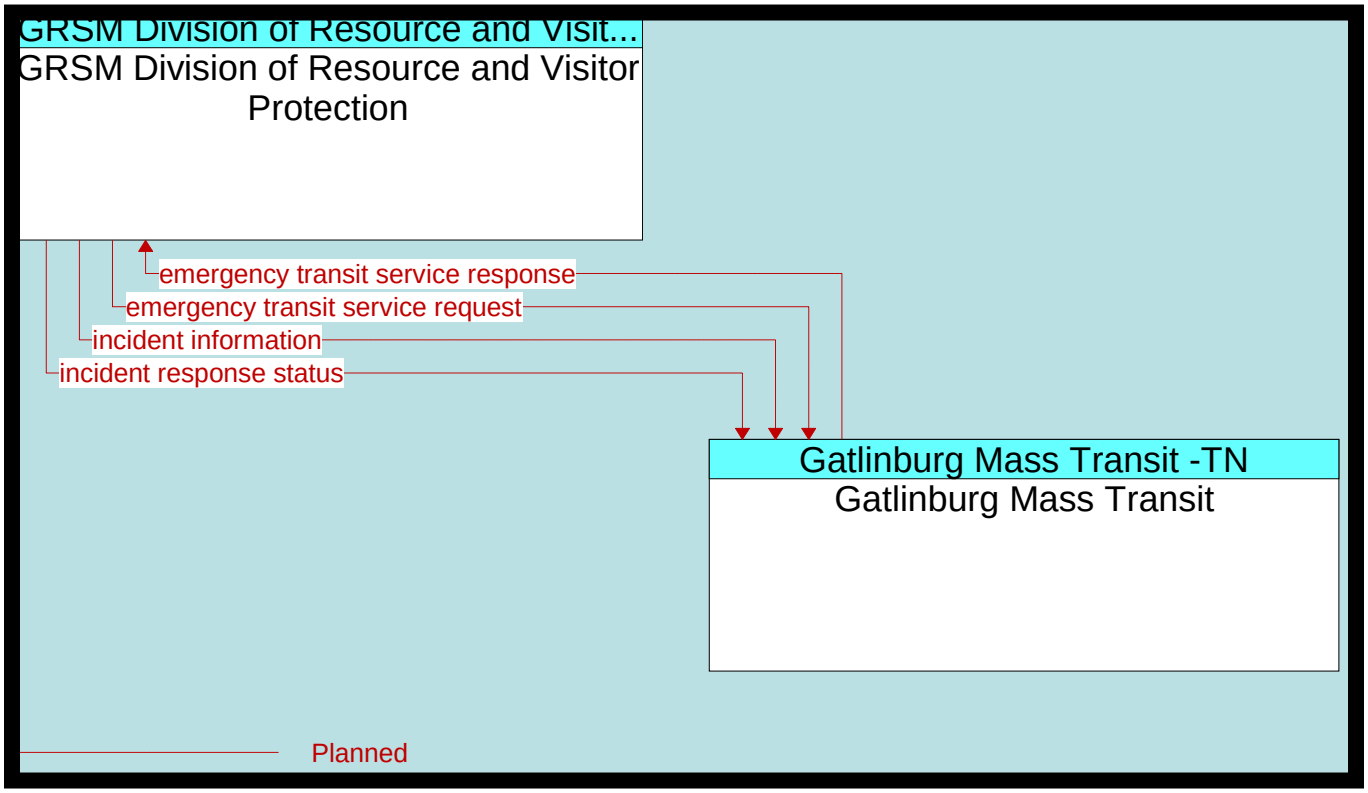

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
Major Roadway Closure Information
Blue Ridge Parkway
Blue Ridge Parkway
Existing

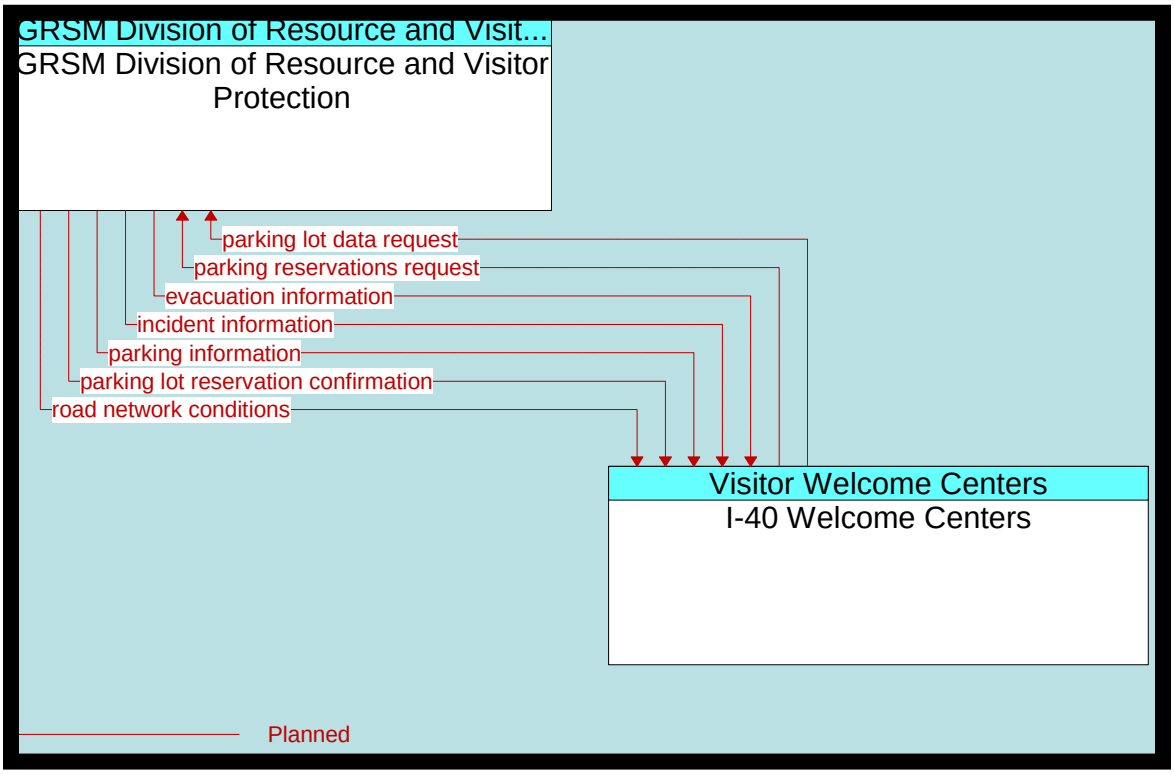

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
road network conditions
traffic information coordination
Cherokee Nation
Cherokee Nation
Planned

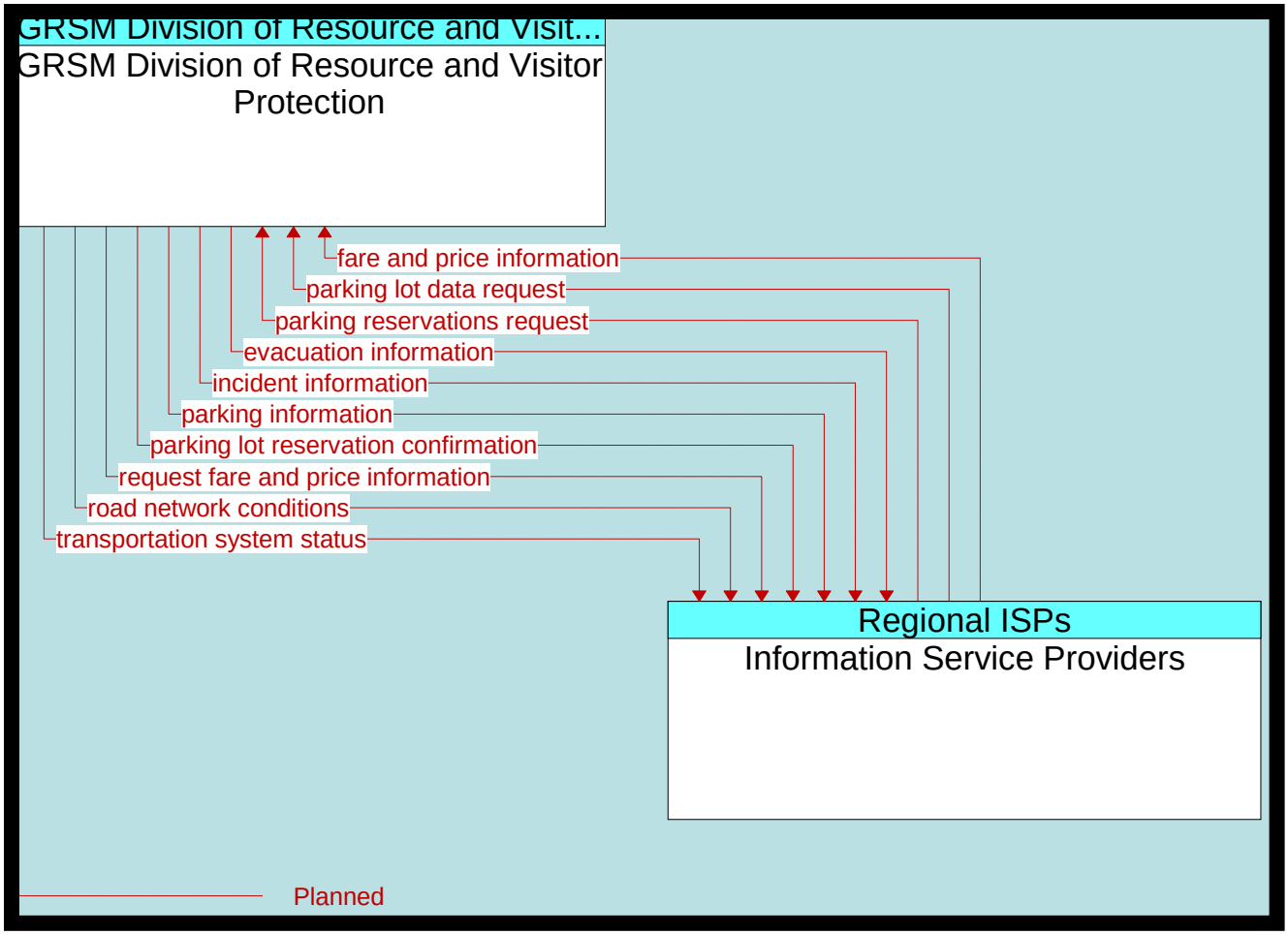

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
emergency transit service response
emergency transit service request
incident information
incident response status
Cherokee Transit
Cherokee Transit
Planned

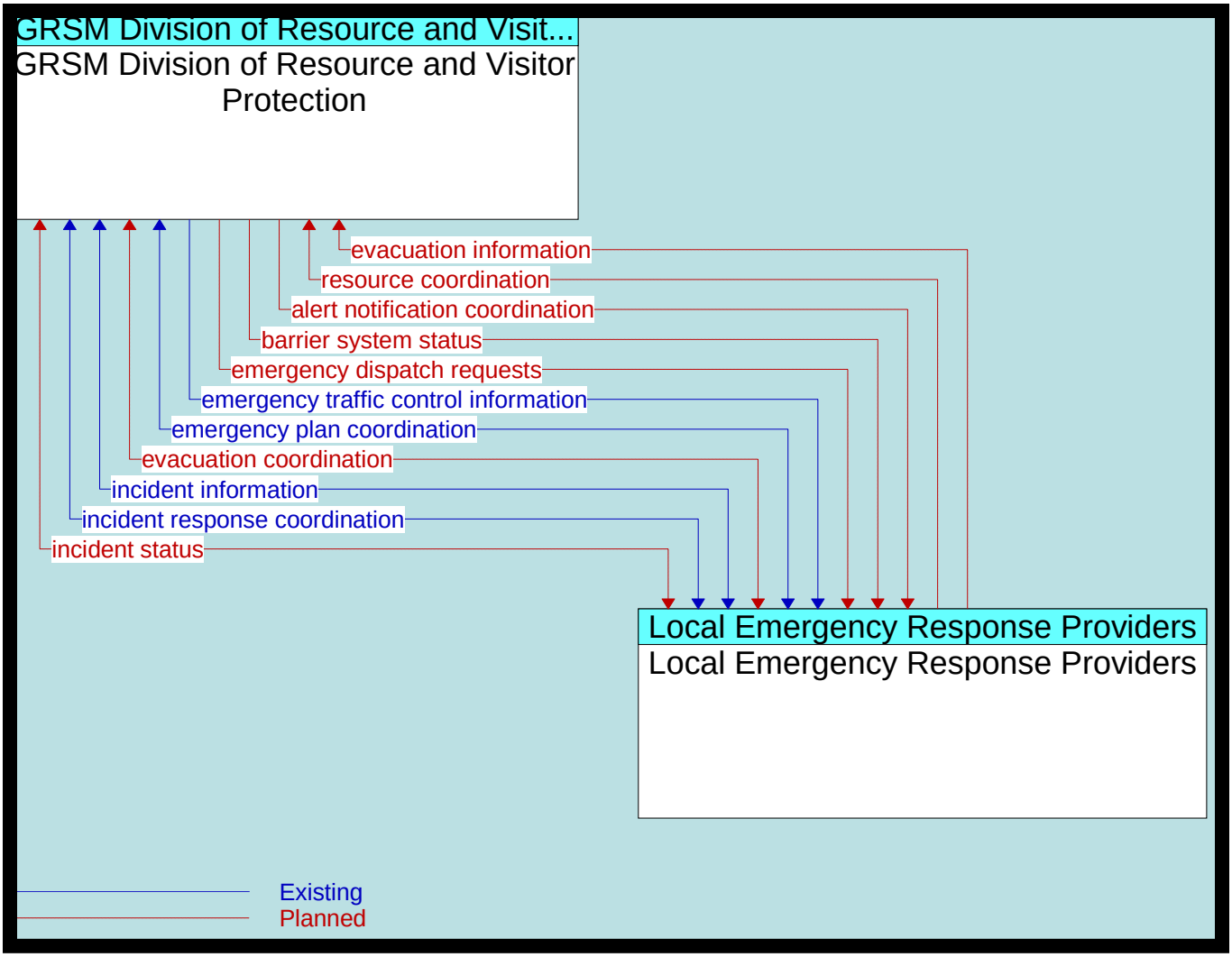

GRSM Division of Administration
GRSM Division of Administration
Emergency/Incident acknowledgement
incident information
road network conditions
transportation system status
Emergency/Incident notification
Major Roadway Closure Information
GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
Existing
Planned

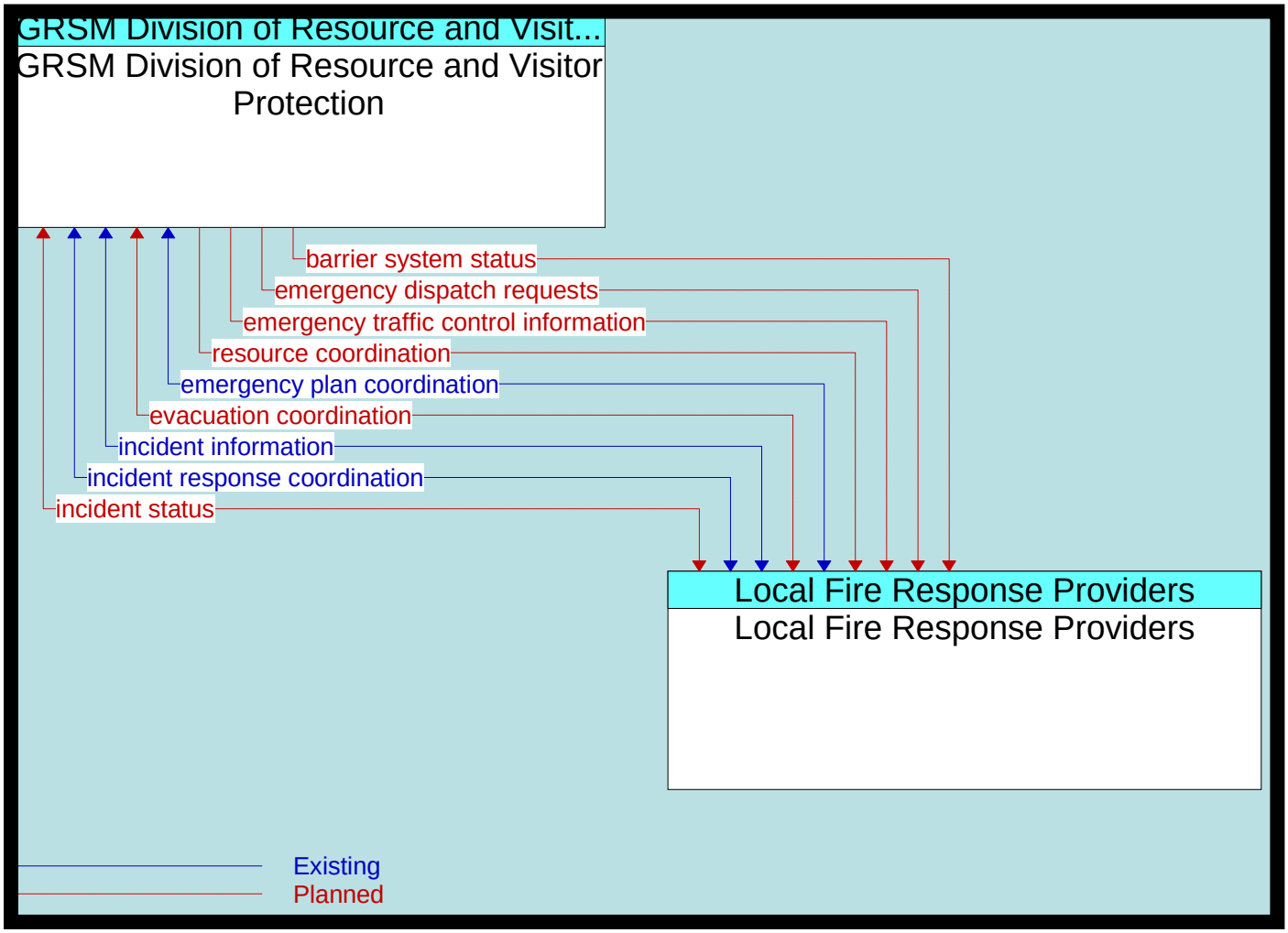

GRSM Division of Facility Management
GRSM Division of Facility Management
alert notification
barrier system status
Emergency/Incident acknowledgement
environmental conditions data
field equipment status
incident response status
maint and constr resource request
roadway treatment system status
security field equipment status
Vehicle Maintenance Request
work plan feedback
current asset restrictions
Emergency/Incident notification
environmental probe data
maint and constr resource response
maint and constr work plans
road weather information
roadway maintenance status
Vehicle Maintenance Support
work zone information
emergency plan coordination
incident information
GRSM Division of Resource and Visitor Protecti...
GRSM Division of Resource and Visitor Protection
Existing
Planned

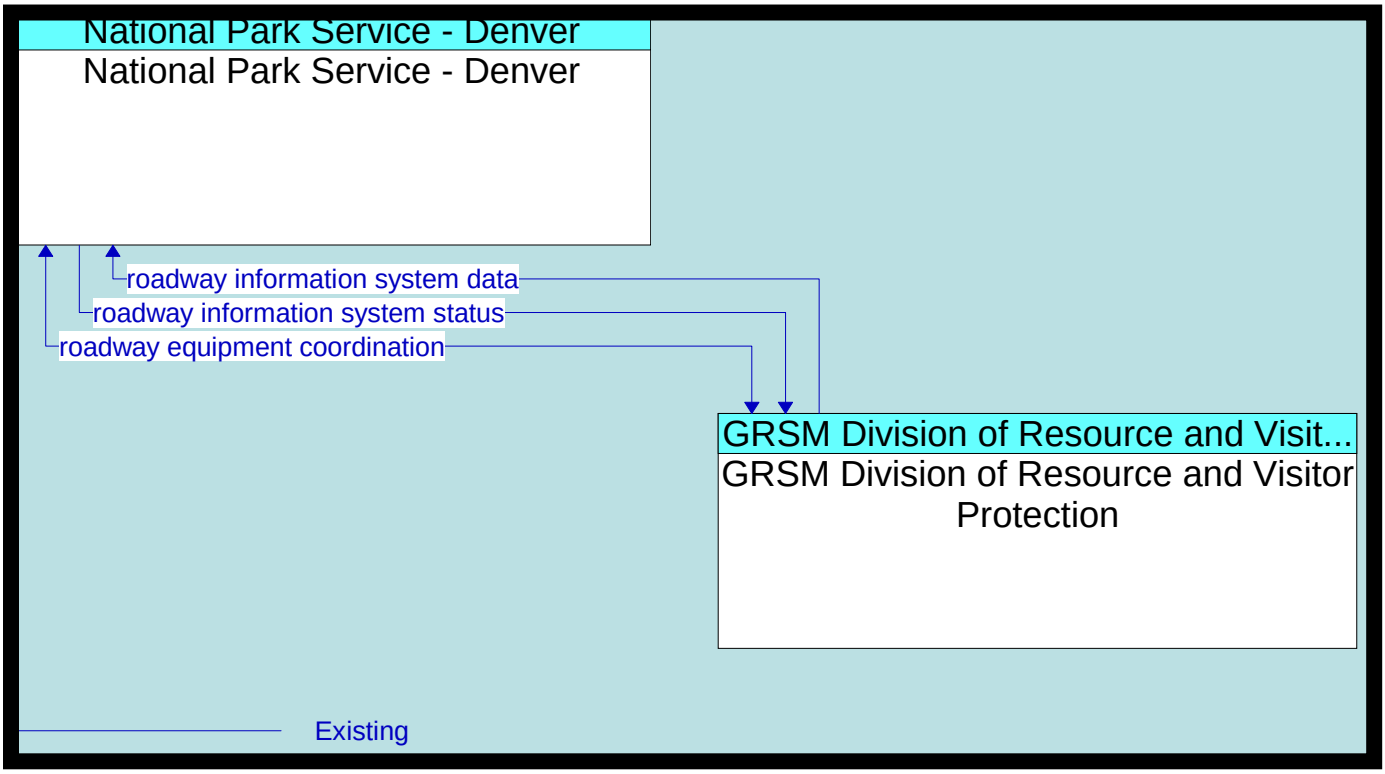

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
emergency transit service response
emergency transit service request
incident information
incident response status
Gatlinburg Mass Transit -TN
Gatlinburg Mass Transit
Planned

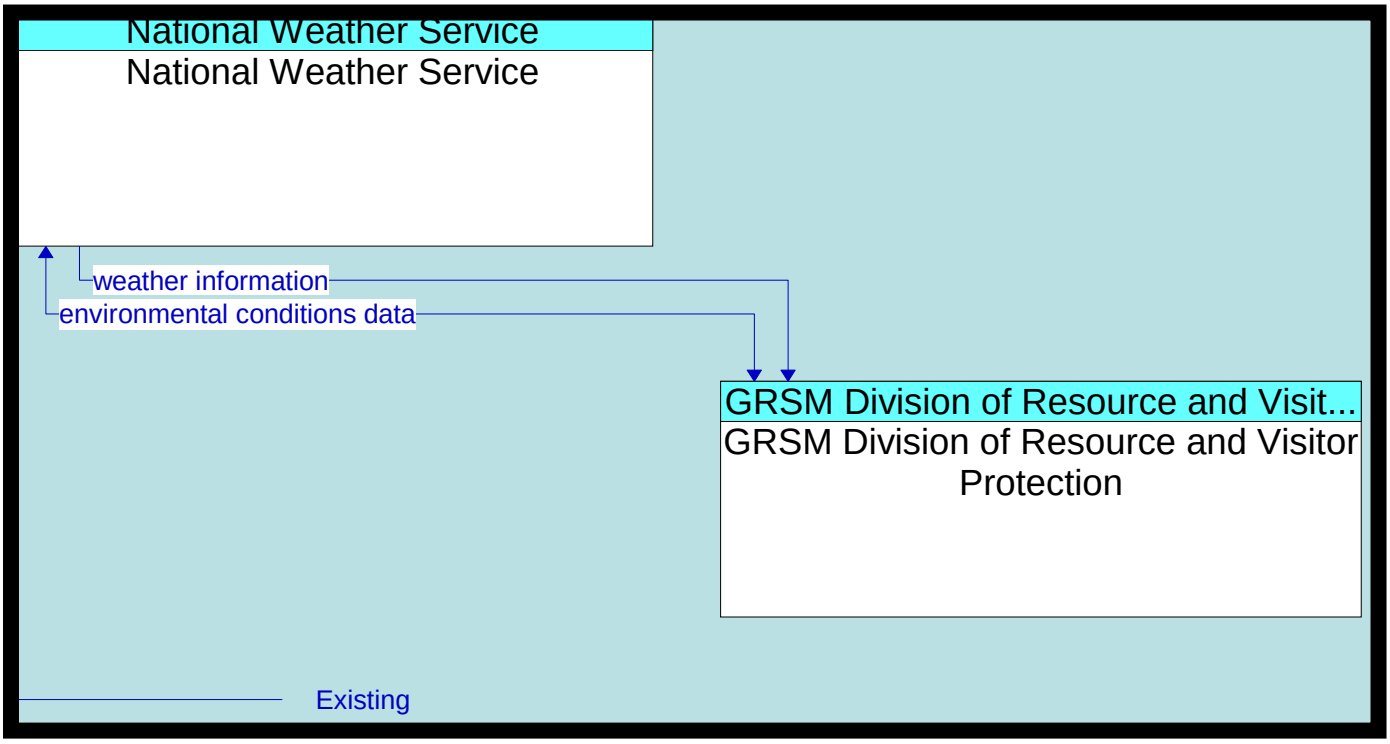

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
parking lot data request
parking reservations request
evacuation information
incident information
parking information
parking lot reservation confirmation
road network conditions
Visitor Welcome Centers
I-40 Welcome Centers
Planned

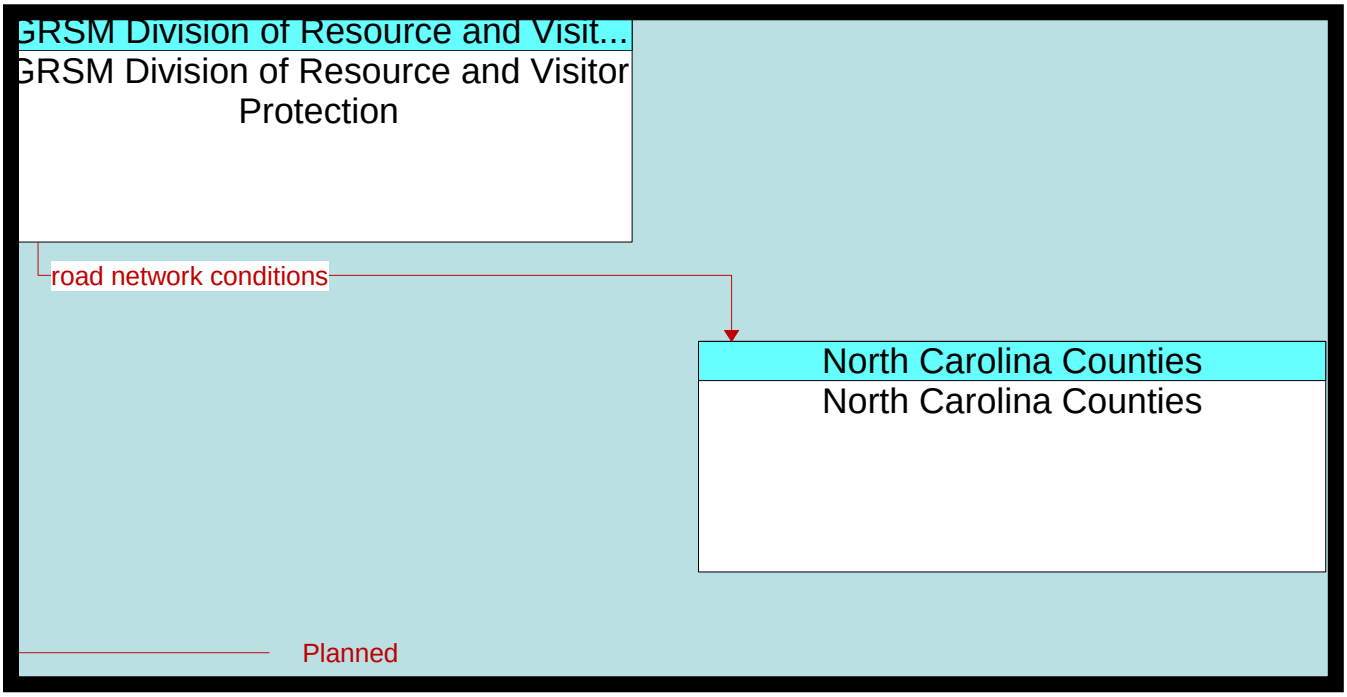

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
fare and price information
parking lot data request
parking reservations request
evacuation information
incident information
parking information
parking lot reservation confirmation
request fare and price information
road network conditions
transportation system status
Regional ISPs
Information Service Providers
Planned

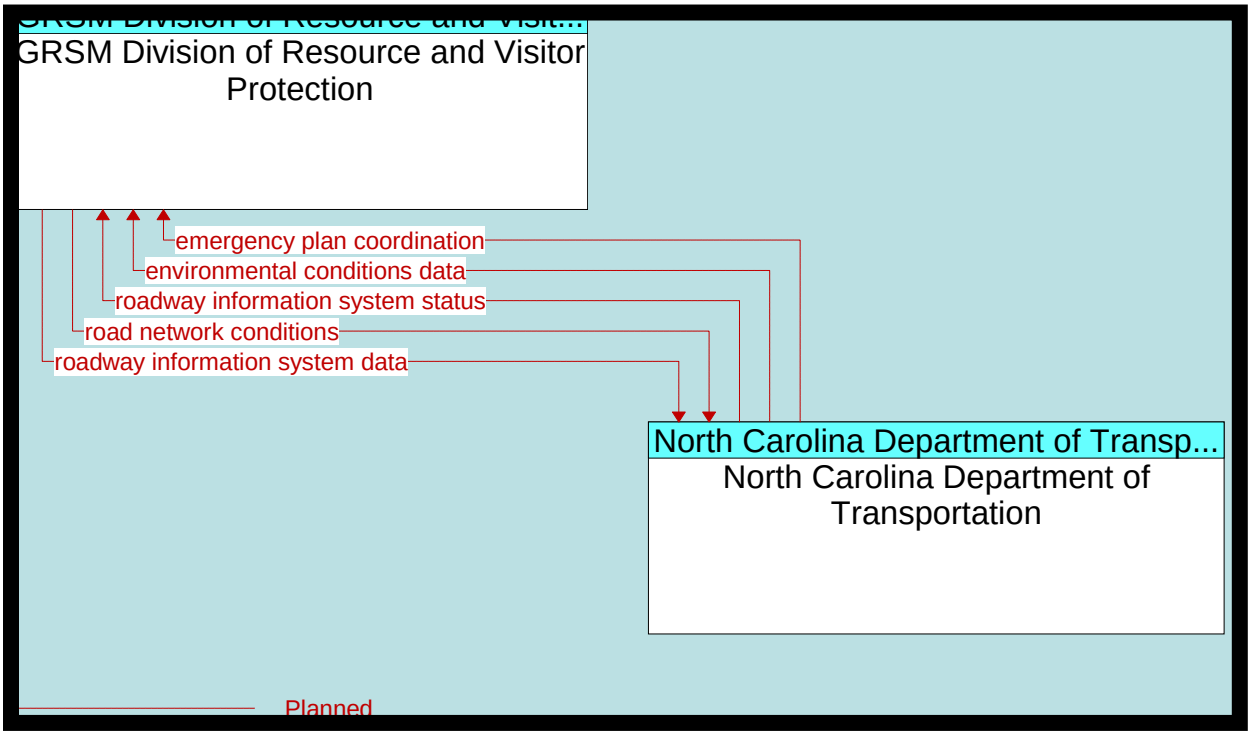

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
evacuation information
resource coordination
alert notification coordination
barrier system status
emergency dispatch requests
emergency traffic control information
emergency plan coordination
evacuation coordination
incident information
incident response coordination
incident status
Local Emergency Response Providers
Local Emergency Response Providers
Existing
Planned

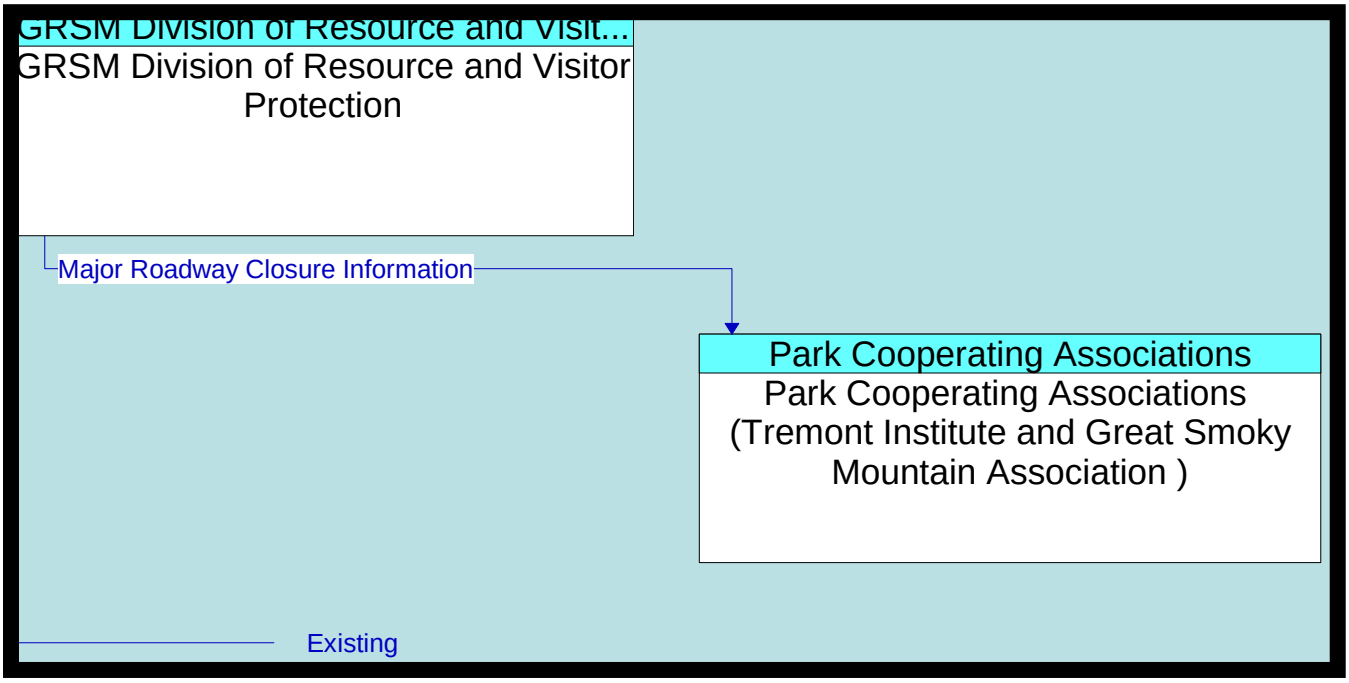

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
barrier system status
emergency dispatch requests
emergency traffic control information
resource coordination
emergency plan coordination
evacuation coordination
incident information
incident response coordination
incident status
Local Fire Response Providers
Local Fire Response Providers
Existing
Planned

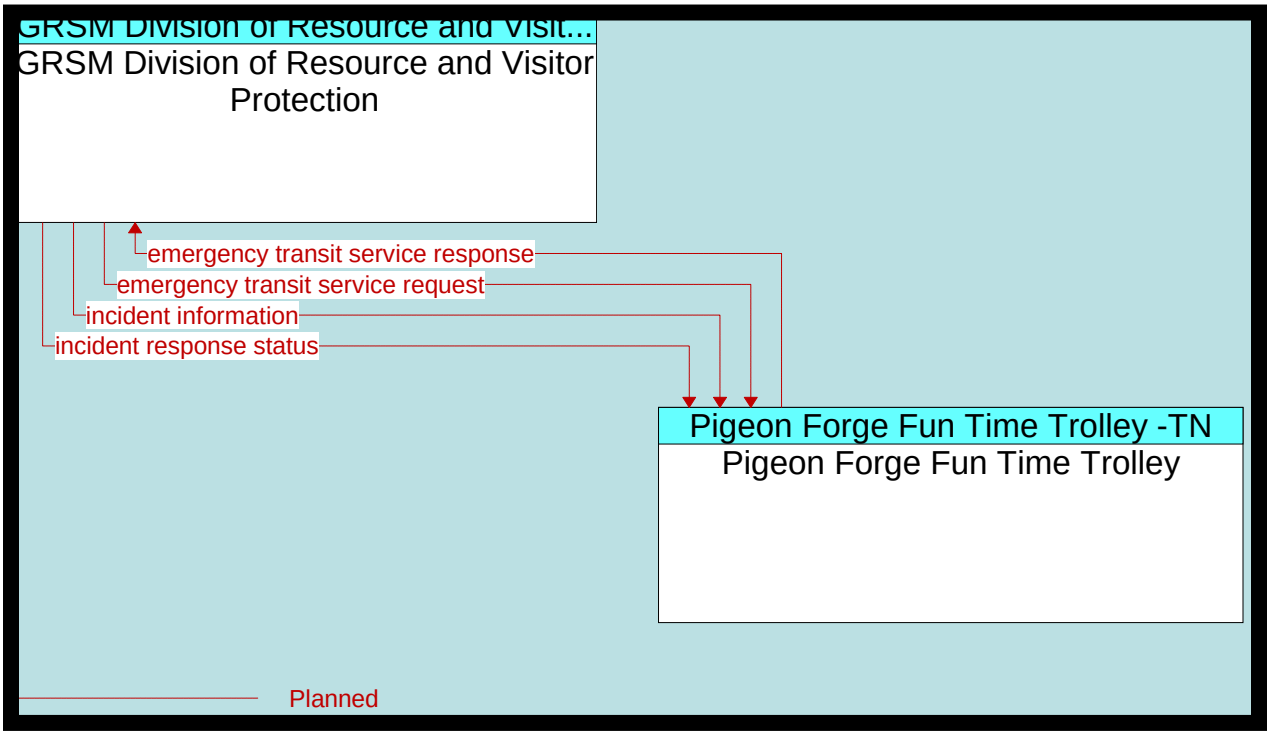

National Park Service - Denver
National Park Service - Denver
roadway information system data
roadway information system status
roadway equipment coordination
GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
Existing

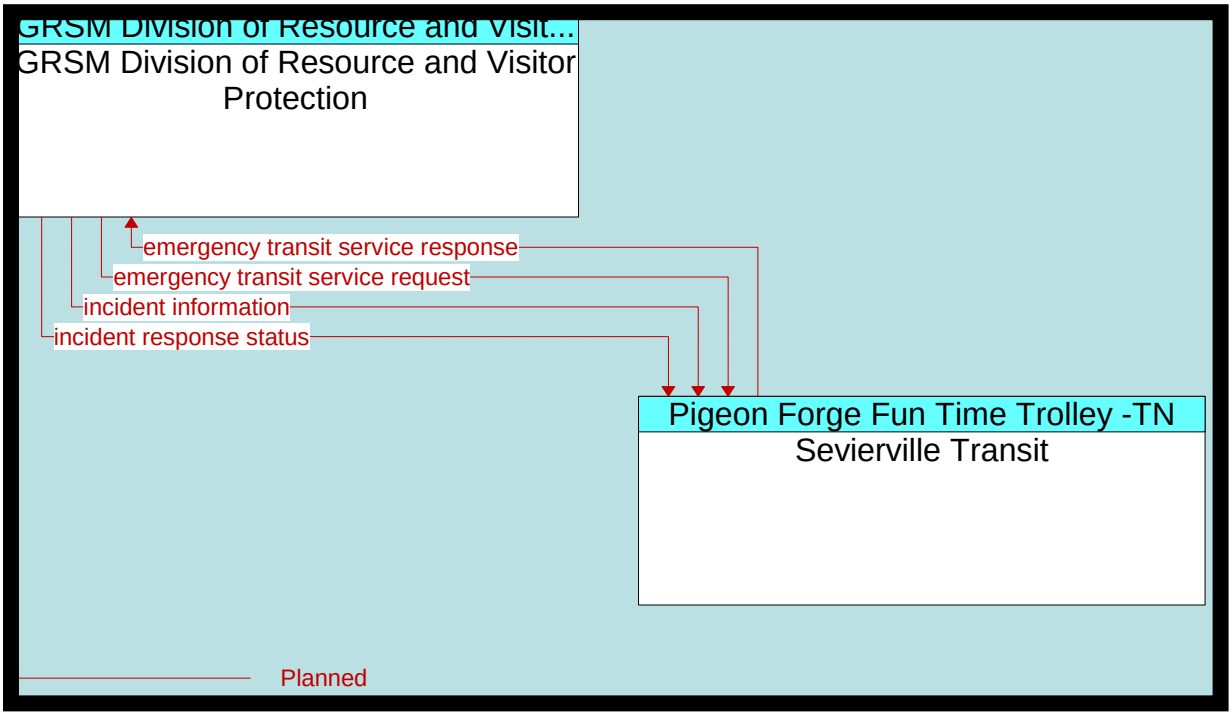

National Weather Service
National Weather Service
weather information
environmental conditions data
GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
Existing

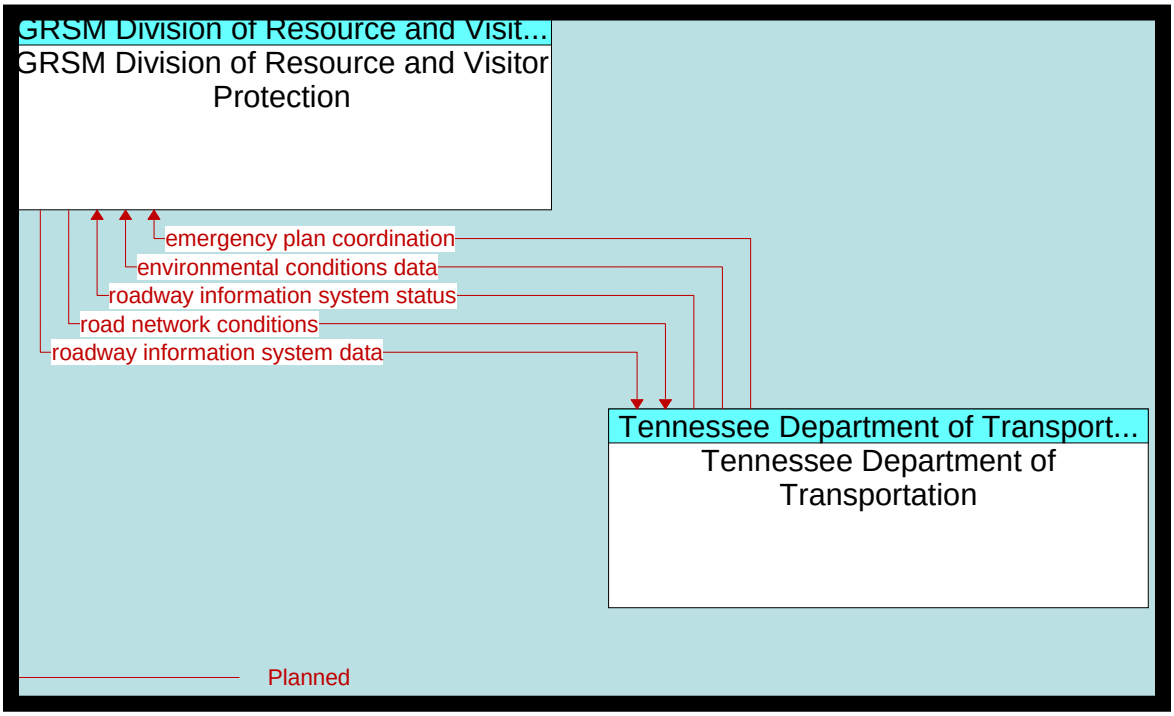

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
road network conditions
North Carolina Counties
North Carolina Counties
Planned

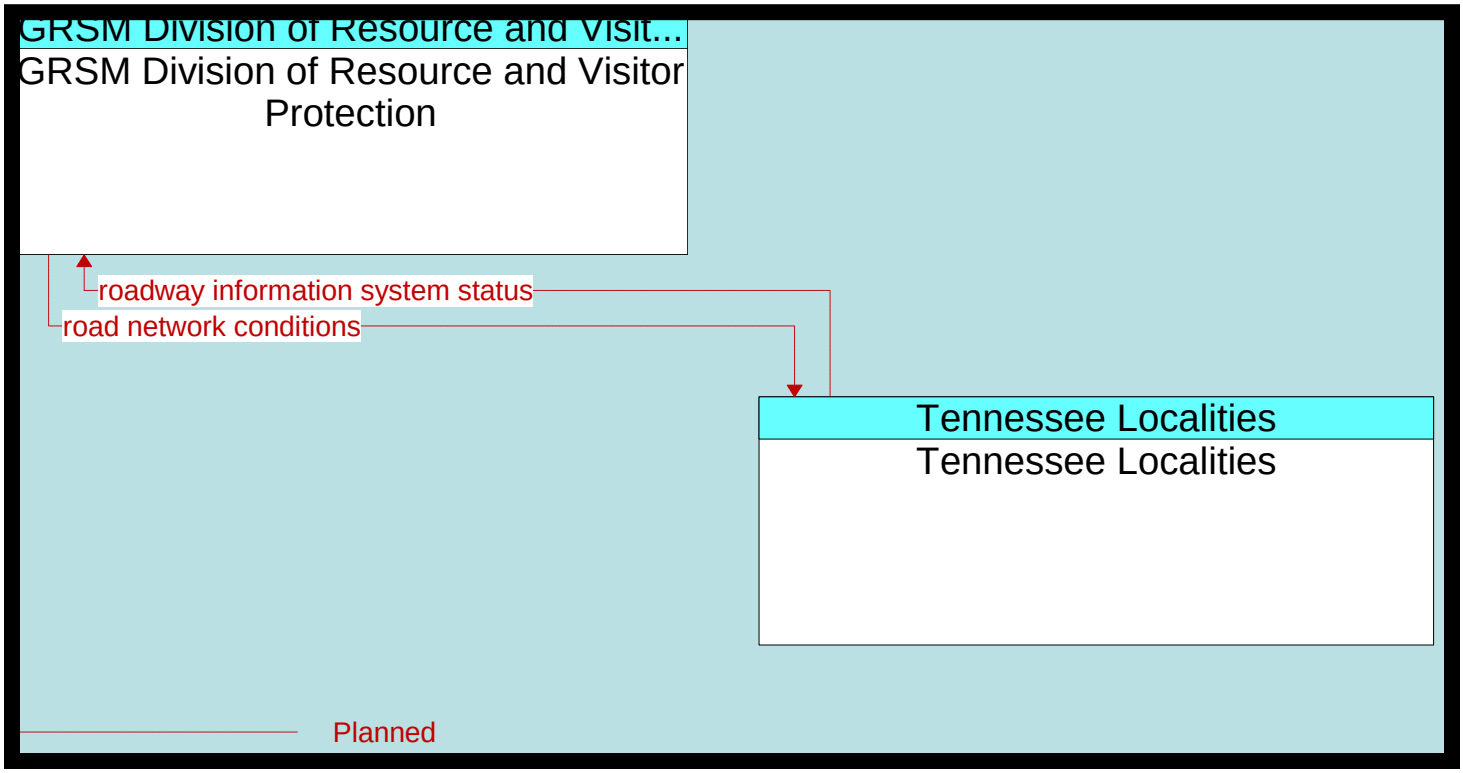

GRSM Division of Resource and Visitor Protection
emergency plan coordination
environmental conditions data
roadway information system status
road network conditions
roadway information system data
North Carolina Department of Transp...
North Carolina Department of Transportation
Planned

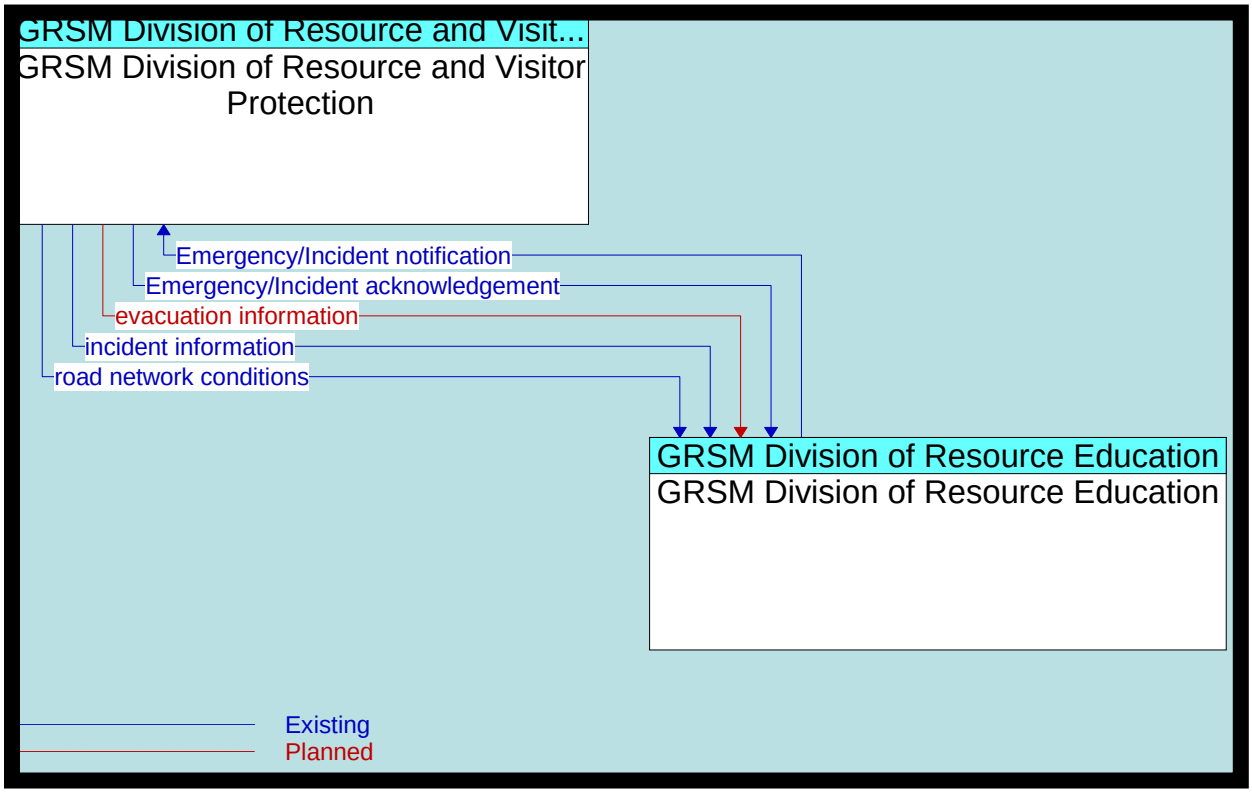

GRSM Division of Resource and Visitor Protection
Major Roadway Closure Information
Park Cooperating Associations
Park Cooperating Associations (Tremont Institute and Great Smoky Mountain Association)
Existing


GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
emergency transit service response
emergency transit service request
incident information
incident response status
Pigeon Forge Fun Time Trolley -TN
Pigeon Forge Fun Time Trolley
Planned

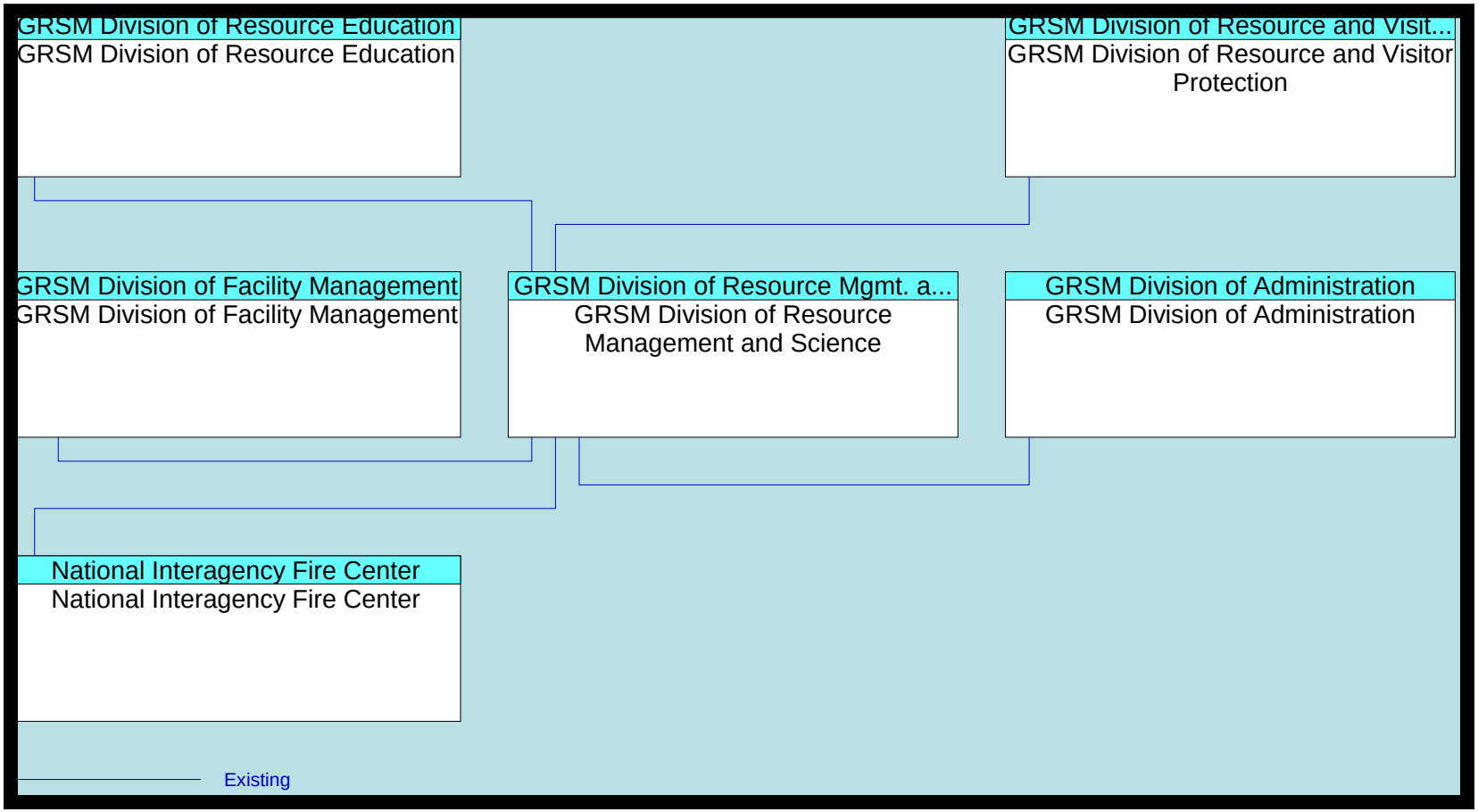

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
emergency transit service response
emergency transit service request
incident information
incident response status
Pigeon Forge Fun Time Trolley -TN
Sevierville Transit
Planned

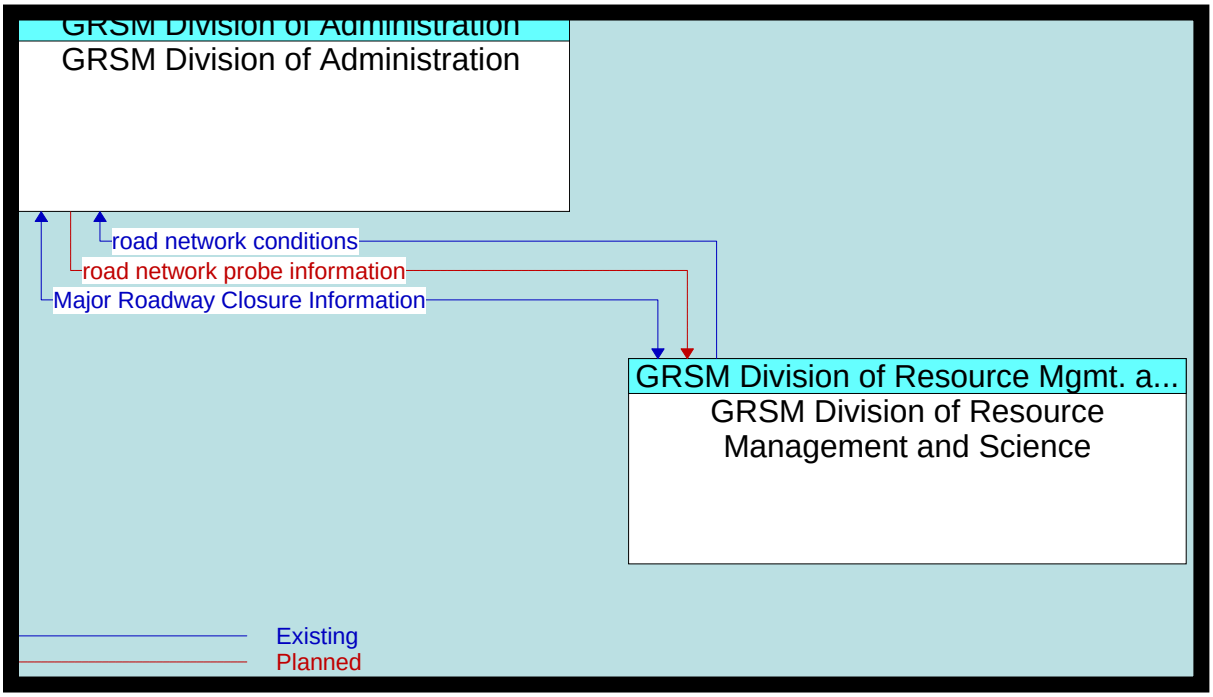

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
emergency plan coordination
environmental conditions data
roadway information system status
road network conditions
roadway information system data
Tennessee Department of Transport...
Tennessee Department of Transportation
Planned

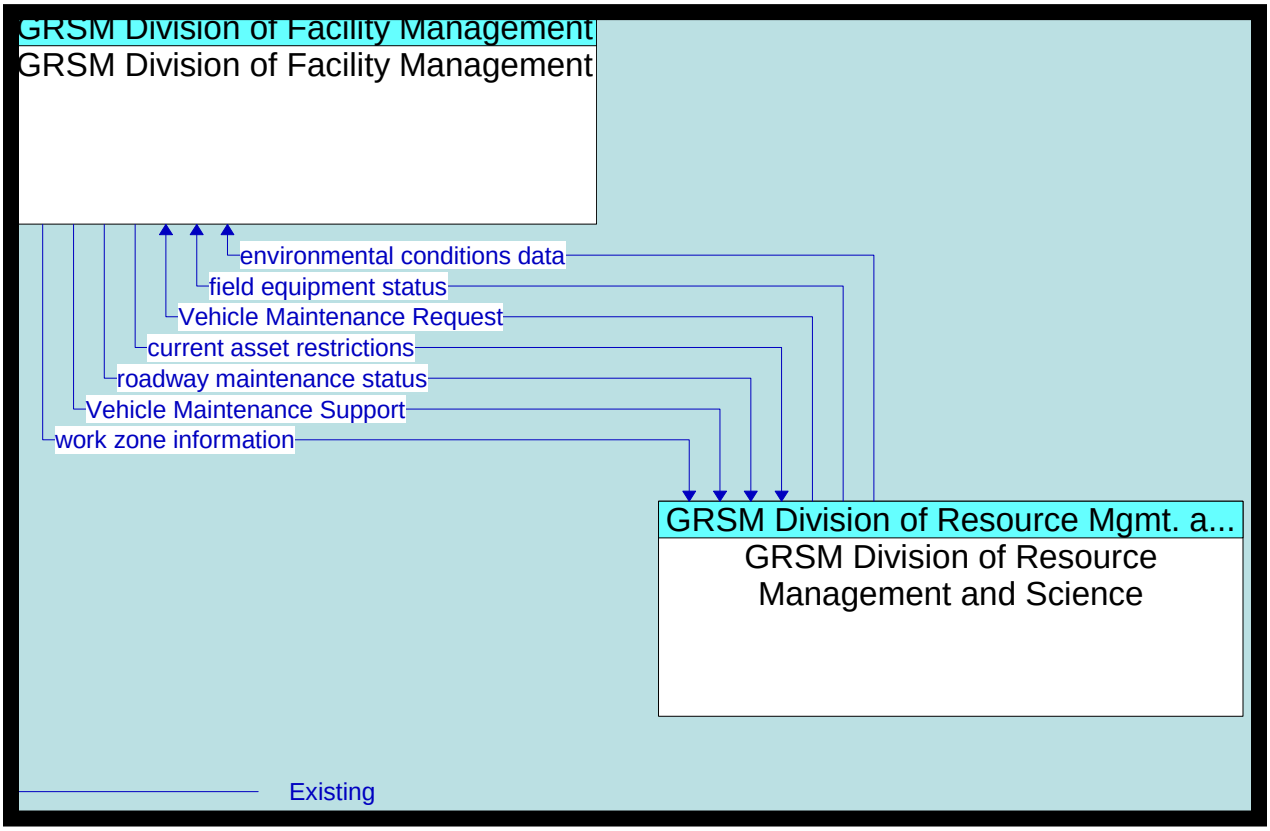

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
roadway information system status
road network conditions
Tennessee Localities
Tennessee Localities
Planned

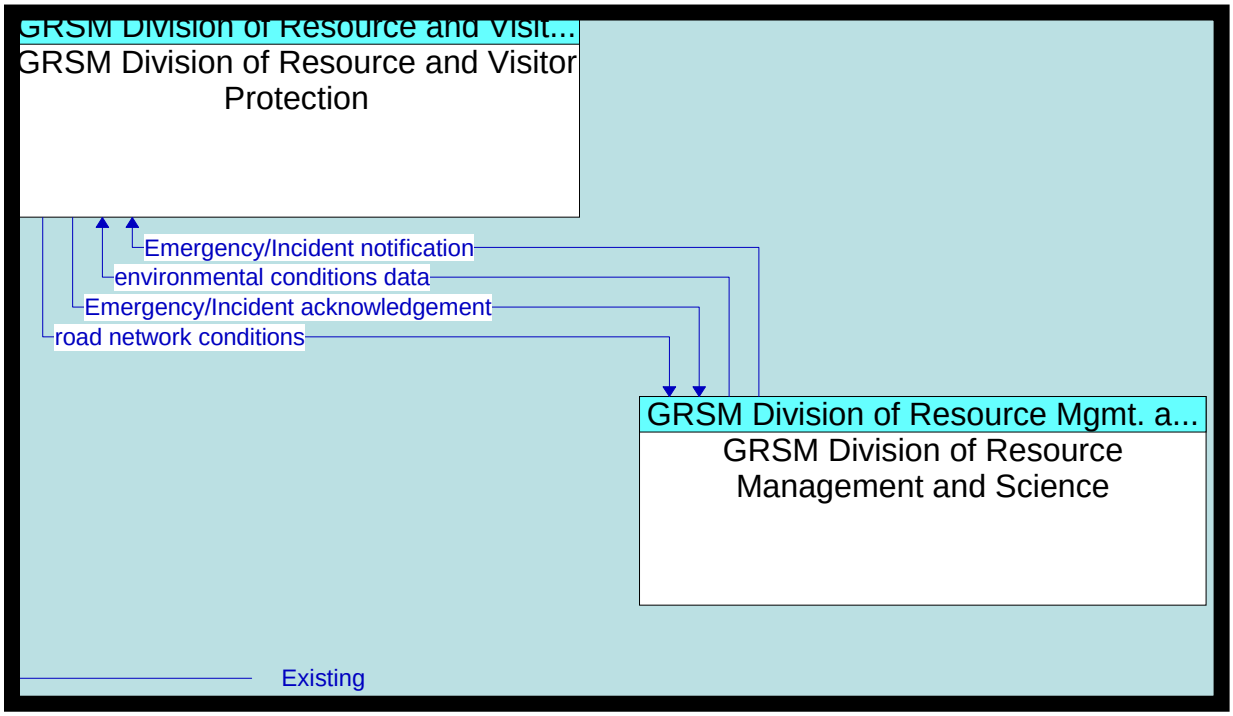

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
Emergency/Incident notification
Emergency/Incident acknowledgement
evacuation information
incident information
road network conditions
GRSM Division of Resource Education
GRSM Division of Resource Education
Existing
Planned

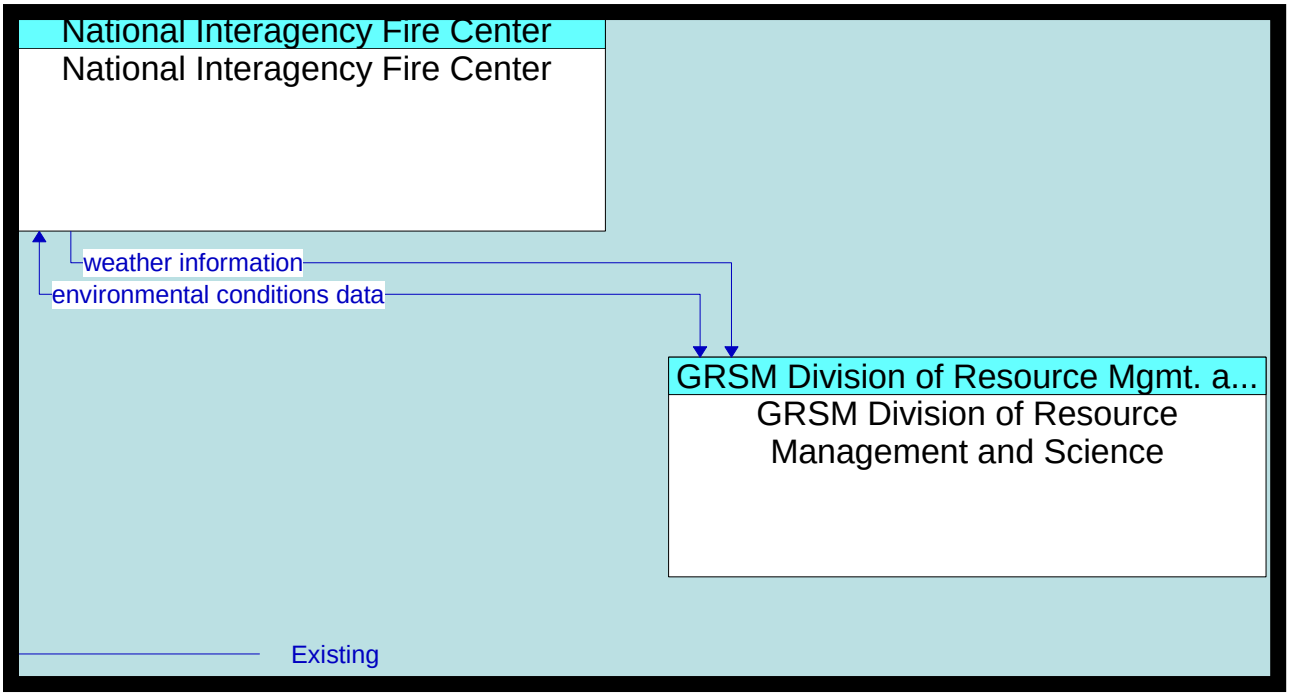
GRSM Division of Resource Management and Sciences Interconnect Diagram

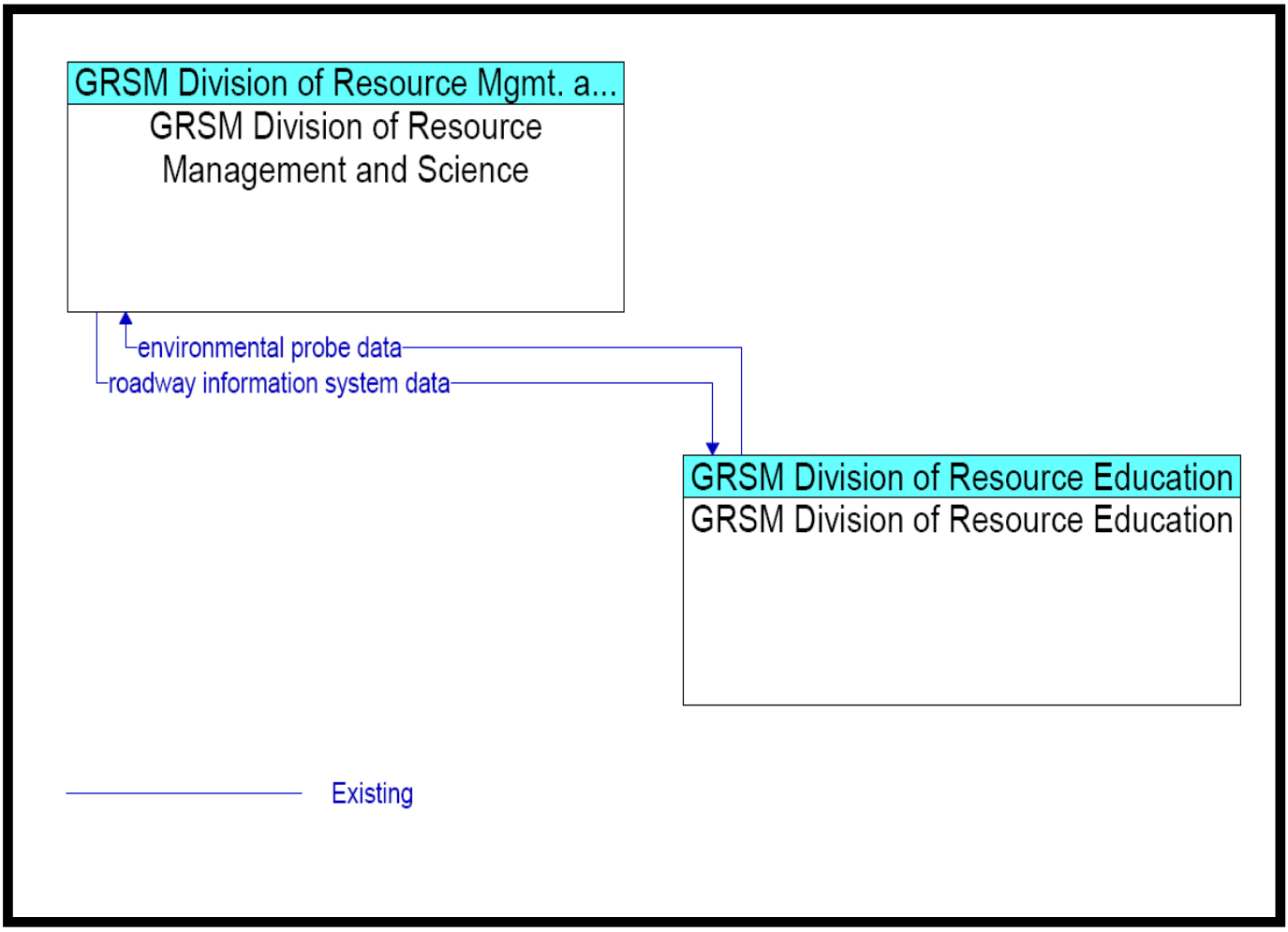



GRSM Division of Administration
GRSM Division of Administration
road network conditions
road network probe information
Major Roadway Closure Information
GRSM Division of Resource Mgmt. a...
GRSM Division of Resource Management and Science
Existing
Planned

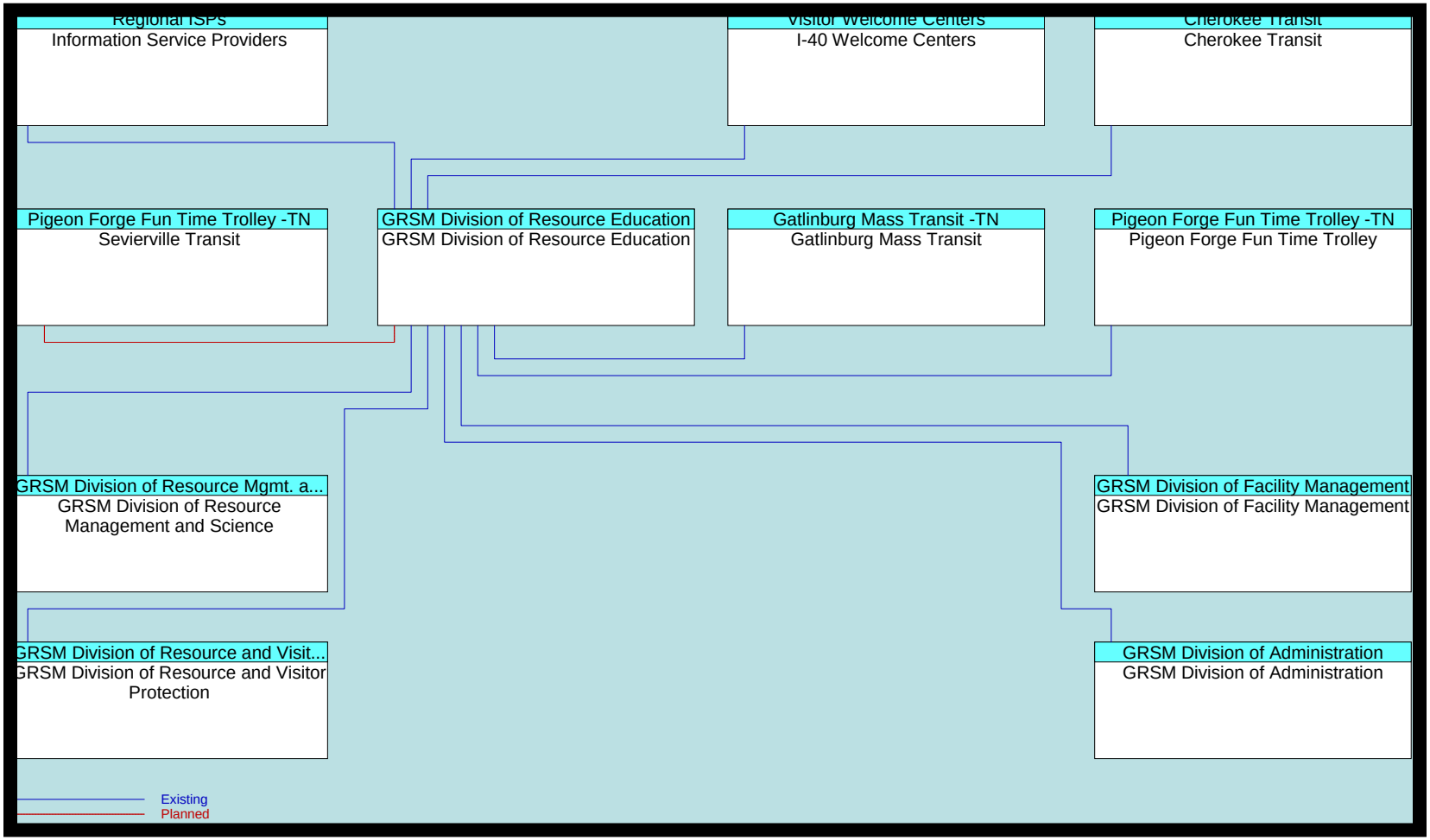

GRSM Division of Facility Management
GRSM Division of Facility Management
environmental conditions data
field equipment status
Vehicle Maintenance Request
current asset restrictions
roadway maintenance status
Vehicle Maintenance Support
work zone information
GRSM Division of Resource Mgmt. a...
GRSM Division of Resource Management and Science
Existing

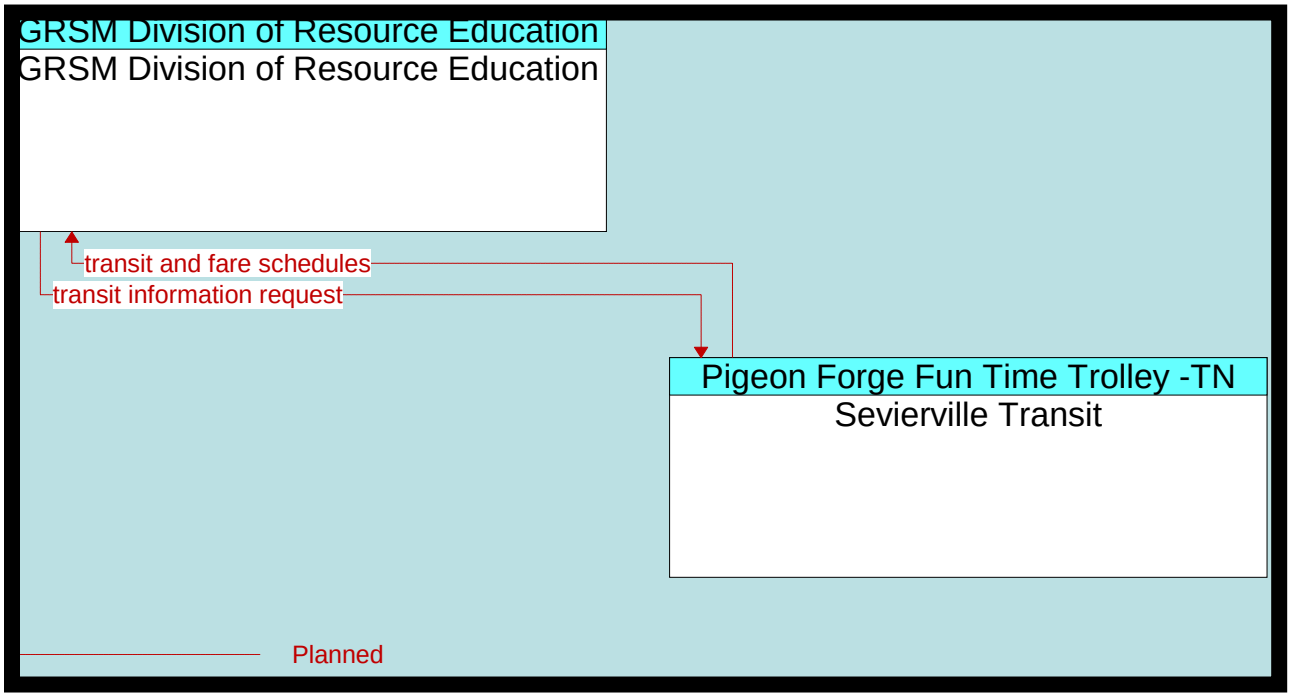

GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
Emergency/Incident notification
environmental conditions data
Emergency/Incident acknowledgement
road network conditions
GRSM Division of Resource Mgmt. a...
GRSM Division of Resource Management and Science
Existing

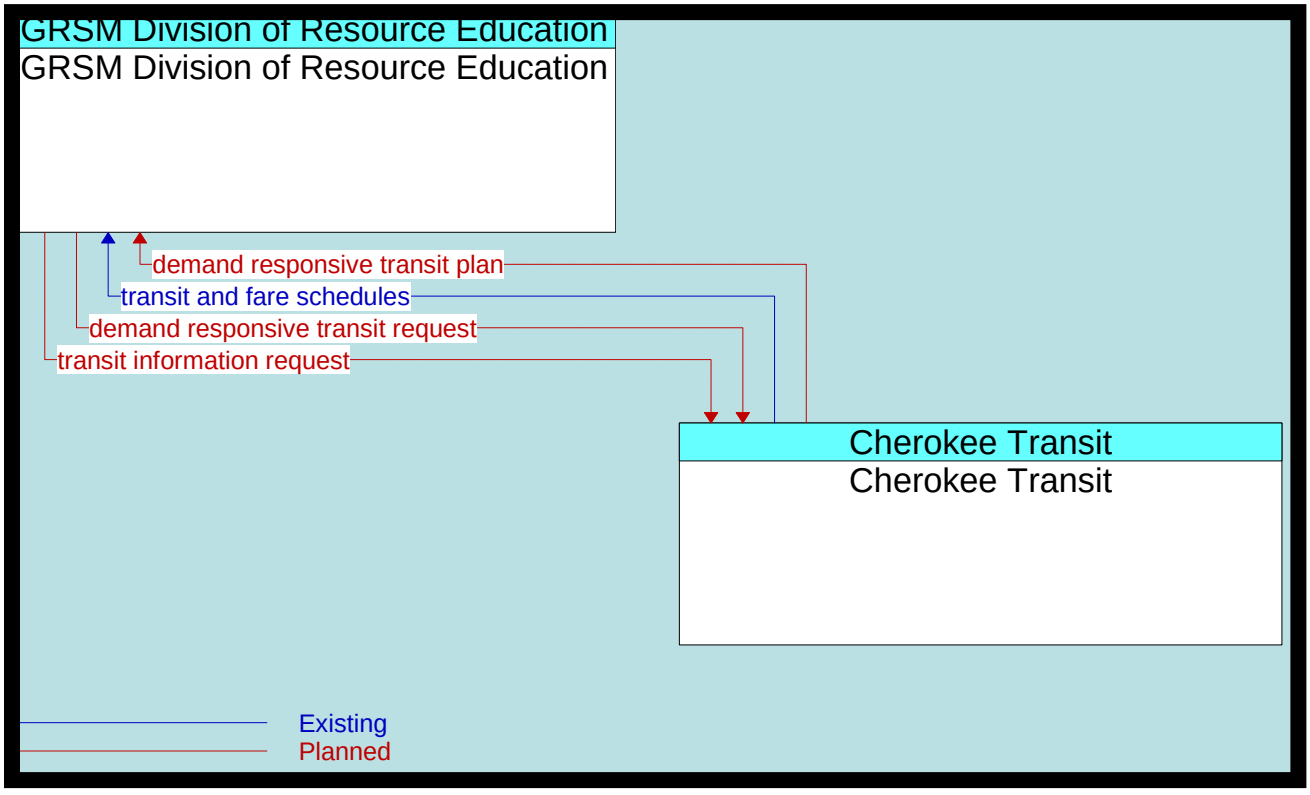

National Interagency Fire Center
National Interagency Fire Center
weather information
environmental conditions data
GRSM Division of Resource Mgmt. a...
GRSM Division of Resource Management and Science
Existing

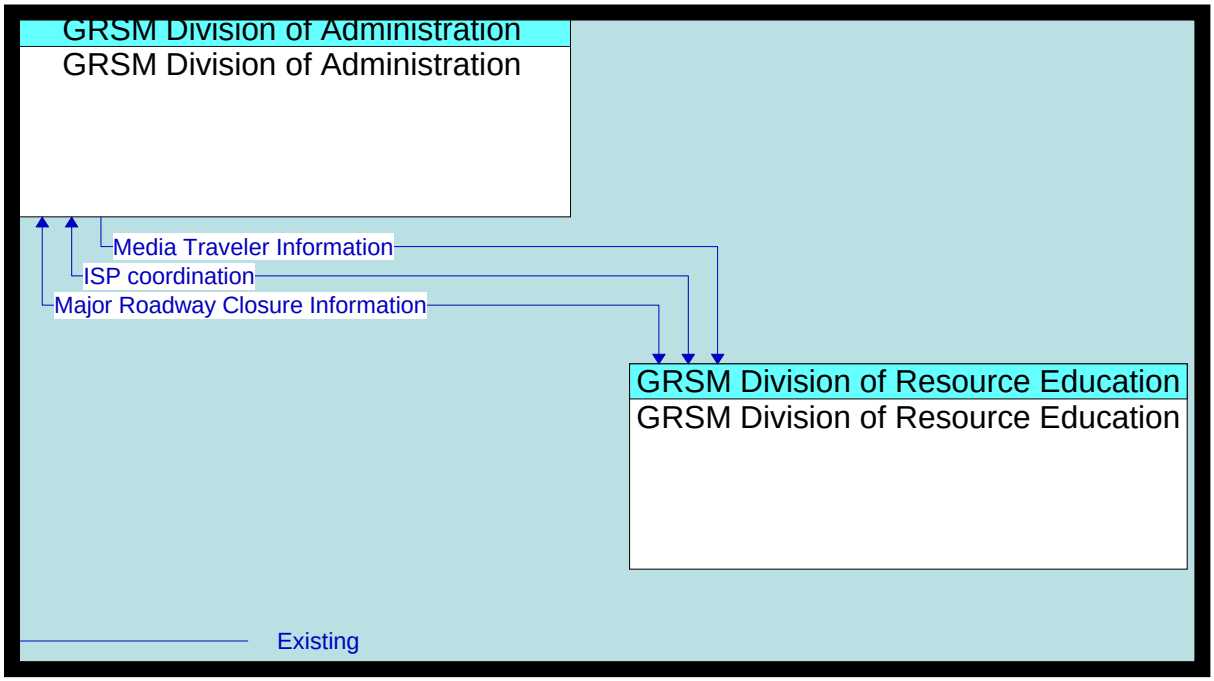

GRSM Division of Resource Mgmt. a...
GRSM Division of Resource Management and Science
environmental probe data
roadway information system data
GRSM Division of Resource Education
GRSM Division of Resource Education
Existing

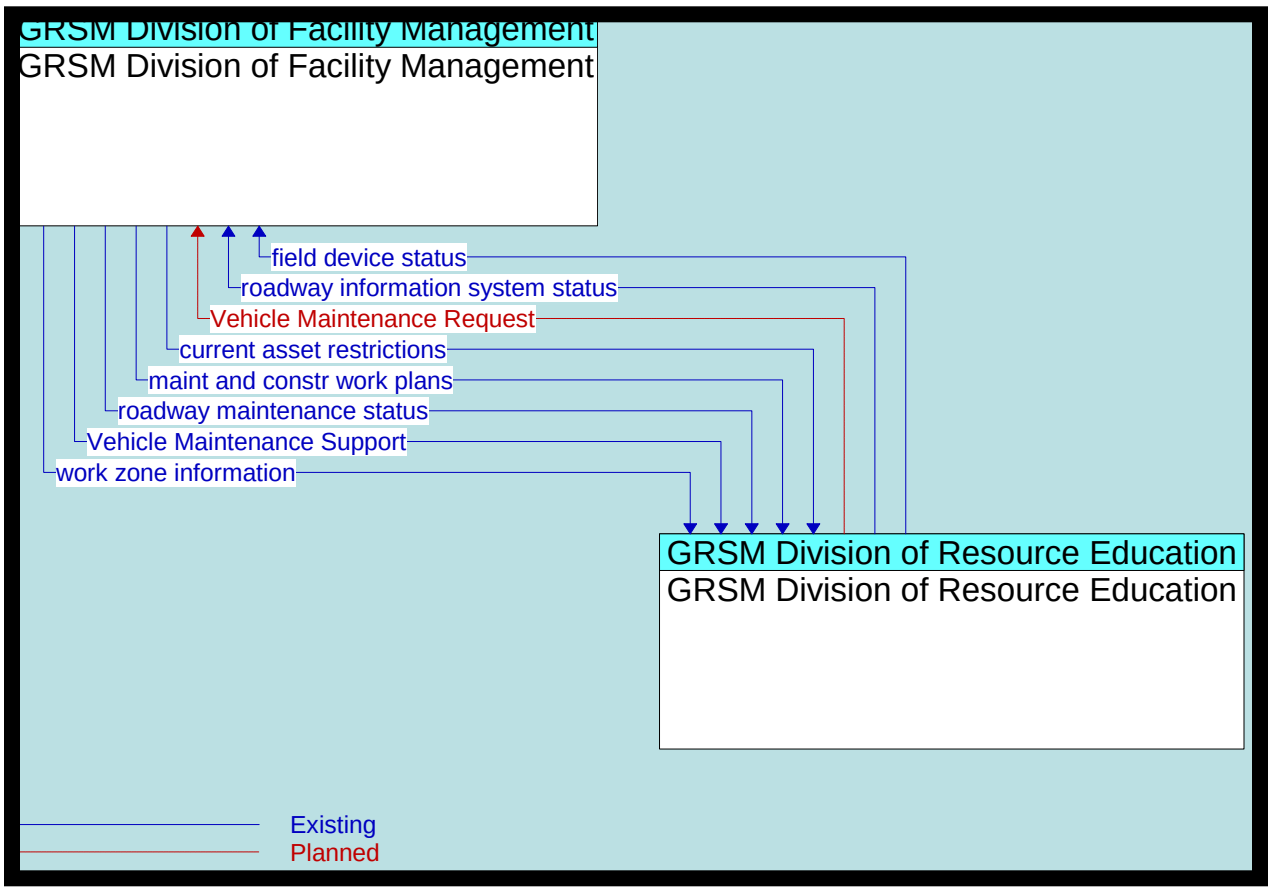
GRSM Division of Resource Education Interconnect Diagram

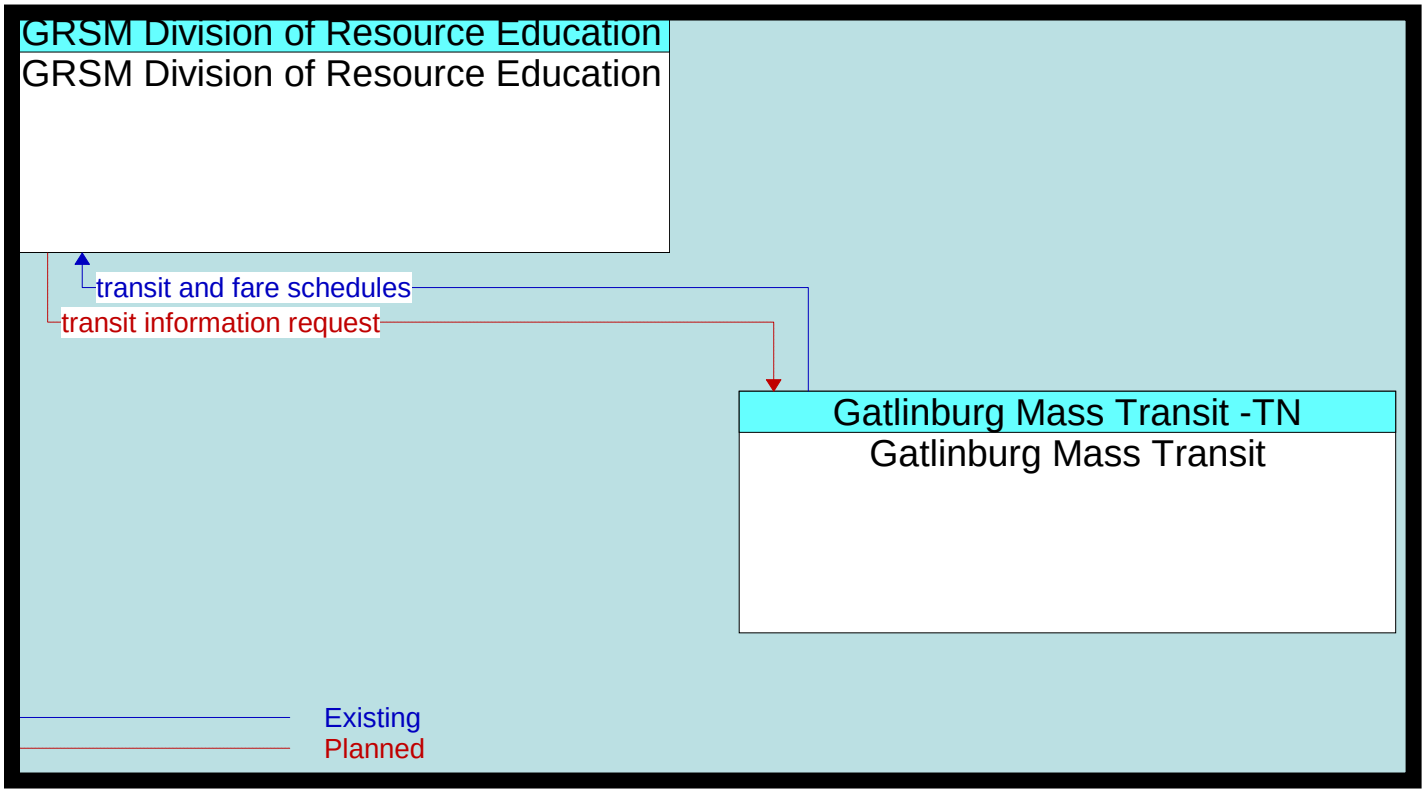


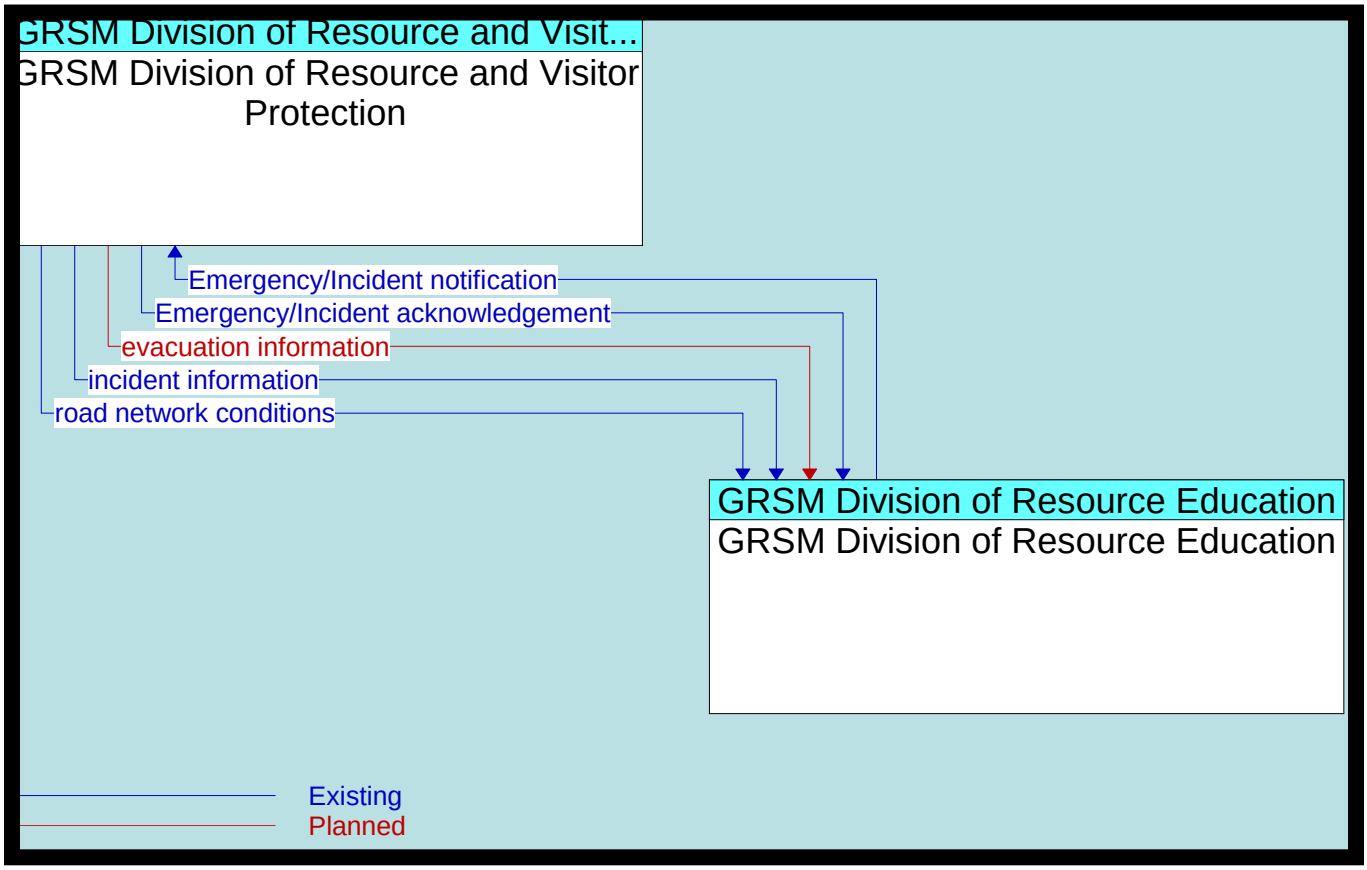

GRSM Division of Resource Education
GRSM Division of Resource Education
transit and fare schedules
transit information request
Pigeon Forge Fun Time Trolley -TN
Sevierville Transit
Planned

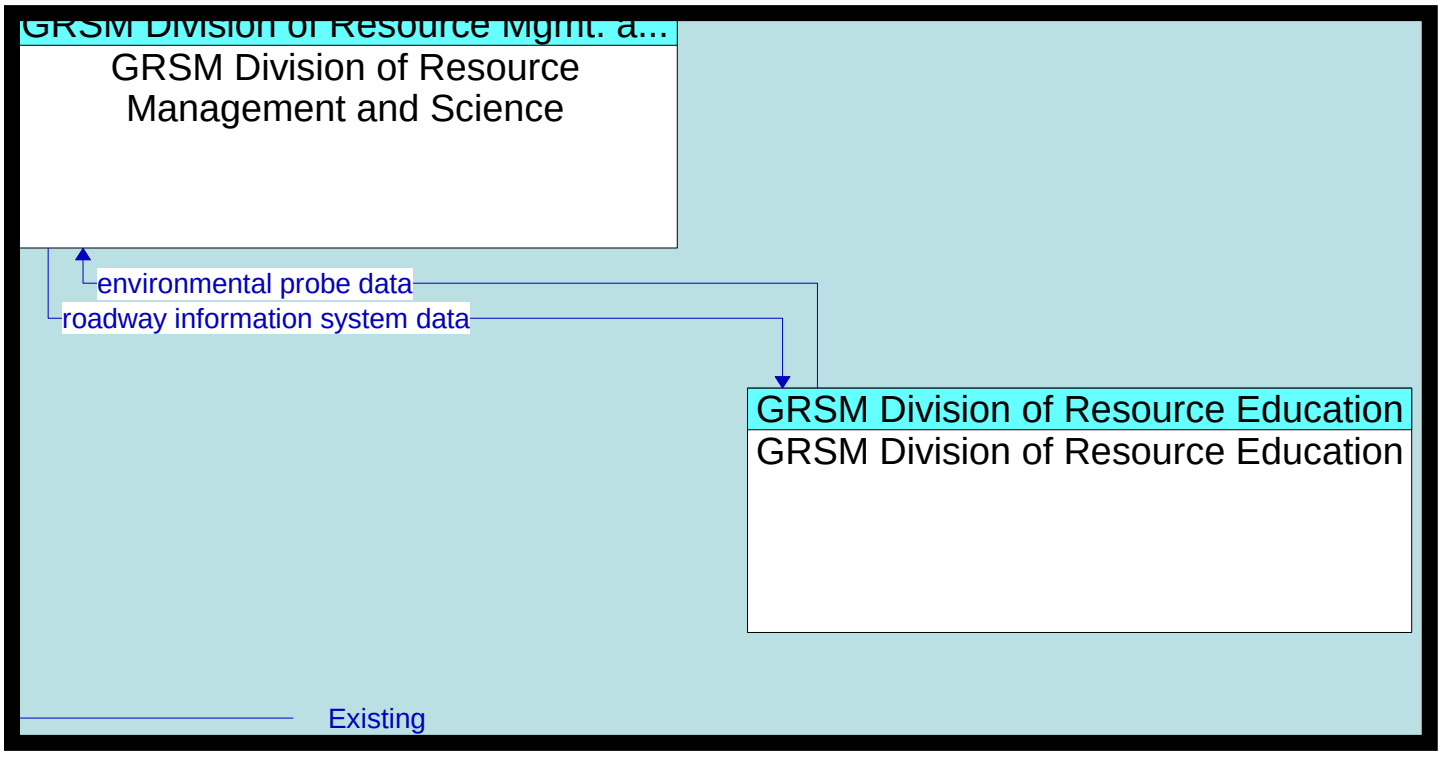

GRSM Division of Resource Education
GRSM Division of Resource Education
demand responsive transit plan
transit and fare schedules
demand responsive transit request
transit information request
Cherokee Transit
Cherokee Transit
Existing
Planned

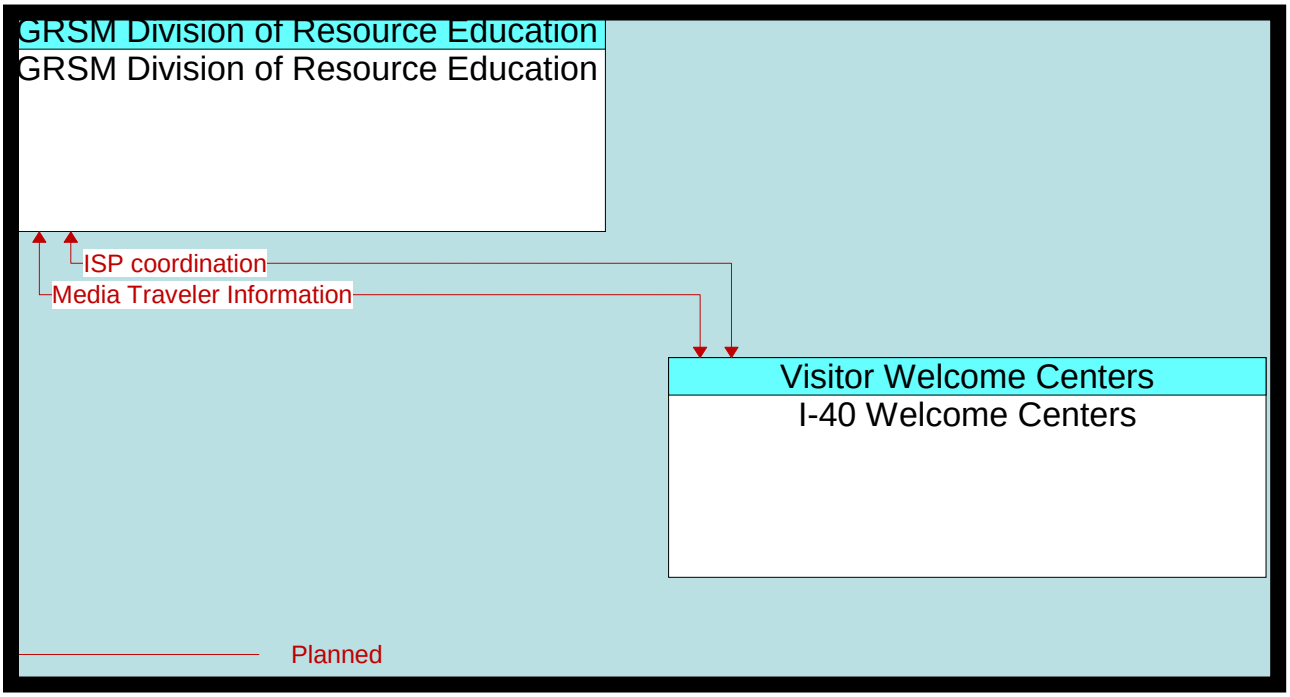

GRSM Division of Administration
GRSM Division of Administration
Media Traveler Information
ISP coordination
Major Roadway Closure Information
GRSM Division of Resource Education
GRSM Division of Resource Education
Existing

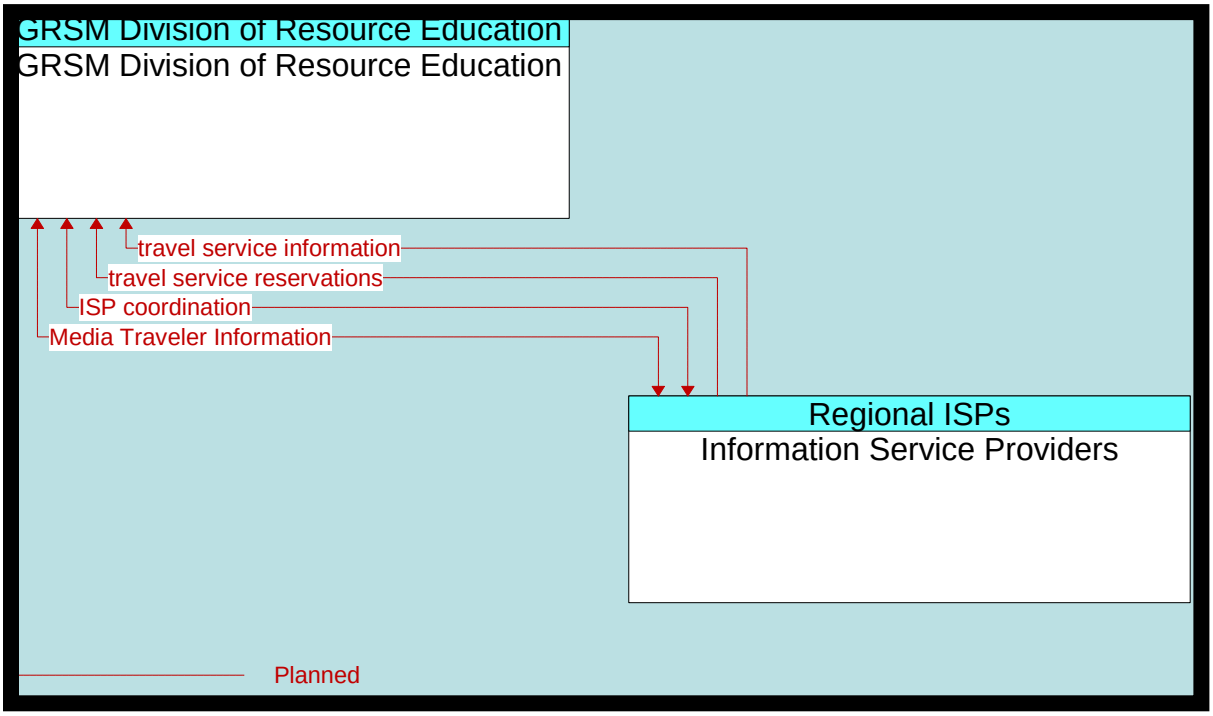

GRSM Division of Facility Management
GRSM Division of Facility Management
field device status
roadway information system status
Vehicle Maintenance Request
current asset restrictions
maint and constr work plans
roadway maintenance status
Vehicle Maintenance Support
work zone information
GRSM Division of Resource Education
GRSM Division of Resource Education
Existing
Planned

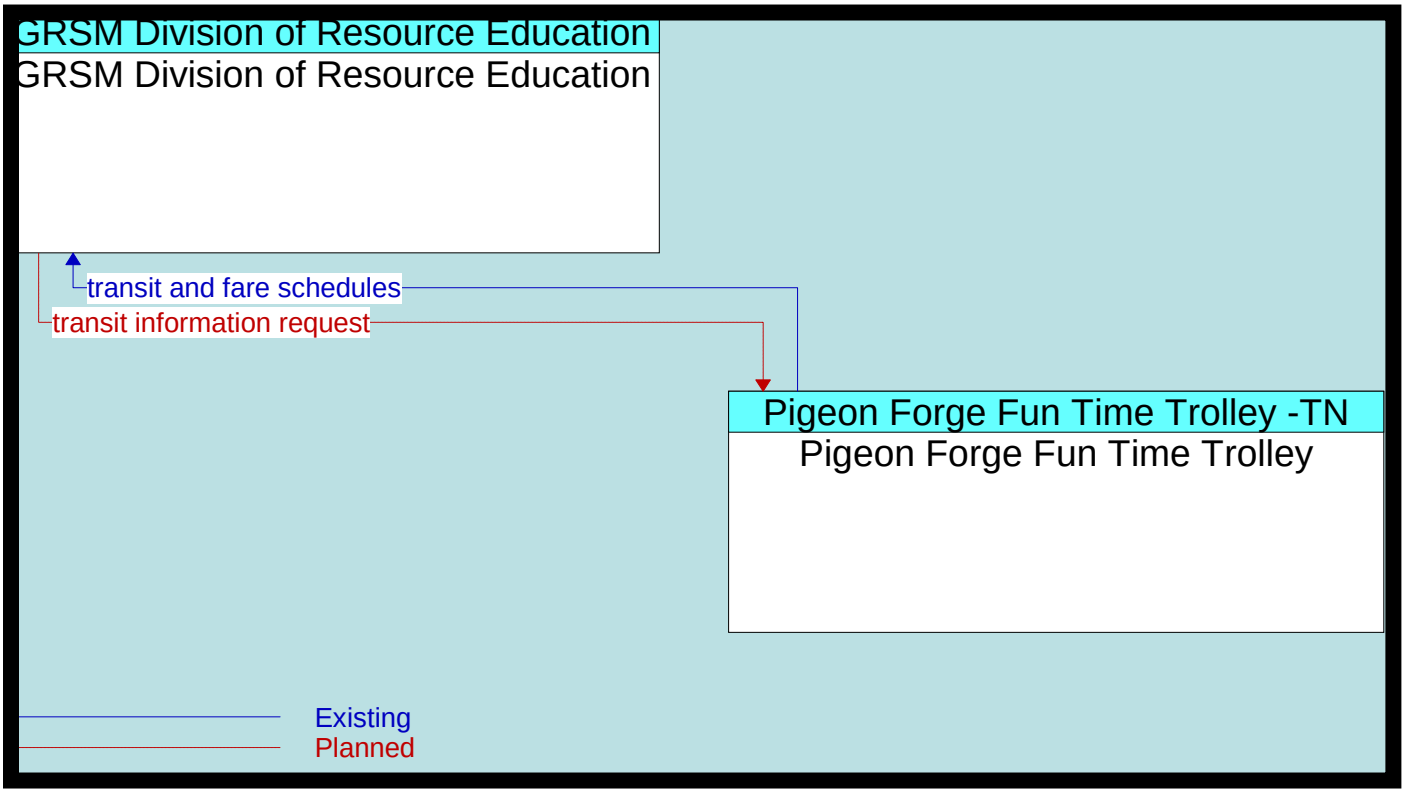

GRSM Division of Resource Education
GRSM Division of Resource Education
transit and fare schedules
transit information request
Gatlinburg Mass Transit -TN
Gatlinburg Mass Transit
Existing
Planned


GRSM Division of Resource and Visit...
GRSM Division of Resource and Visitor Protection
Emergency/Incident notification
Emergency/Incident acknowledgement
evacuation information
incident information
road network conditions
GRSM Division of Resource Education
GRSM Division of Resource Education
Existing
Planned


GRSM Division of Resource Mgmt. a...
GRSM Division of Resource Management and Science
environmental probe data
roadway information system data
GRSM Division of Resource Education
GRSM Division of Resource Education
Existing


GRSM Division of Resource Education
GRSM Division of Resource Education
ISP coordination
Media Traveler Information
Visitor Welcome Centers
I-40 Welcome Centers
Planned


GRSM Division of Resource Education
GRSM Division of Resource Education
travel service information
travel service reservations
ISP coordination
Media Traveler Information
Regional ISPs
Information Service Providers
Planned


GRSM Division of Resource Education
GRSM Division of Resource Education
transit and fare schedules
transit information request
Pigeon Forge Fun Time Trolley -TN
Pigeon Forge Fun Time Trolley
Existing
Planned