DIXIE REGIONAL ITS ARCHITECTURE

FINAL REPORT

SUBMITTED TO:

UDOT CONNECTING COMMUNITIES

UNIFIED TRANSPORTATION PLANNING
DIXIE METROPOLITAN PLANNING ORGANIZATION

and the Dixie Regional ITS Stakeholders

Final Report September 5, 2006

SUBMITTED BY:

ITERIS

Table of Contents

List of Tables

List of Figures

1.0 INTRODUCTION

The primary purpose of the Dixie Regional Intelligent Transportation System (ITS) Architecture project is to establish a Regional ITS Architecture and Strategic ITS Implementation Plan for the Dixie Region in Southwestern Utah.

The Regional ITS Architecture is required for the orderly and consistent deployment of ITS throughout the Region. The planning process also aligns activities in the Region with those in other regions and at the state and national levels. The Plan will serve as a master plan for ITS deployment for ten years and beyond. It will define roles and responsibilities of the various ITS Stakeholders throughout the Region and establish other technical goals to avoid duplication of investments in infrastructure, provide the ability to share data among agencies, and bring the Dixie Region into compliance with nationally established ITS Architecture standards.

The Dixie Metropolitan Planning Organization (MPO) encompasses the urbanized area of Washington County, Utah. However, for the purpose of the Regional ITS Architecture project the Dixie Region encompasses a larger section of Washington County, including "urbanizing" areas that may be included in the MPO boundaries at a later time. Most of Zion National Park is within Washington County, however, its roadways and Park-specific issues are not included in the Regional ITS Architecture. The Park is included to the extent that its needs extend beyond the Park borders into the urbanizing areas.

Iteris, Inc. is performing this work under a contract with the Utah Department of Transportation (UDOT) in close consultation with the Dixie MPO and regional agencies, and the participation of the Federal Highway Administration (FHWA). The project will be conducted over six months, scheduled to be complete in late summer, 2006.

Iteris, Inc. is performing this work under a contract with the Utah Department of Transportation (UDOT) in close consultation with the Dixie MPO, and the participation of the Federal Highway Administration (FHWA). The project will be conducted over six months, scheduled to be complete in late summer, 2006.

1.1 Purpose of the Final Report

The purpose of this Report is to summarize the effort undertaken during the Dixie Regional ITS Architecture Project in a logical order. Four Reports were developed during the Project, and all are incorporated here. The Report takes the reader on a logical progression of how the ITS Architecture was developed. It maps how the Region's ITS goals, needs and existing ITS inventory have evolved into a "roadmap" for future ITS planning and implementation.

The Final Report is a technical document that describes the Dixie Region ITS Architecture at a detailed level, including much specific technical data as required by the National ITS Architecture Process. An executive Summary has also been developed for readers with a less formal understanding of ITS Architecture. The Executive Summary

focuses on the project results, i.e. recommended ITS projects, estimated costs and funding opportunities.

1.2 What is ITS Architecture?

An ITS architecture guides the efficient integration of ITS. It reflects the contributions of a broad cross-section of the transportation community (transportation practitioners, systems engineers, system developers, technology specialists, consultants, etc.). The architecture defines:

- The functions to be performed by ITS;
- The physical entities where the functions will be performed;
- The information flows and data flows that connect the functions and physical subsystems together into an integrated system.
- The roles and responsibilities of the ITS stakeholders;
- Technical goals to avoid duplication of investments in infrastructure; and
- Opportunities for integration and data sharing.

The Architecture also provides a means for tracking the progress of ITS development in the region. The completion of this planning effort is not the end of the architecture development; the architecture is flexible and meant to continue to adapt to reflect the ITS deployments and plans in the Dixie Region.

1.2.1 USDOT Policy

The United States Department of Transportation (USDOT) published the FHWA Final Rule and FTA Policy in 2001. Within the Rule and Policy is a requirement that ITS projects funded through the highway trust fund conform to the National ITS Architecture and its standards. The purpose of the rule is to ensure interoperability of ITS across regions, as well as reducing the cost of ITS deployment by creating common formats and protocols for data exchange.

Because a national or statewide architecture is unlikely to provide adequate detail for local projects, the Rule/Policy requires that regional ITS architectures be developed using the National ITS Architecture as a baseline. The regional architecture must address local issues and needs. A region can be a metropolitan area, state, multi-state or corridor.

1.2.2 Regional ITS Architecture

The Dixie Regional ITS Architecture is an architecture covering the urbanized and urbanizing areas of Washington County, Utah. As required by the Rule/Policy, it uses the National ITS Architecture as its basis to ensure consistency with the Utah Statewide ITS Architecture and ITD District ITS Architectures.

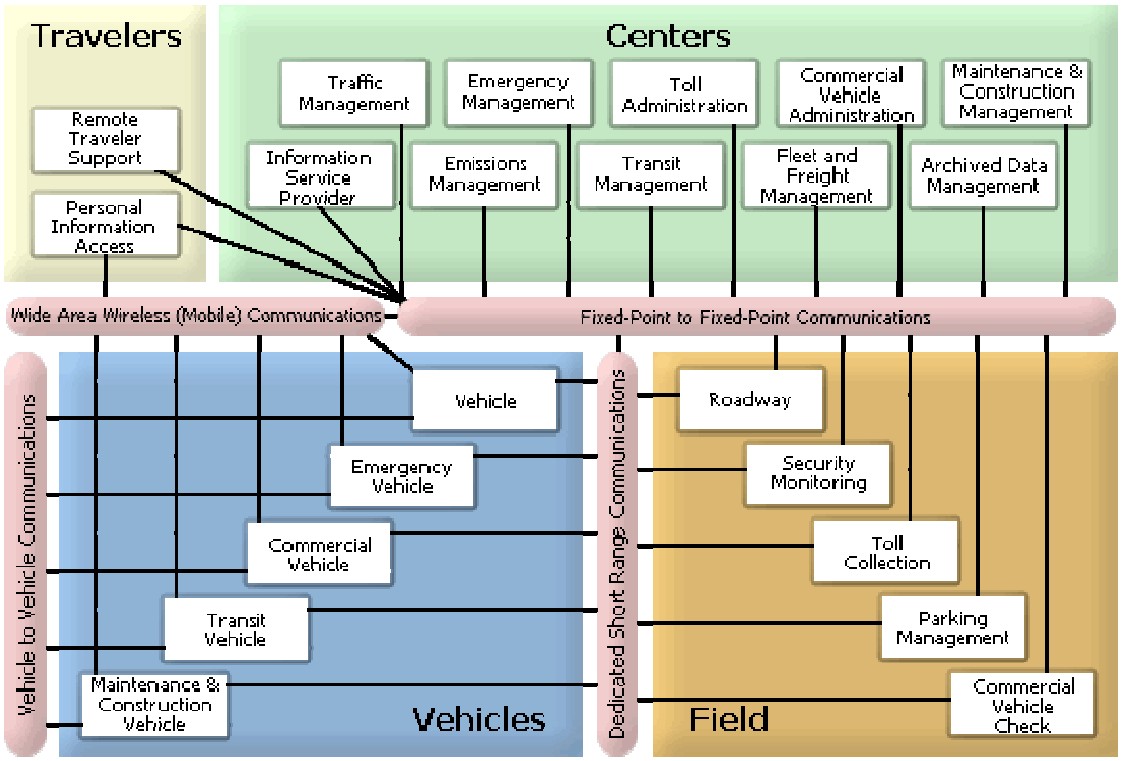
The regional architecture is a tool not only for planning, but also implementation. It documents the ITS that stakeholders wish to deploy in the short, medium and long term. That documentation allows for the "mainstreaming" of ITS, meaning that the individual projects can be adopted in funding plans and in regional transportation plans. The architecture ensures efficient implementation by describing what ITS resources are available. New ITS can be implemented with the opportunity to integrate with existing and planned ITS.

1.2.3 Architecture Elements

The National ITS Architecture contains many different concepts and is rich in transportation industry terminology and acronyms that describe and depict integrated systems. One of the strengths of National ITS Architecture is the introduction of a consistent "language" that can be spoken by transportation professionals nationally, to assure that everyone is "on the same page" with systems implementation, integration, and operation.

Figure 1 is a high level depiction of the world of ITS according to the National ITS Architecture, version 5.0. The diagram is frequently called the "Sausage Diagram" because of the oblong bubbles that link the various subsystems. The diagram illustrates the four types of ITS Subsystems: Travelers, Centers, Vehicles and Field. The oblong bubbles between the various subsystems types represent the communications media that is typically used to connect the various subsystems. Subsystems and information flows are described in more detail in the **Market Packages** section of this report.

Figure 1: National ITS Architecture Sausage Diagram



1.3 Turbo Architecture

Turbo Architecture (Turbo) is an interactive software application that assists ITS planners and system integrators, both in the public and private sectors, in the development of regional and project architectures using the National ITS Architecture as a starting point.

Turbo Architecture Version 3.1, being used for this project, supports development of regional and system architectures that take advantage of features in Version 5.1 of the National ITS Architecture. This version of Turbo, as well as future versions, also contains a feature known as "Turbo Conversion". Turbo Conversion automatically converts existing regional and system architectures so they are consistent with the related version of the National ITS Architecture. Specialized conversion reports document all architecture changes made during the conversion. This tool provides a convenient way to migrate the Dixie regional architecture to newer versions of the National ITS Architecture as they are developed.

Turbo was specifically designed to support development of ITS inventories. It identifies connections between ITS systems or "elements" in the inventory that support selected services or "market packages". Although the software tool identifies all potential connections between ITS systems based on the National ITS Architecture, it will pre-select those connections required to support the desired services.

The inputs to Turbo are based on the systems inventory. Information was entered into Turbo based on the responses to the survey form and all other gathered information. The database for Turbo is Microsoft Access.

2.0 STUDY FOCUS AREAS

The process of developing the Dixie Regional ITS Architecture began with a focus on the timeframe, locale, and stakeholders:

1. Architectural timeframe refers to the planning horizon that the regional ITS architecture will address.

2. Locale refers to the geographic area covered by the ITS architecture.

3. Stakeholders are the core set of agencies with transportation-related oversight, responsibility, and regional transportation interest in the Dixie region.

2.1 Architectural Timeframe

The regional ITS architecture will provide a plan that extends sufficiently into the future to serve its primary purpose of guiding the efficient integration of ITS systems. There is no required minimum timeframe, however, the Dixie timeframe was established based on traditional ITS architecture planning and awareness of how the Architecture will be used. A short timeframe reduces the value of the regional ITS architecture as a planning tool, and also fails to capture needs the region may have but cannot commit resources to in the near future. A long timeframe increases the effort involved since very long-range forecasts are difficult to make and impractical. Additionally, technology and needs change over time, and a long timeframe may create a document that becomes obsolete before it can be fully implemented.

The Dixie Regional Architecture is planned for three terms. The short-term is defined as the next five years, mid-term is within five to ten years, and long-term is ten years and beyond. Naturally, a more detailed level of focus and project definition will occur for near-term projects. The near and mid terms provide duration to include most of the system integration opportunities that can be clearly anticipated by the region's Stakeholders. This timeframe is also sufficient to support other local transportation planning activities and guide project implementation.

The timeframe can be reevaluated and possibly even modified as the regional ITS Architecture takes shape. As the architecture evolves, the timeframe is normally a secondary consideration when determining whether to include a particular system or interface. It is usually best to include the interfaces that are clearly supported by the stakeholders, even if that pushes the timeframe beyond what was initially anticipated. In other words, the timeframe is flexible and can be adjusted as necessary to match the vision of the stakeholders.

2.2 Locale

The Study Region consists of the urbanized and urbanizing areas of Washington County. It is located in the southwestern part of Utah and contained within UDOT Region 4. The Dixie Region's population in 2005 was about 125,000, and is predicted to grow to as many as 610,000 residents by 2050. Washington is one of the fastest growing counties in Utah. The St. George metropolitan area nearly doubled in population between 1990 and 2000, and could become the largest city in Utah by 2035 if current projections are accurate.

The region includes the cities listed in Table 1.

Table 1: Most Populous Cities in the Dixie Region

City	Estimated 2005 Population
Hurricane	9,750
Ivins	6,404
St. George	56,497
Santa Clara	5,864
Washington	11,521

As a result of rapid population growth, traffic congestion is a key issue in the area. Many plans are already underway to alleviate congestion. Twenty-eight highway projects were identified in the Dixie Urbanizing Area Interim Long-Rang (2000-2020) Transportation Plan. These include a new Northern Corridor and a new four-lane Southern Parkway. The Southern Parkway connects the Hurricane Valley to the planned site of the new St. George Airport, and the Bluff Street Widening. It will extend eastward from a planned interchange on I-15 near milepost 2, past the proposed new St. George airport site, through Washington City and into Hurricane City. There it will connect with State Route 9. The new airport will be larger and more sophisticated than the existing airport. The projected start is 2006 or 2007 with completion by 2011. Additional highway and transit projects are being studied and developed to further alleviate congestion within the region.

St. George is the most urbanized city in the region. It has a developed surface transportation network, including arterial streets, traffic signals and a transit system. No other city in the area operates its own traffic signals, although others do have signals within their city limits operated by UDOT.

In addition, nearly three million visitors per year visit Zion National Park, most travel through Washington County. The Dixie National Forest north of the study area also attracts many recreational travelers, as well as significant commercial vehicles serving the lumber-industry.

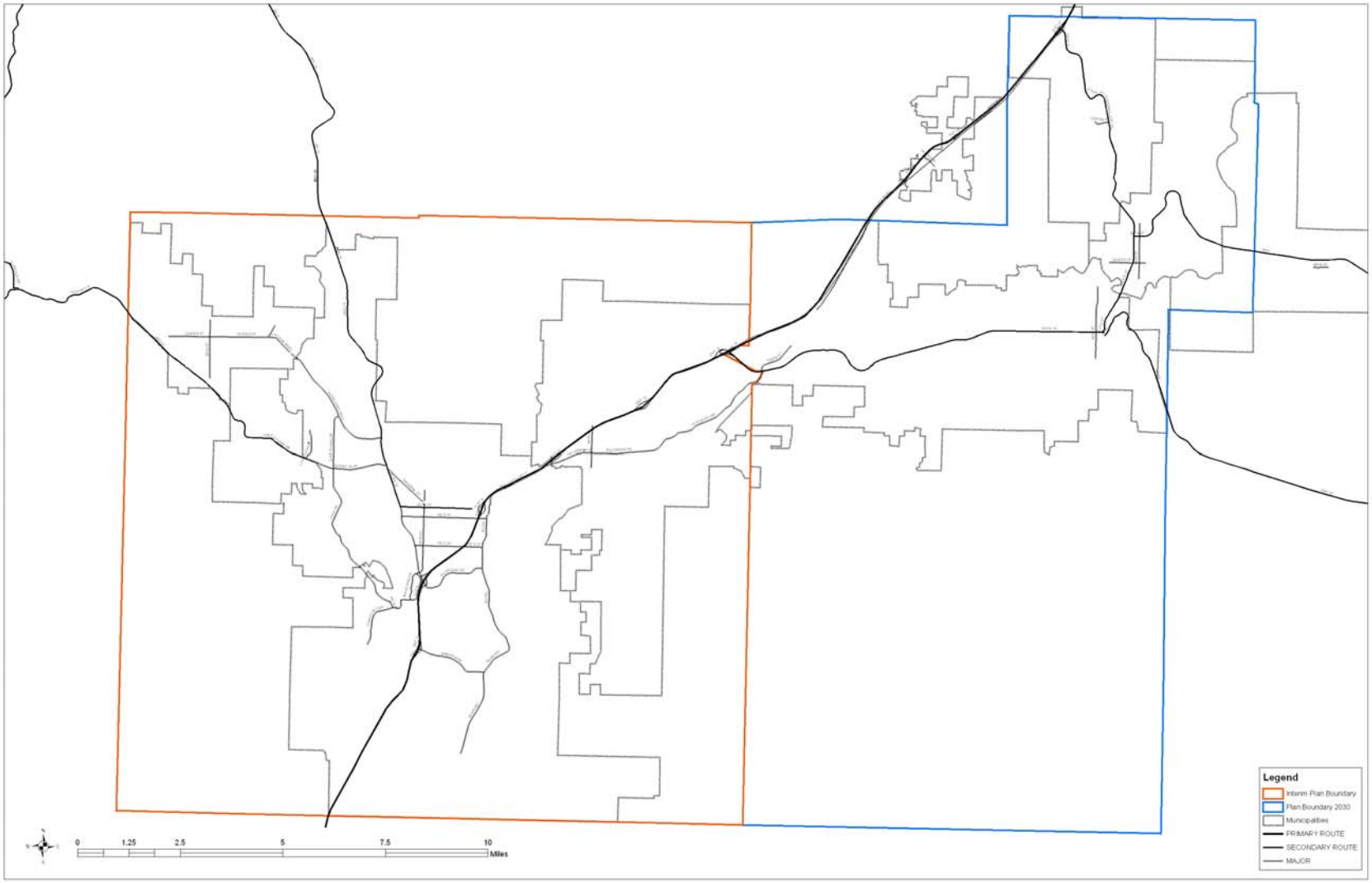
A significant amount of traffic uses Interstate 15. It is a primary route between southern California/southern Nevada and Colorado (and points east via I-70). It also is a part of the CanaMex Corridor for commercial vehicles. I-15 is also used for local, cross-town access, and is used as an alternative to local arterials to get across the city. The Interstate has been shut down several times as a result of flooding, fire and severe weather to the

north. The section within the study area is also impacted by incidents and restrictions on the portions of I-15 farther north in Utah, and south in Arizona and Nevada.

Weather in the region ranges from very warm and desert-like in the St. George area, to below freezing in the winter with the potential for severe winter weather in the higher elevations of the Dixie National Forest. St. George has experience temperatures as low as -11 °F to high of 117 °F, according to the National Oceanic & Atmospheric Administration Climatology information (1971-2000).

A map of the urbanized St. George area is shown in **Figure 2**. The image is available for download in a higher resolution from the Dixie MPO. Figure 2 is available from Washington County in a higher resolution.

Figure 2: Dixie Region



2.3 Stakeholders

The success of a regional ITS architecture depends on participation by a diverse set of regional stakeholders. **Table 2** contains a list of agencies and the respective departments that have been invited to participate in this project. The list was developed by Iteris and the **Project Steering Committee, whose member agencies are listed in bold on the list.** The list developed as the project progressed and new invitees were identified. The stakeholders, and any others that joined the project throughout the process, assisted in developing the regional ITS architecture by providing an overview of their operations, defining their needs and reviewing project documents.

The majority of the project stakeholders on the contact list are from public agencies in the Dixie region. UDOT is represented through its Region 4 office, the Transit office and the Traffic Operations Center. Traffic, transit (St. George), commerce and public safety interests were represented for the cities within the region. The Utah Highway Patrol also participated. Input from stakeholders was provided via one-on-one phone interviews, site visits and in the Kickoff Workshop conducted on March 23, 2006.

Table 2: Stakeholder Candidates

Bureau of Land Management*	Shivwits Band, Paiute Tribe
Cedar City Corporation	St. George Area Chamber of Commerce
City of Santa Clara (Police & Fire)	St. George City Fire Department
City of St. George	St. George Municipal Airport*
Clark County Nevada*	St. George City Police Department
Clark County Public Works*	SunTran Bus System
Division of Emergency Services & Homeland Security*	**UDOT Region 4**
Dixie Ambulance Service	UDOT Cedar City District Office*
Dixie National Forest-Pine Valley Ranger District*	UDOT Southern Regional Office*
Dixie Regional Medical Center	**UDOT Traffic Operations Center**
Dixie Regional MPO	UDOT Transit Office*
Five Counties Association of Governments	Utah Highway Patrol
Federal Highway Administration	Utah State and Institutional Lands Administration*
Hurricane Valley Chamber of Commerce	Utah Transit Authority*
Iron County Circuit Rider Planner*	Utah Trucking Association
Ivins City Public Safety (Police & Fire)	Washington City Chamber of Commerce
Mesquite City Nevada*	Washington City Fire Department
Mojave County Community Development*	Washington City Public Safety
Mojave County Planning & Zoning*	**Washington County**
Mohave County Public Works	Washington County Emergency Services
Nevada Dept. of Transportation District 1 – Las	Zion National Park

Table 2: Stakeholder Candidates

Vegas Office*	
Santa Clara City Economic Development Committee	

* = did not attend stakeholder meetings

3.0 ITS GOALS AND OBJECTIVES

The development of project goals and objectives is important for bringing focus and structure to the ITS planning process. The goals produce a picture of what the regional ITS program can become in the future. They also are important in communicating to agency management and staff, the public, and funding decision makers what the intent of the ITS plan is.

To help guide the ITS planning process, a mission statement and goals were developed with the Steering Committee. They reflect the work, input, and local knowledge of the group, and represent a common view of the role of ITS in addressing the Dixie Region's transportation issues.

> ***Draft Mission:*** *The Dixie Regional ITS Plan will create a coordinated and consistent blueprint for deploying cost-effective and practical technology to enhance the safety, capacity, and operations of the area's roadways and public transportation systems.*

ITS Architecture Goals:

1. The Dixie Regional ITS Architecture project shall accomplish the following:
    a. Identify a series of ITS programs and projects for the near, medium and long-term
    b. Provide a framework for institutional relationships required to successfully deploy ITS.
    c. Create clear and easy-to-understand architecture documents to be used by decision makers and planners.
2. Identify and plan realistic ITS that addresses the stakeholders' needs and also understands regional budget, technical and institutional limitations.
3. Build consensus on how technology can effectively be deployed and operated in the region.
4. ITS Architecture will be used to capture and refine the needs of the region.
5. Ensure integration of ITS activities within the region and with outside entities.
6. Ensure that the region-wide ITS system will be operational across jurisdictional boundaries.
7. Develop a protocol on how to acquire/qualify for ITS FHWA funding.
8. Ensure architecture documents can be maintained and the update process is clear.
9. Ensure agencies in the region are aware of the architecture, and are able to use it as a resource for planning.
10. Ensure consistency among stakeholders.

11. Improve communication region-wide, statewide and nationwide.
12. Clearly define near, medium and long-term strategies.
13. Provide a basis to allow for federal funding of ITS projects.

4.0 ITS INVENTORY

As defined in the FHWA Regional ITS Architecture Rule, an ITS inventory is a list of systems, such as traffic and emergency vehicle management, and the elements that interface with them. Elements are the devices such as traffic signals, dynamic message signs or emergency and maintenance vehicles that are connected to systems through electronic communications. Essentially, any element that may be used or be improved through technology or improved communications may be considered an ITS element.

A system inventory is an inventory of software, hardware, and functions that take place in a region to accomplish ITS device control and monitoring, as well as electronic data exchange in support of ITS services. Systems are not just “brick and mortar” or “facility oriented” but rather systems are a collection of functions. For example, a Traffic Management Center may provide the functionality of several "systems" such as emergency services management, traffic control and traveler information dissemination. There may be one system used throughout a region and interconnected to many stakeholders, or a system may be a tool used for exchange of information between specific and limited agencies. The systems inventory includes only systems that are able to exchange data with other external systems.

The focus of this section is on identifying Intelligent Transportation Systems and their related elements, both existing and planned, within the Dixie region. In association with the ITS inventory, it is important to identify the ITS owners and/or operators, the presence of operation centers, and the connections (communication links and data flows) among system elements and externally to other systems. Identifying technological aspects of the ITS inventory is not necessary at this point of the project. Technological aspects will be explored during project recommendations. At this stage, it is vital to assessing the function and capabilities of the various systems. Furthermore, the total number of various ITS elements (such as signals, CCTV cameras, busses with automatic vehicle location, etc.) that exist, and the location of all these elements, is not critical with respect to developing a Regional ITS Architecture.

A system inventory is also the baseline for the development of an architecture database in Turbo Architecture. Turbo is described in more detail in *Section 1.3*.

4.1 Collection Methodology

The methodology used to compile the ITS inventory for Dixie consisted of several different mechanisms including document review, telephone interviews, e-mail, individual meetings and a workshop. Since the stakeholders are diverse, different methods helped improve outreach and participation from stakeholders.

Previous Studies, Reports, and Architecture Databases
The process of creating an inventory of ITS for the Dixie region started with the review of existing inventory documentation. No ITS inventory had previously been performed specifically for the Dixie region. However, the statewide architecture contains elements and systems relevant to Dixie, and they were collected and imported into the regional architecture.

Telephone Interviews and E-mail
Stakeholders were contacted by phone or e-mail and interviewed using a standard questionnaire for each functional category. The categories included: transit management; emergency management; arterial management; freeway management; and traveler information. Transit stakeholders were interviewed using the transit questionnaire.

Workshop
Although most potential stakeholders were interviewed, not all responded to an interview request. Further data collection was performed at the first workshop in March 2006. The workshop was followed by visits to key sites in the Region, including the St. George Traffic Control Center and the St. George Dispatch Center.

4.2 ITS Inventory

This section contains a brief discussion of the ITS elements of relevance to the Dixie Region. Often a wide latitude is given to the types of systems that may be included and the level of detail specified in an ITS inventory. Although every regional inventory varies based on the unique needs of specific regions, there are several general “best practices” guidelines that were used during the development of this inventory.

The term “terminator” is used in the National ITS Architecture to define the outer boundaries of an ITS architecture, or those ITS elements used to operate systems inside a regional ITS Architecture whose functions are not completely controlled by the transportation industry. An example of this is employees that operate the ITS elements are identified as “human terminators” in the National ITS Architecture. In an effort to manage the regional inventory, humans were not included. It is understood that they will be the users and controllers of ITS systems and their inclusion is not necessary. Other terminators, such as “Other Incident Management”, are included. They may include the systems of surrounding states, and regions, the media, or devices owned by private entities. Because information may be exchanged, or planned to be exchanged, with devices and systems within Dixie they are considered terminators in the Dixie Regional ITS Architecture.

The level of detail in the inventory also varies within the regional architecture. For example, larger systems in the Dixie Regional ITS Architecture (e.g. the St. George Traffic Control Center) are explicitly identified, while smaller systems are represented more broadly with a few general elements, such as "Local Maintenance". The approach

of consolidating smaller systems into a general inventory element implies that these systems should integrate with other regional systems in a consistent fashion.

UDOT

The Department of Transportation operates statewide traveler information via the Commuterlink web site (www.commuterlink.utah.gov) and the 511 telephone system. Both are able to provide travelers with information regarding travel conditions in the Dixie Region.

UDOT operates a statewide Traffic Operations Center (TOC) in Salt Lake City. The TOC is able to control and operate UDOT devices such as cameras, signs and signals in the Dixie Region. Currently, UDOT operates approximately 24 traffic signals in the Dixie Region. Those include signals on state highways and at interstate ramps. UDOT currently has access to images from and the ability to control many of these traffic signals remotely using the i2TMS Traffic Signal Control System and is also able to monitor several intersections using Closed Circuit Television (CCTV) traffic surveillance cameras.

UDOT Region 4 has automatic traffic recorders and several traffic signals in the region. There are plans to deploy at least one Dynamic Message Sign (DMS), additional CCTV cameras, and traffic detection devices during the Interstate 15 rehabilitation project. Additionally, the region also has maintenance yards that dispatch regional UDOT maintenance vehicles.

UDOT also plans to develop a Traffic Control Center (TCC) in Richfield, UT that would have access to and control of some devices in the Dixie Region.

Utah Highway Patrol

The Utah Highway Patrol has a dispatch center in Cedar City that covers the Dixie Region. The dispatch center is able to exchange emergency calls with the St. George Dispatch Center (described later) and coordinate emergency response with other responders in the Dixie Region.

The Highway Patrol operates several emergency response vehicles in the region, including many trooper vehicles.

The City of St. George

St. George operates a dispatch center and is the Public Service Answering Point (PSAP) for Washington County. It is owned and operated by St. George and housed in the St. George police station. It provides emergency call-taking and emergency response dispatching service to the county and other cities under agreement. There are plans to expand the dispatch center in 2006. The expansion will include:

- approximately 40% increase in dispatch terminals;
- space for meetings;

- the addition of a geographic information system (GIS); and the implementation of an automatic vehicle location system (AVL) on many of the region's emergency response vehicles.

The St. George TCC provides a central location for monitoring traffic through traffic cameras and detectors. Operators are able to make adjustments to signal timing for City-operated signals from the control center. The TCC is also able to monitor the local UDOT signals. There is a dedicated broadband connection between the TCC and UDOT's TOC in Salt Lake City.

On the roadways, St. George has five traffic cameras that can be controlled from the control center and by UDOT at the Salt Lake City TOC. There are plans to add more cameras. Twenty-five traffic signals are operated by the City, many with either loop or video vehicle detection.

St. George has police and fire department vehicles that are deployed from the dispatch center. Many of these vehicles currently have laptops that serve as mobile data terminals (MDT) and will be fitted with global positioning system (GPS) vehicle tracking equipment in summer of 2006. The City also has maintenance vehicles, but do not currently have plans to equip them with vehicle tracking systems.

SunTran

SunTran is a division of the City of St. George Public Works and provides fixed-route and dial-a-ride type transit service for the City. SunTran operates three fixed-routes and one dial-a-ride bus. Vehicles are dispatched from SunTran's transit center. The provider also has a web site (www.sgcity.org/suntran/) that contains updated route changes and general information including schedules, fares and rules.

Local Transportation Management

The cities of Hurricane, Ivins, Santa Clara and Washington each have maintenance vehicles for maintaining and operating their local roadways. Each dispatches and manages its own maintenance fleets. Washington County also has maintenance vehicles that are dispatched from a central yard.

Local Emergency Service Providers

There are several other emergency providers operating in the Dixie Region. The cities of Hurricane, Ivins, Santa Clara and Washington each have police and fire departments with their own vehicles. Washington County also has sheriff, fire and rescue vehicles. The vehicles are all dispatched from the St. George dispatch center. All are planned to be part of the GPS-based vehicle-tracking project previously described.

In addition to these public emergency responders, the Dixie Ambulance Service is a private operator providing ambulance response for injury and illness. The Dixie Ambulance Service is dispatched from the St. George dispatch center, but is currently not scheduled to be a part of the vehicle-tracking project. The Fire Service District for the national forest also has a fleet of vehicles that are classified as emergency responders.

5.0 ITS NEEDS AND PRIORITIES

The ITS inventory and existing conditions provide a baseline for developing the ITS plan. They provide an understanding of the existing ITS elements, their purpose and uses and how they may integrate with future ITS projects.

The existing conditions are also a starting point in understanding the needs of a region. They also help planners understand any gaps in the existing service. For example, in the Dixie Region, it is clear from the existing conditions that the growing population and resulting traffic will create a need for additional traffic management technologies to operate the system as efficiently as possible.

During the needs assessment step, the Project Team conducted a workshop and worked with the stakeholders to further define the ITS needs of the region. This section discusses the needs collection and assessment process and summarizes the results of that process.

5.1 Needs Collection

A Dixie Regional ITS Architecture Project workshop was held in late March 2006. At the meeting, the stakeholders were given an overview of the Dixie ITS Regional Architecture Project, typical ITS applications. The history and use of ITS in Utah followed. Finally, a needs collection exercise was conducted.

During the exercise, a range of typical ITS needs were presented to the stakeholders. The "typical" needs list was developed through Iteris's experience in similar regions and through previous discussions with stakeholders. Stakeholders were encouraged to consider these needs and add any that were specific to the Dixie Region. During the workshop exercise, stakeholders were given a "budget" of twenty votes. The stakeholders could vote for any of the typical needs or new ones proposed at the workshop. Stakeholders were allowed to spend their budget of votes any way they chose; they could put all twenty votes for a single need, or spread them out among several needs. The purpose of this budgeting exercise was to help identify which needs the stakeholders would like to see addressed if they are budget-constrained. The needs that receive the most votes are not necessarily the highest priority needs, but the exercise gives the Project Team a good high-level view of the value of addressing specific needs.

Following the voting exercise and a discussion of the needs that received the most votes, each stakeholder was asked to complete a survey that identified their agency and allowed them to rank each need as "High", "Medium" or "Low". Needs were listed in the following categories:

- Arterial/Traffic Management
- Freeway Management
- Public Transportation Management
- Emergency Management

- Maintenance and Construction Operations
- Regional Traveler Information
- Commercial Vehicle Operations
- Integration

High priority needs are those the stakeholder feels need to be addressed first. Medium priority needs are important, but not considered critical. Low priority needs are those that are issues but not critical and do not need to be addressed in the near future, or that have already been successfully addressed. This exercise gives the Project Team more detail on the priority of needs because the priorities are linked to the agency responding to the survey. For example, the Project Team could view the priorities given by local public safety officials in the emergency management category.

The Project Team collected the voting and surveys after the workshop and discussion. The results of the exercise and subsequent discussion at the workshop and in interviews follow in this section. A detailed summary of the voting and prioritization exercises are in **Appendix A**.

5.2 Arterial/Traffic Management Needs

Arterial/traffic management needs are those that apply to local roads, congestion and traffic signals. A common theme of the discussion and exercise results was concern over increasing traffic levels in the Dixie Region. In particular the stakeholders expressed needs for improving management of flow and monitoring on the arterial roadways. The City of St. George has three major corridors: Sunset Boulevard, Bluff Street and St. George Boulevard. Each of these corridors is signalized, carries significant traffic and represents an opportunity for network and corridor-wide solutions.

There are also many state highways that are signalized in the region, including principal arterials in other cities. The state highways and their traffic signals are controlled and operated by UDOT. While St. George is able to observe the traffic signals and timing patterns on these arterials, there is a need for increased coordination between State and City's traffic signals.

A common need that was ranked as a high priority under the emergency management and traffic management categories is reducing the delay and stops for emergency vehicles in congested areas. Another specific need cited was improving the flow of traffic resulting from special events.

Table 3 summarizes the needs and priority assigned by the stakeholders for Arterial/traffic management.

Table 3. Arterial/Traffic Management Needs

Priority	Needs
High	• Better manage congestion at signals • Improve system-wide arterial management strategies • Reduce emergency vehicle delays • Better manage periods of high traffic demand in poor roadway conditions • Improve signal optimization • Implement or improve signal coordination • Improve traffic flow monitoring • Improve system operation monitoring • Improve arterial roadway traffic surveillance • Develop access management plan/strategies
Medium	• Improve signal control and timing • Provide quality real-time congestion information • Remote monitoring of signal system status/operations by public safety agencies • Improve/implement ability to remotely modify signal timing • Provide more centralized computer control • Develop network vs. corridor based signal coordination • Upgrade signal hardware
Low	• Reduce transit vehicle delays at signals • Better balance signal timings favoring local traffic over through traffic • Reduce detector failures when pavement "breaks up"

5.3 Freeway Management Systems Needs

Freeway management systems typically address safety and traffic flow on state-operated, controlled access roadways. In the Dixie Region, the only freeway is Interstate 15. Stakeholders generally expressed a lower level of priority for freeway management than for arterial management. However, high priorities included a need for improved management of interchanges, including queues that can extend onto the freeway mainline, and for detecting incidents on the freeway. Another priority that received significant discussion is a need for more information exchange between UDOT, who manages I-15, and local agencies, including public safety, in order to understand how freeway congestion and incidents will impact local arterials.

Table 4 summarizes the needs and priority assigned by the stakeholders for freeway management systems.

Table 4. Freeway Management System Needs

Priority	Needs
High	• Improve information exchange between UDOT and local agencies • Improve incident detection • Improve inter-agency coordination • Improve incident response, especially in rural areas • Improve incident response in urban areas • Better manage periods of high traffic demand in poor roadway conditions
Medium	• Improve traveler information/directions • Provide quality real-time congestion related information • Improve freeway traffic surveillance • Improve collection of traffic demand data • More timely incident information dissemination • Implement additional field device interconnect • Improve information exchange between Dixie and neighboring architectures/regions • Provide quality construction and maintenance information
Low	• Perform additional vehicle detection

5.4 Public Transportation Management Needs

SunTran in St. George is a relatively small transit agency, with three fixed routes and one dial-a-ride vehicle. However, there is an understanding among the stakeholders that as the region's population grows, the role of transit in helping to provide transportation and reduce congestion will increase.

While none of the transit needs were given a high priority, several were considered important enough to include in the ITS plan as medium and low priorities. Among those that were considered the most important transit needs were providing information to the transit fleet from emergency responders during incidents and events, and improving the information exchange among transit vehicle operators and traffic management personnel in order to allow transit vehicles to reroute during roadway incidents or construction.

Table 5 summarizes the needs and priority assigned by the stakeholders for public transportation.

Table 5. Public Transportation Needs

Priority	Needs
Medium	• Improve regional and interregional trip planning • Enable emergency information dissemination for transit providers • Improved information exchange between transit agencies and freeway/arterial management centers • Receive and provide quality real time congestion related information • Improve the efficiency of social service transportation providers • Improve patron safety (in-vehicle and at stations/waypoints) • Better notification and coordination of special event loads resulting in congestion • Improve transit transfers within and between systems and modes to improve service delivery • Enable transit agencies to locate bus fleet • Improved information exchange between/among transit agencies • Improved service planning (scheduling and runcutting) • Remote monitoring of mechanical condition of transit vehicles
Low	• Provide transit priority at signals • Implement bus queue jump lanes • Enable dissemination/display of bus arrival times • Improved "back-office" systems (interface between personnel scheduling systems and payroll systems, etc.) • Deploy universal fare payment system

5.5 Emergency Management Needs

Emergency management needs are those that relate to planning response and responding to incidents and emergencies as well as how emergency vehicles interact with other traffic and the transportation network. Emergency management received the most attention from the stakeholders at the March workshop, and many public safety agencies noted several high-priority needs regarding emergency vehicle travel on arterials and during congestion. In particular, the need for improved right of way for emergency vehicles on arterial roads was cited, particularly at intersections. In fact, the stakeholders proposed additional needs not included on the survey that specifically addressed improved intersection management for emergency vehicles.

Other needs that were indicated to be high priorities included improved detection of incidents and response management on both arterials and the freeway, and alternate route guidance for both emergency vehicles and traffic during incidents and events. Because St. George has a limited number of through routes, the need for improved detour and rerouting was very high.

Table 6 summarizes the needs and priority assigned by the stakeholders for emergency management.

Table 6. Emergency Management Needs

Priority	Needs
High	• Improve intersection delay and safety for emergency vehicles • Reduce response delay at signals • Improve incident response times • Provide mobile incident response units to incident sites • Provide alternate route plans • Improve incident detection • Improve traffic management during wildfires/floods (evacuation, response, suppression, etc.) • Improve response to hazardous materials spills/incidents (better manage resulting traffic congestion, improve cleanup time) • Improve incident response coordination among agencies
Medium	• Increase the use of portable traffic control equipment (message signs, highway advisory radio, etc.) • Provide quality real-time congestion related information • Improve ability to detect and warn about floods • Improve communications in mountains and rural areas of the region • Improve response to adverse weather events • Increase broad understanding of, and implement Standardized Emergency Management System • Improve traveler information/directions (suggested routing for travelers unfamiliar with area)
Low	• Better notification of recreational routes closed in winter

5.6 Maintenance and Construction Operations Needs

Maintenance and construction for this discussion is constrained to work done to maintain and expand the roadway network. This includes methods to improve the speed and efficiency of the operations as well as methods to improve safety for both travelers and workers in construction zones. It should be noted that this category refers to planned maintenance and construction and does not include maintenance operations resulting from unplanned incidents, such as major accidents or cargo spills. These incidents are addressed under Emergency Management.

The highest priority among stakeholders in construction and maintenance is for the coordination of traffic control plans among jurisdictions. In particular, agencies such as UDOT and the cities see a need for sharing plans to restrict traffic for construction in locations where it may impact roadways operated by more than one jurisdiction.

Table 7 summarizes the needs and priority assigned by the stakeholders for maintenance and construction operations.

Table 7. Maintenance and Construction Operation Needs

Priority	Needs
High	• Coordinate traffic control plans between jurisdictions
Medium	• Provide quality real-time congestion information • Improve/enhance work zone traffic handling plans • Improve detection and removal of falling rocks, snow, mud and trees on roadway • Provide more data source locations for the National Weather Service • Improve coordination on construction notification and information distribution • Improve coordination on construction notification and information distribution • Increase use of portable traffic control equipment (message signs, highway advisory radio, etc.) • Deploy mobile/portable traffic management field equipment (mobile surveillance equipment, mobile ramp metering, mobile highway advisory radio, etc.) • Improved traveler information/directions (suggested routing for travelers not familiar with the region) • Provide automated vehicle location systems for maintenance and construction operation vehicles
Low	• Interagency coordination on most advantageous placement of maintenance vehicles (prior to anticipated need) • Improve fleet information/management (maintenance schedules, mileage accumulations, tracking snow removal vehicles) • Provide signal preemption for some maintenance fleet vehicles • Automated pavement treatment systems

5.7 Regional Traveler Information Needs

Regional traveler information is used for several purposes. It is a useful tool in attracting tourists and making them aware of what is available in the region. It also can help improve the quality of their visit by providing timely information to improve their travel. Traveler information can also be used to improve the trips of locals who can use it to find out road conditions for planned trips, or to select an alternate mode such as transit for some trips. It can also provide an effective means for agencies to access and share transportation system related information.

Because the Dixie Region has numerous attractions and recreational areas, one focus of the traveler information needs was in guiding tourists to their destination. Another emphasis was on ensuring that travelers get quality information in a timely manner that can help them select the appropriate time, route and mode of travel and improve the overall efficiency of the transportation network.

Table 8 summarizes the needs and priority assigned by the stakeholders for regional traveler information.

Table 8. Regional Traveler Information Needs

Priority	Needs
High	• Provide timely, accurate information on road conditions • Improve quality and timeliness of communications
Medium	• Improve traveler information/directions (suggested routing for travelers not familiar with the region) • Provide quality real-time congestion information • Provide National Park entry, parking and shuttle information • Provide better road construction information and notification • Provide more timely dissemination of traveler information • Improve method of disseminating congestion and incident data from UDOT • Provide weather and road information access at rest stops/visitor center • Better manage traffic flow to and from recreation areas • Improve targeted traveler information for tourists and recreation travelers at visitor information areas/rest stops, etc. • Expand traveler information delivery methods • Use public access cable television to disseminate traffic and weather information • Improve procedures to get accurate information disseminated in a timely manner • Develop interstate/inter-region traveler information covering a wide area and targeting commercial vehicle operations • Provide alternate road and weather information
Low	• Provide information distribution to private/commercial information service providers

5.8 Commercial Vehicle Operations Needs

Commercial Vehicle Operations is involved in the safe and efficient operation of trucks. Many commercial vehicle issues such as permitting, licensing and security are addressed at the state level. However, the Dixie Region still experiences significant truck traffic and the needs may define safety and efficiency issues for both truckers and other travelers impacted by truck traffic.

The stakeholders found no commercial vehicle needs that rose to the level of high priority, but did find there are issues related to truck parking and commercial-vehicle-specific information that can be improved in the Region for the benefit of all. In fact, many of the needs identified for commercial vehicles are general needs that the trucking community may also benefit from having addressed.

Table 9 summarizes the needs and priority assigned by the stakeholders for commercial vehicle operations.

Table 9. Commercial Vehicle Operations Needs

Priority	Needs
Medium	• Provide quality real-time congestion related information • Improve truck storage/parking information (during major road closures) • Provide interstate/inter-region traveler information covering a wide area (targeted to commercial vehicles) • Expand weigh-in-motion technologies • Provide tracking of hazardous materials vehicles • Expand the automated clearance system • Disseminate better information regarding limited alternative routes • Provide better information dissemination of winter vehicle restrictions (chain control issues) • Improve congestion management during seasonal/local events

5.9 Integration Needs

Integration is not a specific category of user services in the National ITS Architecture. However, many of the needs of stakeholders can be addressed not only through new technology, but through better integration and coordination of existing systems. In addition, integration should be considered during any new ITS development in order to ensure that the benefits of collecting and sharing information are maximized. Integration is also specifically mentioned in the Dixie Urbanizing Area Interim Long-Range Transportation Plan as factor to consider when developing projects and strategies to ensure that they will enhance the integration and connectivity of the transportation system.

The highest integration priorities for Dixie Region stakeholders revolved around information sharing. There is a need to improve information and data sharing. This might include sharing camera images, traffic signal control status, incident information, weather data, etc. In addition, as the Region develops and deploys more ITS devices, the amount of information will increase, and so will its value to many agencies.

Another key need identified by stakeholders was for an integrated geographic information system (GIS) that may contain geospatial data from a variety of agencies, not only transportation. GIS have been used to map bus system ridership, sign and device inventories, congestion delays, and census and crash data. Integration of GIS will allow multiple agencies to see the effects of various types of information on the transportation network.

Table 10 summarizes the needs and priority assigned by the stakeholders for integration.

Table 10. Maintenance and Construction Operation Needs

Priority	Needs
High	• Develop an integrated GIS for the region • Improve information sharing among agencies • Develop interagency governmental agreements that would allow the sharing of information
Medium	• Improve system compatibility • Reduce dependency on proprietary systems • Improve understanding and capabilities of other agencies • Develop better understanding of needs of other agencies • Provide central information clearinghouse • Use common verbiage/terminology across agencies • Use common road condition classifications • Improve communication limitations
Low	• Coordination with schools and Division of Emergency Management

6.0 MARKET PACKAGES

Market Packages are the deployable "units" of the National ITS Architecture sausage diagram. They are defined by their functions, which usually directly address regional ITS needs. For example, a Market Package called "Network Surveillance" provides the function of monitoring traffic flow and incidents on the transportation network. It addresses several high-priority Dixie needs including improved incident detection and comprehensive surveillance.

Market Packages are comprised of one or more subsystems. For example, the "Network Surveillance" package usually consists of, at least, a center subsystem for traffic management where data and images are collected, observed and processed, and a field subsystem for observing traffic.

Market Packages may not define the functional boundaries of projects. Projects may be comprised of one, two or several Market Packages, integrated for technical, financial or institutional reasons. For example, the Network Surveillance Market Package describes a service to monitor traffic conditions and report those conditions back to a center. In St. George, several projects have been proposed that include network surveillance through the addition of closed circuit television (CCTV) cameras. The CCTV system will require the installation of conduit and fiber optic cable, which can also be used to interconnect signals. So, those projects are comprised of Network Surveillance and the Market Package Surface Street Control.

Market Packages that correlate most directly to the services required to address the needs identified in *Section 5* have been selected from the National ITS Architecture. The selected Market Packages will serve as a beginning point for discussion of project definition. Market Packages are then tailored to fit, separately or in combination, real world local transportation problems and needs identified during the ITS planning process.

Key items contained within Market Packages are:

- **Subsystems** and **Terminators** that regional Stakeholders can identify or map to local systems.
- **Information Flows** that go between systems and show the types of information that will be exchanged between Stakeholders' systems.

Subsystems & Terminators – Subsystems are a cohesive set of functional definitions with required interfaces to other Subsystems. Subsystems are defined functionally, not physically. Subsystems as defined by the National ITS Architecture are typically related to transportation management or information processing. A Terminator, unlike the Subsystems, cannot be defined by the transportation industry. An example of a Terminator is a banking institution that may be utilized during the purchase of fare cards for transit. The banking institution subscribes to its own industry standards, but these standards and processes are critical to fare card payment, toll collection and other services provided in a region. Examples of Subsystems could include the following:

- A regional implementation may include a single physical center that co-locates the capabilities of several Subsystems. An example is the Traffic Control Center in St. George. A single facility may be identified or "mapped to" numerous Subsystems or functionalities. In this example, functions may include traffic management, archived data management, future transit management and information service provider.
- On the other hand, a single Subsystem may be replicated in many different physical centers. An example may be Maintenance and Construction Management, which may take place at one or more maintenance yards, including UDOT, Washington County and the cities.

Terminators are on the outside of what a region defines as transportation, but are frequently used by transportation to accomplish a mission or perform specific functions. Examples of Terminators could include the following:

- Local media, such as newspapers and television, may be used to reach travelers with important information about transportation issues. Media are called Terminators because the transportation industry does not define what they do or how they will use the information provided to them. They receive traveler information and will use it however it best fits their purpose.
- A computer user who accesses traveler information from traveler information web sites to view traffic images or road conditions. Again, the computer user does not define how information will be provided, and the information provider cannot define how they use it.

Information Flows – Information flows are defined as the information and data exchange between and among various Stakeholders systems that have been mapped to Subsystems and/or Terminators. Information Flows allow for coordinated system operation by following pre-defined interfaces between Subsystems, which may be deployed by different procuring and operating sectors.

Examples of Information Flows could include the following:

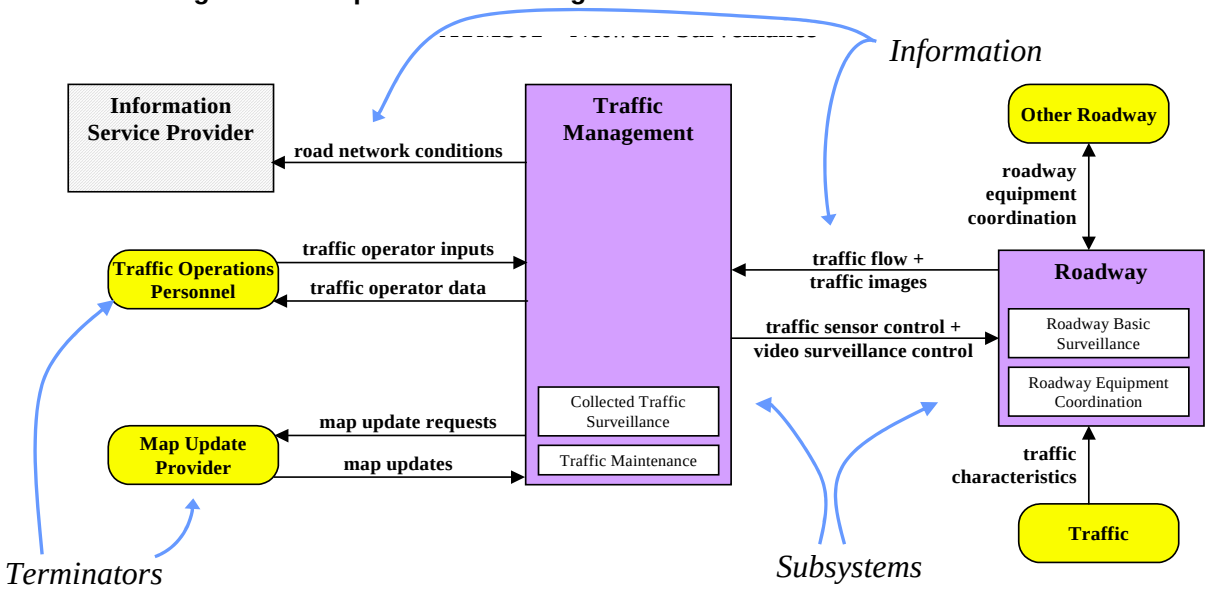
- This example cites two complementary information flows: “signal control data” and “signal control status.” The “signal control data” information flow starts at the Traffic Management Subsystem (the traffic signal control system) and flows to the Roadway Subsystem (the traffic signal controller in the field). “Signal control data” is information used to configure and control traffic signal systems. In response, the Roadway Subsystem returns the “signal control status” information flow to the Traffic Management Subsystem. “Signal control status” is the status of surface street signal controllers.

Market Packages bring together elements that will work together to deliver a given transportation service. In other words, Market Packages identify the pieces of the

Physical Architecture that are required to implement a particular transportation service. The services are what directly address a region's needs.

For a more detailed visual understanding of a Market Package, **Figure 3** shows a traffic management Market Package as an example. Only the most relevant elements from the Architecture definition (e.g., directly involved Subsystems, system Terminators, and the highest level Information Flows) are depicted in the graphic to ensure clarity. It should be noted that Market Packages can be modified to meet each Architecture's purposes. Some regions may not include all of the potential information flows, while others may identify unique flows and be tailored to accommodate them.

Figure 3: Sample Market Package ATMS01 – Network Surveillance



In Version 5.1 of the National ITS Architecture there are 85 Market Packages, in eight groupings. **Table 11** contains a summary listing of all current National ITS Architecture Market Packages, by group. Each of the Market Packages is described in the National ITS Architecture documentation and has an accompanying diagram similar to **Figure 4**. To further review the National ITS Architecture Market Package descriptions and diagrams, please refer to the National ITS Architecture web site at http://itsarch.iteris.com/itsarch/.

Table 11: National ITS Architecture Market Packages

ARCHIVED DATA MANAGEMENT
Archived Data (AD)
AD1 ITS Data Mart
AD2 ITS Data Warehouse
AD3 ITS Virtual Data Warehouse

PUBLIC TRANSPORTATION
Advanced Public Transportation Systems (APTS)
APTS1 Transit Vehicle Tracking
APTS2 Transit Fixed-Route Operations
APTS3 Demand Response Transit Operations
APTS4 Transit Passenger and Fare Management
APTS5 Transit Security
APTS6 Transit Maintenance
APTS7 Multi-modal Coordination
APTS8 Transit Traveler Information

TRAVELER INFORMATION
Advanced Traveler Information Systems (ATIS)
ATIS1 Broadcast Traveler Information
ATIS2 Interactive Traveler Information
ATIS3 Autonomous Route Guidance
ATIS4 Dynamic Route Guidance
ATIS5 ISP Based Route Guidance
ATIS6 Integrated Transportation Mgmt/Route Guidance
ATIS7 Yellow Pages and Reservation
ATIS8 Dynamic Ridesharing
ATIS9 In Vehicle Signing

TRAFFIC MANAGEMENT
Advanced Transportation Management Systems (ATMS)
ATMS01 Network Surveillance
ATMS02 Probe Surveillance
ATMS03 Surface Street Control
ATMS04 Freeway Control
ATMS05 HOV Lane Management
ATMS06 Traffic Information Dissemination
ATMS07 Regional Traffic Control
ATMS08 Traffic Incident Management System
ATMS09 Traffic Forecast and Demand Management
ATMS10 Electronic Toll Collection
ATMS11 Emissions Monitoring and Management
ATMS12 Virtual TMC and Smart Probe Data
ATMS13 Standard Railroad Grade Crossing
ATMS14 Advanced Railroad Grade Crossing
ATMS15 Railroad Operations Coordination
ATMS16 Parking Facility Management
ATMS17 Regional Parking Management
ATMS18 Reversible Lane Management
ATMS19 Speed Monitoring
ATMS20 Drawbridge Management
ATMS21 Roadway Closure Management

From the National ITS Architecture (v5.1)

VEHICLE SAFETY
Advanced Vehicle Safety Systems (AVSS)
AVSS01 Vehicle Safety Monitoring
AVSS02 Driver Safety Monitoring
AVSS03 Longitudinal Safety Warning
AVSS04 Lateral Safety Warning
AVSS05 Intersection Safety Warning
AVSS06 Pre-Crash Restraint Deployment
AVSS07 Driver Visibility Improvement
AVSS08 Advanced Vehicle Longitudinal Control
AVSS09 Advanced Vehicle Lateral Control
AVSS10 Intersection Collision Avoidance
AVSS11 Automated Highway System

COMMERCIAL VEHICLE OPERATIONS
Commercial Vehicle Operations (CVO)
CVO01 Fleet Administration
CVO02 Freight Administration
CVO03 Electronic Clearance
CVO04 CV Administrative Processes
CVO05 International Border Electronic Clearance
CVO06 Weigh-In-Motion
CVO07 Roadside CVO Safety
CVO08 On-board CVO and Freight Safety & Security
CVO09 CVO Fleet Maintenance
CVO10 HAZMAT Management
CVO11 Roadside HAZMAT Security Detection & Mitigation
CVO12 CV Driver Security Authentication
CVO13 Freight Assignment Tracking

EMERGENCY MANAGEMENT
Emergency Management (EM)
EM01 Emergency Call-Taking and Dispatch
EM02 Emergency Routing
EM03 Mayday Support
EM04 Roadway Service Patrols
EM05 Transportation Infrastructure Protection
EM06 Wide-Area Alert
EM07 Early Warning System
EM08 Disaster Response and Recovery
EM09 Evacuation and Reentry Management
EM10 Disaster Traveler Information

MAINTENANCE & CONSTRUCTION OPERATIONS
Maintenance & Construction Operations (MCO)
MC01 Maintenance & Construction Vehicle & Equip. Tracking
MC02 Maintenance and Construction Vehicle Maintenance
MC03 Road Weather Data Collection
MC04 Weather Information Processing and Distribution
MC05 Roadway Automated Treatment
MC06 Winter Maintenance
MC07 Roadway Maintenance and Construction
MC08 Work Zone Management
MC09 Work Zone Safety Monitoring
MC10 Maintenance and Construction Activity Coordination

6.1 Dixie Region Market Packages

Table 12 is a summary of Market Packages that provide functions for which a need has been identified in the Dixie Region. The selected Market Packages reflect the needs identified by Dixie Region Stakeholders and in existing ITS plans. The table shows all of the National ITS Architecture Market Packages and their status in the region as existing, planned or not planned. Following the table is a description of each Market Package that is either existing or planned in the Dixie Region. Existing Market Packages are those that are already deployed in the Dixie Region. Planned are those identified as addressing the needs identified by Stakeholders. Note that a "planned" Market Package is not one for which funding or a project has been identified. Planned in this context means that it meets a need and a project will be developed that includes the planned Market Package. The priority, cost and timing of each project planned for the Dixie Region will be defined later in this study. In addition, Market Packages may be added or deleted from this list during the Project Definition stage.

Table 12: Dixie Region Market Package Analysis

Market Packages		Existing	Planned	Not Planned
ARCHIVED DATA MANAGEMENT *Archived Data (AD)*				
AD1	ITS Data Mart			X
AD2	ITS Data Warehouse			X
AD3	ITS Virtual Data Warehouse			X
PUBLIC TRANSPORTATION *Advanced Public Transportation Systems (APTS)*				
APTS1	Transit Vehicle Tracking		X	
APTS2	Transit Fixed-Route Operations		X	
APTS3	Demand Responsive Transit Operations		X	
APTS4	Transit Passenger and Fare Management			X
APTS5	Transit Security			X
APTS6	Transit Maintenance			X
APTS7	Multi-modal Coordination			X
APTS8	Transit Traveler Information		X	
TRAVELER INFORMATION *Advanced Traveler Information Systems (ATIS)*				
ATIS1	Broadcast Traveler Information		X	
ATIS2	Interactive Traveler Information		X	
ATIS3	Autonomous Route Guidance			X
ATIS4	Dynamic Route Guidance			X
ATIS5	ISP Based Route Guidance			X
ATIS6	Integrated Transportation Management/Route Guidance			X
ATIS7	Yellow Pages and Reservation			X
ATIS8	Dynamic Ridesharing			X
ATIS9	In Vehicle Signing			X

Table 12: Dixie Region Market Package Analysis

Market Packages		Existing	Planned	Not Planned
TRAFFIC MANAGEMENT *Advanced Transportation Management Systems (ATMS)*				
ATMS01	Network Surveillance	X		
ATMS02	Probe Surveillance			X
ATMS03	Surface Street Control	X		
ATMS04	Freeway Control			X
ATMS05	HOV Lane Management			X
ATMS06	Traffic Information Dissemination		X	
ATMS07	Regional Traffic Control		X	
ATMS08	Traffic Incident Management System		X	
ATMS09	Traffic Forecast and Demand Management			X
ATMS10	Electronic Toll Collection			X
ATMS11	Emissions Monitoring and Management			X
ATMS12	Virtual TMC and Smart Probe Data			X
ATMS13	Standard Railroad Grade Crossing			X
ATMS14	Advanced Railroad Grade Crossing			X
ATMS15	Railroad Operations Coordination			X
ATMS16	Parking Facility Management			X
ATMS17	Regional Parking Management			X
ATMS18	Reversible Lane Management			X
ATMS19	Speed Monitoring			X
ATMS20	Drawbridge Management			X
ATMS21	Roadway Closure Management			X
VEHICLE SAFETY *Advanced Vehicle Safety Systems (AVSS)*				
AVSS01	Vehicle Safety Monitoring			X
AVSS02	Driver Safety Monitoring			X
AVSS03	Longitudinal Safety Warning			X
AVSS04	Lateral Safety Warning			X
AVSS05	Intersection Safety Warning			X
AVSS06	Pre-Crash Restraint Deployment			X
AVSS07	Driver Visibility Improvement			X
AVSS08	Advanced Vehicle Longitudinal Control			X
AVSS09	Advanced Vehicle Lateral Control			X
AVSS10	Intersection Collision Avoidance			X
AVSS11	Automated Highway System			X
COMMERCIAL VEHICLE OPERATIONS *Commercial Vehicle Operations (CVO)*				
CVO01	Fleet Administration			X
CVO02	Freight Administration			X
CVO03	Electronic Clearance			X
CVO04	CV Administrative Processes			X
CVO05	International Border Electronic Clearance			X
CVO06	Weigh-In-Motion			X

Table 12: Dixie Region Market Package Analysis

Market Packages		Existing	Planned	Not Planned
CVO07	Roadside CVO Safety			X
CVO08	On-board CVO and Freight Safety & Security			X
CVO09	CVO Fleet Maintenance			X
CVO10	HAZMAT Management			X
CVO11	Roadside HAZMAT Security Detection & Mitigation			X
CVO12	CV Driver Security Authentication			X
CVO13	Freight Assignment Tracking			X
EMERGENCY MANAGEMENT *Emergency Management (EM)*				
EM01	Emergency Call-Taking and Dispatch	X		
EM02	Emergency Routing		X	
EM03	Mayday Support			X
EM04	Roadway Service Patrols		X	
EM05	Transportation Infrastructure Protection			X
EM06	Wide-Area Alert		X	
EM07	Early Warning System		X	
EM08	Disaster Response and Recovery		X	
EM09	Evacuation and Reentry Management		X	
EM10	Disaster Traveler Information		X	
MAINTENANCE & CONSTRUCTION OPERATIONS *Maintenance & Construction Operations (MCO)*				
MC01	Maintenance and Construction Vehicle Tracking			X
MC02	Maintenance and Construction Vehicle Maintenance			X
MC03	Road Weather Data Collection			X
MC04	Weather Information Processing and Distribution			X
MC05	Roadway Automated Treatment			X
MC06	Winter Maintenance			X
MC07	Roadway Maintenance and Construction			X
MC08	Work Zone Management			X
MC09	Work Zone Safety Monitoring			X
MC10	Maintenance and Construction Activity Coordination		X	

6.2 ITS Market Package Descriptions

This section describes the 20 Market Packages that are existing or planned for the Dixie Region. The descriptions are directly from the National ITS Architecture.

6.2.1 Advanced Public Transportation Systems Market Packages

APTS1: Transit Vehicle Tracking (Planned) - This market package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. Fixed route transit systems may also employ beacons along the route to enable position determination and facilitate communications with each vehicle at fixed intervals. The Transit Management Subsystem processes this information, updates the transit schedule and makes real-time schedule information available to the Information Service Provider.

APTS2: Transit Fixed-Route Operations (Planned) - This market package performs vehicle routing and scheduling, as well as automatic operator assignment and system monitoring for fixed-route and flexible-route transit services. This service determines current schedule performance using AVL data and provides information displays at the Transit Management Subsystem. Static and real time transit data is exchanged with Information Service Providers where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.

APTS3: Demand Response Transit Operations (Planned) - This market package performs vehicle routing and scheduling as well as automatic operator assignment and monitoring for demand responsive transit services. In addition, this market package performs similar 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 a transit management center or be independently owned and operated by a separate 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.

APTS08: Transit Traveler Information (Planned) - 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.

6.2.2 Advanced Traveler Information Systems Market Packages

ATIS01: Broadcast Traveler Information (Planned) **-** This market package collects traffic conditions, advisories, general public transportation, toll and 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., FM subcarrier, cellular data broadcast). 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, probe vehicles or other sources.

ATIS02: Interactive Traveler Information (Planned) – 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 or remote traveler systems 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. A traveler may also input personal preferences and identification information via a “traveler card” that can convey information to the system about the traveler as well as receive updates from the system so the card can be updated over time.

ATMS01: Network Surveillance (Existing) - This market package includes traffic detectors, other surveillance equipment, the supporting field equipment, and fixed-point to fixed-

point communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Subsystem). 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.

ATMS03: Surface Street Control (Existing) - This market package provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management. A range of traffic signal control systems are represented by this market package ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This market package is generally an intra jurisdictional package that does not rely on real-time communications between separate control systems to achieve area-wide traffic signal coordination. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would be represented by this package. This market package is consistent with typical urban traffic signal control systems.

ATMS06: Traffic Information Dissemination - This market package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. 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/bridge closures due to maintenance and construction activities to be disseminated.

ATMS07: Regional Traffic Control (Planned) - This market package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. This market package advances the Surface Street Control and Freeway Control Market Packages by adding the communications links and integrated control strategies that enable integrated interjurisdictional traffic control. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Surface Street Control and Freeway Control Market Packages and adds hardware, software, and fixed-point to fixed-point communications

capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers.

ATMS08: Traffic Incident Management System (Planned) - 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 (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and 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.

6.2.3 Emergency Management Market Packages

EM01: Emergency Call-Taking and Dispatch (Existing) - 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.

EM02: Emergency Routing (Planned) - 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. The service provides for information exchange between care facilities and both the Emergency Management Subsystem and emergency vehicles.

EM04: Roadway Service Patrols (Planned) - This market package supports roadway service patrol vehicles that monitor roads that aid motorists, offering rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median). The market package monitors service patrol vehicle locations and supports vehicle dispatch to identified incident locations. Incident information collected by the service patrol is shared with traffic, maintenance and construction, and traveler information systems.

EM06: Wide Area Alert – This Market Package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in some scenarios. The ITS technologies will supplement and support other emergency and homeland security alert systems such as the Emergency Alert System (EAS). When an emergency situation is reported and verified and the terms and conditions for system activation are satisfied, a designated agency broadcasts emergency information to traffic agencies, transit agencies, information service providers, toll operators, and others that operate ITS systems. The ITS systems, in turn, provide the alert information to transportation system operators and the traveling public using ITS technologies such as dynamic message signs, highway advisory radios, in-vehicle displays, transit displays, 511 traveler information systems, and traveler information web sites.

EM07: Early Warning System – This market package monitors and detects potential, looming, and actual disasters including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and acts of terrorism including nuclear, chemical, biological, and radiological weapons attacks). The market package monitors alerting and advisory systems, ITS sensors and surveillance systems, field reports, and emergency call-taking systems to identify emergencies and notifies all responding agencies of detected emergencies.

EM08: Disaster Response and Recovery (Planned) - This market package enhances the ability of the surface transportation system to respond to and recover from disasters. It addresses the most severe incidents that require an extraordinary response from outside the local community. All types of disasters are addressed including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and national security emergencies such as nuclear, chemical, biological, and radiological weapons attacks).

The market package supports coordination of emergency response plans, including general plans developed before a disaster as well as specific tactical plans with short time horizon that are developed as part of a disaster response. The market package provides enhanced access to the scene for response personnel and resources, provides better information about the transportation system in the vicinity of the disaster, and maintains situation awareness regarding the disaster itself. In addition, this market package tracks and coordinates the transportation resources - the transportation professionals, equipment, and materials - that constitute a portion of the disaster response.

The market package identifies the key points of integration between transportation systems and the public safety, emergency management, and other allied organizations that form the overall disaster response. In this market package, the Emergency Management subsystem represents the federal, regional, state, and local Emergency Operations Centers and the Incident Commands that are established to respond to the disaster. The interface between the Emergency Management Subsystem and the other center subsystems provides situation awareness and resource coordination among transportation and other allied response agencies. In its role, traffic management implements special traffic control strategies and detours and restrictions to effectively manage traffic in and around the disaster. Maintenance and construction provides damage assessment of road network facilities and manages service restoration. Transit management provides a similar assessment of status for transit facilities and modifies transit operations to meet the special demands of the disaster. As immediate public safety concerns are addressed and disaster response transitions into recovery, this market package supports transition back to normal transportation system operation, recovering resources, managing on-going transportation facility repair, supporting data collection and revised plan coordination, and other recovery activities.

This market package builds on the basic traffic incident response service that is provided by ATMS08, the Traffic Incident Management market package. This market package addresses the additional complexities and coordination requirements that are associated with the most severe incidents that warrant an extraordinary response from outside the local jurisdictions and require special measures such as the activation of one or more emergency operations centers. Many users of the National ITS Architecture will want to consider both ATMS08 and this market package since every region is concerned with both day-to-day management of traffic-related incidents and occasional management of disasters that require extraordinary response.

Disaster Response and Recovery is also supported by EM10, the "Disaster Traveler Information" market package that keeps the public informed during a disaster response. See that market package for more information.

EM09: Evacuation and Reentry Management (Planned) - This market package supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. The market package addresses evacuations for all types of disasters, including disasters like hurricanes that are anticipated and occur slowly, allowing a well-

planned orderly evacuation, as well as disasters like terrorist acts that occur rapidly, without warning, and allow little or no time for preparation or public warning.

This market package supports coordination of evacuation plans among the federal, state, and local transportation, emergency, and law enforcement agencies that may be involved in a large-scale evacuation. All affected jurisdictions (e.g., states and counties) at the evacuation origin, evacuation destination, and along the evacuation route are informed of the plan. Information is shared with traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes. Reversible lanes, shoulder use, closures, special signal control strategies, and other special strategies may be implemented to maximize capacity along the evacuation routes. Transit resources play an important role in an evacuation, removing many people from an evacuated area while making efficient use of limited capacity. Additional shared transit resources may be added and managed in evacuation scenarios. Resource requirements are forecast based on the evacuation plans, and the necessary resources are located, shared between agencies if necessary, and deployed at the right locations at the appropriate times.

Evacuations are also supported by EM10, the "Disaster Traveler Information" market package, which keeps the public informed during evacuations. See that market package for more information.

EM10: Disaster Traveler Information (Planned) - This market package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster. This market package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. The collected information is processed and the public is provided with real-time disaster and evacuation information using ITS traveler information systems.

A disaster will stress the surface transportation system since it may damage transportation facilities at the same time that it places unique demands on these facilities to support public evacuation and provide access for emergency responders. Similarly, a disaster may interrupt or degrade the operation of many traveler information systems at the same time that safety-critical information must be provided to the traveling public. This market package keeps the public informed in these scenarios, using all available means to provide information about the disaster area including damage to the transportation system, detours and closures in effect, special traffic restrictions and allowances, special transit schedules, and real-time information on traffic conditions and transit system performance in and around the disaster.

This market package also provides emergency information to assist the public with evacuations when necessary. Information on mandatory and voluntary evacuation zones, evacuation times, and instructions are provided. Available evacuation routes and destinations and current and anticipated travel conditions along those routes are provided

so evacuees are prepared and know their destination and preferred evacuation route. Information on available transit services and traveler services (shelters, medical services, hotels, restaurants, gas stations, etc.) is also provided. In addition to general evacuation information, this market package provides specific evacuation trip planning information that is tailored for the evacuee based on origin, selected destination, and evacuee-specified evacuation requirements and route parameters.

This market package augments the ATIS market packages that provide traveler information on a day-to-day basis for the surface transportation system. This market package provides focus on the special requirements for traveler information dissemination in disaster situations.

6.2.4 Maintenance and Construction Market Packages

MC10: Maintenance and Construction Activity Coordination (Planned) - 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.

7.0 OPERATIONAL CONCEPTS

An operational concept summarizes the system operational characteristics from the Stakeholder's viewpoint. In transportation management and operations, an operational concept is a strategy for achieving a shared set of expectations of operations and delivery of services by a regional transportation system.

Operational concepts focus on a definition of each Stakeholder's role in delivering transportation systems and services. They are frequently referred to as "roles and responsibilities" because they describe what will be expected from each Stakeholder in order to achieve the objective of the ITS. For example, among its roles and responsibilities, St. George Public Works may have: "Operate and maintain the Traffic Control Center." This defines who will perform the task and what is required of St. George Public Works. Of course, St. George Public Works, and most other Stakeholders, have multiple operational concepts associated with them.

By reviewing the operational concepts, Stakeholders can quickly understand what is expected of them, as well as identify proposed responsibilities that may not be feasible or cost-effective for them to provide.

The benefits of developing and using operational concepts include:

- Improved accountability and control for the various activities and functions that are undertaken in transportation management and operations.
- Avoidance of duplicative and/or conflicting efforts by various transportation and public safety jurisdictions, agencies, departments, and other entities.
- Clarifications of expectations and intent so that all Stakeholders are aware of the consequences their actions have on other Stakeholders.
- Clarification of roles/responsibilities of all Stakeholders so that key activities do not "fall through the cracks."
- Sharing of data and information across agency and jurisdictional boundaries to allow for seamless operations.

Table 13 lists the roles and responsibilities of the Dixie Regional ITS Stakeholders. Included here is only a list of ITS-related roles and responsibilities, and is not a complete list of all responsibilities beyond ITS.

Table 13: ITS Operational Concepts

Operating Agency	Roles / Responsibility
Bureau of Land Management (BLM)	• Track and report incidents and events on lands owned and operated by BLM
Clark County, Nevada	• Track and report incidents and events within Clark County that may restrict or close the Interstate or other major highways • Receive and respond accordingly to incident information from the Dixie Region
Department of Homeland Security	• Share incident and threat information with state and local emergency management agencies • Receive and respond accordingly to incident information from the Dixie Region • Assist in the coordination of major emergency response in the Dixie Region
Dixie Ambulance Service	• Receive routing and traffic information from the St. George Dispatch Center • Operate and maintain emergency vehicles, including onboard ITS-related equipment • Provide incident status to St. George Dispatch Center • Issue requests for emergency signal preemption
Dixie National Forest	• Track and report incidents and events on lands owned and operated by the National Forest
Local Maintenance	• Provide construction and maintenance information with other maintenance, safety and traffic agencies in the Dixie Region • Coordinate with traffic and other maintenance agencies for scheduling and performing maintenance and construction activities.
Local Public Safety	• Create, store and utilize emergency response plans to facilitate coordinated response • Receive routing and traffic information from the St. George Dispatch Center • Operate and maintain emergency vehicles, including onboard ITS-related equipment • Provide incident status to St. George Dispatch Center • Issue requests for emergency signal preemption
Media	• Monitor closed circuit television • Collect information from traffic and emergency agencies regarding incidents, road closures, delays, congestion and weather related travel issues • Disseminate traffic and transportation information to the public
Mojave County	• Track and report incidents and events within Arizona that may restrict or close the Interstate or other significant highways • Receive and respond accordingly to incident information from the Dixie Region
St. George Airport	• Oversee operations and maintenance of the St. George Airport, including aviation-related and groundside transportation infrastructure • Interface with emergency and traffic agencies to support coordinated emergency response • Create, store and utilize emergency response plans to facilitate coordinated emergency response • Exchange incident and threat information with emergency

Table 13: ITS Operational Concepts

Operating Agency	Roles / Responsibility
	management systems • Maintain centralized emergency management software systems
St. George Police	• Receive public safety calls and provide appropriate response • Dispatch emergency vehicles • Monitor traffic via closed circuit television • Monitor the St. George Traffic Control Center • Interface with other emergency and transportation agencies to support coordinated emergency response • Create, store and utilize emergency response plans to facilitate coordinated response • Exchange incident and threat information with other emergency management systems and with maintenance and construction systems • Maintain centralized emergency management systems • Track the location of emergency vehicles • Dynamically route emergency vehicles based on real-time traffic information • Receive routing and traffic information from the St. George Dispatch Center • Operate and maintain emergency vehicles, including onboard ITS-related equipment • Provide incident status to St. George Dispatch Center • Issue requests for emergency signal preemption
St. George Maintenance	• Provide construction and maintenance information with other maintenance, safety and traffic agencies in the Dixie Region • Coordinate with traffic and other maintenance agencies for scheduling and performing maintenance and construction activities.
St. George Public Works	• Operate and maintain the Traffic Control Center • Manage traffic on city-owned arterials using traffic signals • Operate and maintain local traffic signal network • Coordinate with emergency responders for the deployment, operation and maintenance of emergency vehicle preemption • Provide traffic and incident information to the public, including construction, maintenance, road closures, detours, delays, congestion and incident information • Share traffic information with emergency responders and other transportation agencies • Interface with emergency and other traffic agencies to support coordinated emergency response • Exchange incident information with emergency management systems • Collect traffic data, including speed and volumes • Create data archives of various operational parameters of the local transportation system for use in regional, state and national planning activities • Monitor traffic on local arterial roads and interstates • Maintain centralized traffic signal software • Coordinate with other Dixie Region agencies on the deployment and integration of new traffic signals • Monitor freeway operations • Implement traffic control response to incidents

Table 13: ITS Operational Concepts

Operating Agency	Roles / Responsibility
	• Coordinate traffic control response to incidents with emergency responders and other transportation agencies • Operate and monitor dynamic message signs • Operate, monitor and maintain closed circuit television system
SunTran	• Schedule and dispatch fixed-route and paratransit vehicles • Maintain and service transit vehicles • Collect, process and disseminate transit information to the public • Operate and maintain centralized transit management software
Traveling Public	• Receive, process and use traffic and transit information using personal devices (e.g. personal computers, telephones) to make educated travel choices • Receive, process and use traffic and transit information using en-route systems (e.g. dynamic message signs and highway advisory radio) to make educated travel choices
UDOT	• Operate and maintain and 511 web site and telephone system • Operate and maintain a statewide Traffic Operations Center • Operate and maintain a Traffic Control Center in Cedar City • Collect, process and disseminate traffic information • Manage traffic on state-owned arterials using traffic signals • Operate and maintain state-owned traffic signals • Coordinate with emergency responders for the deployment, operation and maintenance of emergency vehicle preemption • Share traffic information with emergency responders and other transportation agencies • Interface with emergency and other traffic agencies to support coordinated emergency response • Maintain and operate dynamic message signs • Monitor traffic via closed circuit television • Receive weather data from road weather information systems and disseminate information to the traveling public • Operate and maintain road weather information systems • Collect traffic data on freeways and state routes • Maintain and operate incident response vehicles • Dispatch incident response vehicles
Utah Highway Patrol	• Receive public safety calls and provide appropriate response • Dispatch emergency vehicles • Monitor traffic via closed circuit television • Monitor the St. George Traffic Control Center • Operate and maintain incident response vehicles • Create, store and utilize emergency response plans to facilitate coordinated response • Exchange incident and threat information with other emergency management systems and with maintenance and construction systems • Maintain centralized emergency management systems • Operate and maintain emergency vehicles, including onboard ITS-related equipment • Issue requests for emergency signal preemption
Washington County	• Create, store and utilize emergency response plans to facilitate coordinated response • Receive routing and traffic information from the St. George Dispatch

Table 13: ITS Operational Concepts

Operating Agency	Roles / Responsibility
	Center • Operate and maintain emergency vehicles, including onboard ITS-related equipment • Provide incident status to St. George Dispatch Center • Issue requests for emergency signal preemption • Provide construction and maintenance information with other maintenance, safety and traffic agencies in the Dixie Region • Coordinate with traffic and other maintenance agencies for scheduling and performing maintenance and construction activities
Zion National Park	• Track and report incidents and events on lands owned and operated by the National Park

8.0 FUNCTIONAL REQUIREMENTS

The development of Functional Requirements follows the definition of Operational Concepts in the architecture development. While Operational Concepts focused on the people and agencies, Functional Requirements focus on the activities of the equipment and systems. They define what is required of each element to accomplish the Dixie Region's ITS goals.

Note that while the National ITS Architecture provides for roles and responsibilities of "Terminators", there are no Functional Requirements to be developed for "Terminators".

Table 14 provides a sample of the Functional Requirements by listing those anticipated for the planned Emergency Vehicle Tracking Project. Functional Requirements by definition are identified by "shall" statements. Note that the use of "shall" statements, such as "the system shall" or "the center shall", is deliberate as it sets forth a declarative statement about what a system needs to do. In the example table, emergency vehicles that will be equipped for automated vehicle tracking, and which will be tracked by the St. George Dispatch Center, are expected to operate similarly. Although each is a distinct fleet, and in the case of Local Emergency Vehicles an aggregation of several small fleets, each will have similar functionality.

Table 14: Emergency Vehicle Tracking Functional Requirements

Elements: Dixie Ambulance Service Vehicles, Washington County Sheriff, St. George Emergency Vehicles, Other Local Emergency Vehicles		
Entity: Emergency Vehicle Subsystem		
Requirement	**Description**	**Status**
1	The emergency vehicle, including roadway service patrols, shall compute the location of the emergency vehicle based on inputs from a vehicle location determination function.	Planned
2	The emergency vehicle, including roadway service patrols, shall send the vehicle's location and operational data to the center for emergency management and dispatch.	Planned
3	The emergency vehicle, including roadway service patrols, shall receive incident details and a suggested route when dispatched to a scene.	Planned
4	The emergency vehicle shall send the current en route status (including estimated time of arrival) and requests for emergency dispatch updates.	Planned
6	The emergency vehicle shall provide the personnel on-board with dispatch information, including incident type and location, and forward an acknowledgment from personnel to the center that the vehicle is on its way to the incident scene.	Planned
7	The emergency vehicle shall send patient status information to the care facility along with a request for further information.	Planned
8	The emergency vehicle shall forward care facility status information to emergency vehicle personnel, including the location, specialized services, quality of care, waiting time, number of rooms available, and emergency room status of hospitals or emergency care providers.	Planned

Table 14: Emergency Vehicle Tracking Functional Requirements

Element: St. George Dispatch Center		
Entity: Emergency Management		
Requirement	**Description**	**Status**
5	The center shall calculate emergency vehicle routes, under center personnel control, based on information from traffic management and maintenance centers.	Planned
7	The center shall provide the capability to request special traffic control measures, such as signal preemption, from the traffic management center to facilitate emergency vehicle progress along the suggested route.	Planned
8	Once the route is calculated the route shall be provided to the dispatch function.	Planned
9	The center shall provide the capability for digitized map data to act as the background to the information presented to the emergency system operator.	Planned

A comprehensive list of Functional Requirements for all Stakeholders is too voluminous to include in the body of this report. In fact, because of the size and redundancy in the Functional Requirements, Stakeholders are encouraged to focus their attention on reviewing and verifying the Functional Requirements associated with projects in which they are involved. The complete list is included in the Turbo Architecture Database for the Dixie Region.

9.0 INTERCONNECTS AND INFORMATION FLOWS

Interconnect Diagrams and Information Flow Diagrams are very important in documenting and understanding a regional ITS architecture. They also provide a clear depiction of how the ITS subsystems will connect and interact. The Interconnect Diagrams graphically depict the various systems in a given region that are connected to other systems. Information Flow Diagrams graphically depict the type of information flowing between the connected systems. Both of these types of diagrams are among the output generated by the Turbo Architecture tool. This Section describes the Turbo Architecture tool, Interconnect Diagrams and Information Flows in more detail.

9.1 Use of Turbo Architecture

Turbo Architecture (Turbo) is a software application that supports development of regional and project ITS architectures using the National ITS Architecture as a starting point. It uses the Microsoft Access database application as the underlying foundation.

Turbo provides powerful customization tools that allow the architecture developer to customize the architecture to match a Region's specific requirements. For example, in addition to the ITS Market Package selection process, the developer is also able to select which systems in the inventory interconnect to other systems in the inventory, based on certain criteria of the National ITS Architecture. This interconnection also extends to the selection of information flows between the interconnected systems.

Many reports and diagrams are available from Turbo for display, print, or publication in other documents/formats. The user can extend the National ITS Architecture by adding their own information flows and transportation elements for those areas not covered by the National ITS Architecture.

9.2 Interconnect Diagrams

Interconnect Diagrams and Information Flow Diagrams are standard outputs from Turbo. The Interconnect Diagram depicts how a particular element of a regional ITS architecture interconnects to other elements in the regional architecture. Interconnect diagrams are less detailed than Information Flow diagrams. The Interconnect Diagram simply shows a physical or logical connection between two or more elements in the architecture.

Figure 4 is an example of an Interconnect Diagram for the Network Surveillance Market Package as it will be applied in the Dixie Region. The reviewer will note that all connections are shown as existing. That is because there currently exists interconnects among the elements used in Network Surveillance for the Dixie Region. The Information Flow Diagram in **Figure 6** provides more detail on what information is and will be exchanged.

Figure 4 is a small subset of the entire Region's Interconnect Diagram. **Figure 5** includes all the ITS elements in the Region, and all the existing and planned Interconnects. Because of the number of elements, the complete regional Interconnect Diagram can make it difficult to view the interconnects related to each project. **Appendix C** contains Interconnect Diagrams focused on each Market Package selected for the Dixie Region.

Figure 4: Network Surveillance Interconnect Diagram

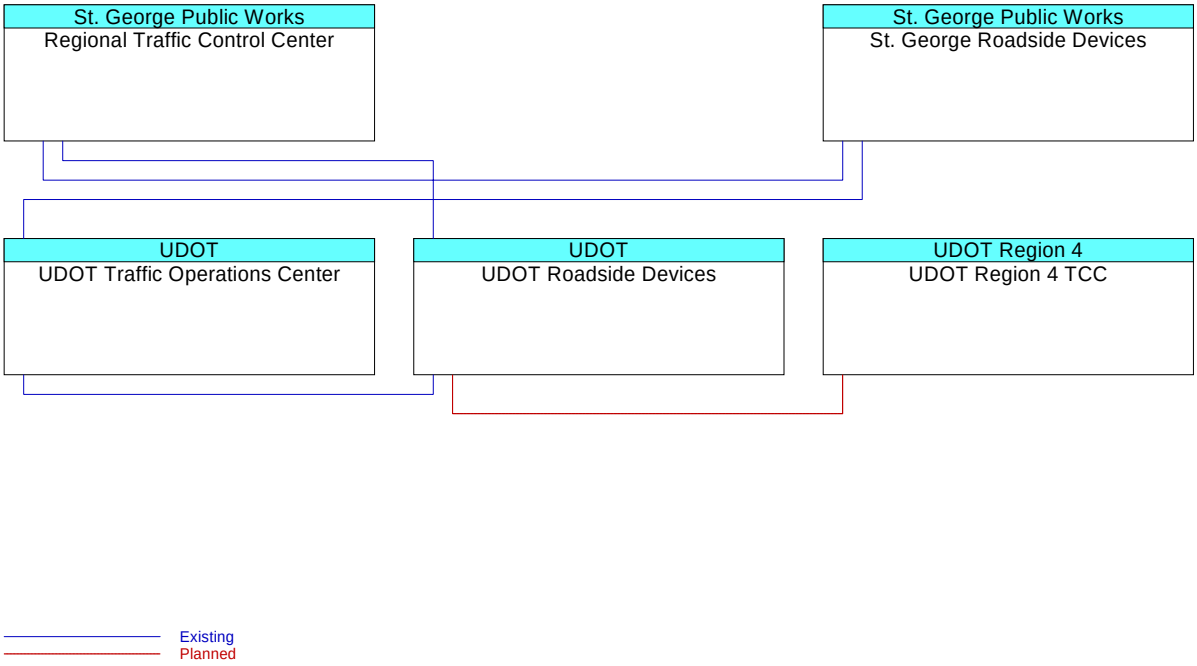
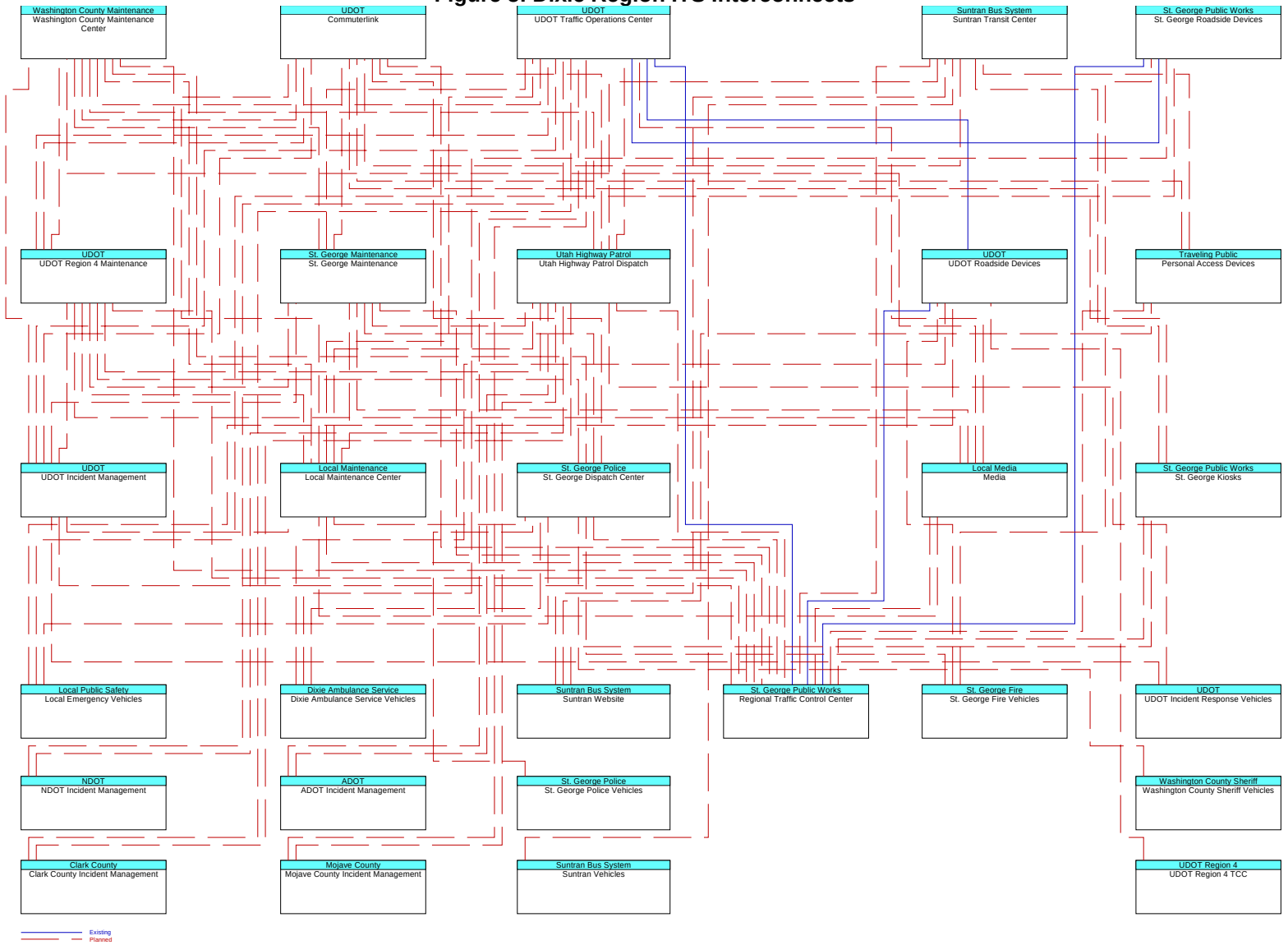


Figure 5: Dixie Region ITS Interconnects



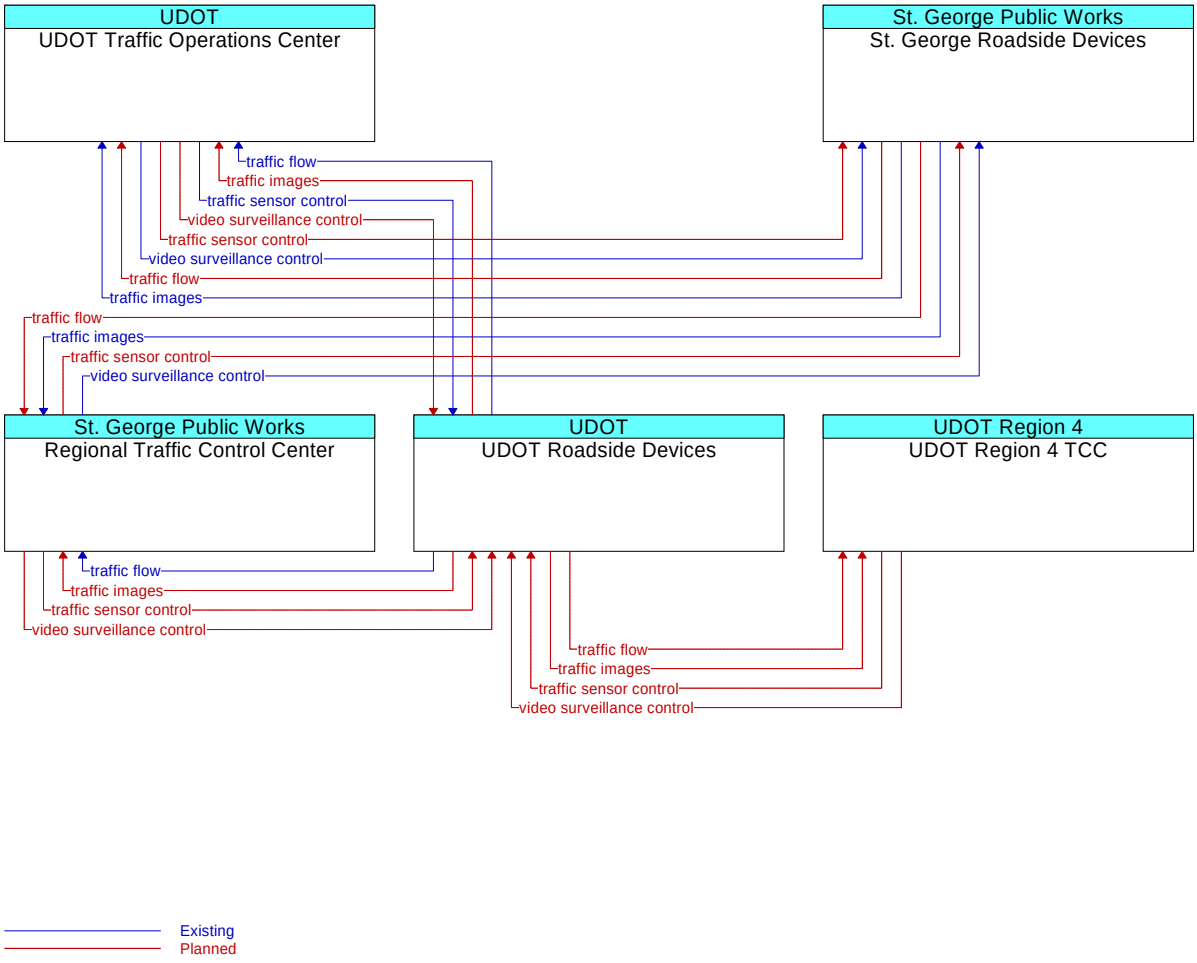
9.3 Information Flow Diagrams

Information Flow Diagrams show the detailed information exchange between elements. One line on an Interconnect Diagram between two systems may represent many lines on the Information Flow Diagram between the same systems. Each line describes the data that is exchanged and the direction in which it flows.

Figure 7 is an example of an Information Flow Diagram in the Dixie Regional ITS Architecture for the Network Surveillance. Notice that where there was only one line connecting the Dispatch Center to each of the other Elements in the Interconnect Diagram there are now several lines connecting it to each of the other Elements.

Because of the quantity of flows, a single diagram containing all information flows cannot be legibly reproduced in this document. However, **Appendix C** contains Information Flow Diagrams focused on each Market Package selected for the Dixie Region.

Figure 6: Information Flow Diagram For Network Surveillance



10.0 ITS PROJECTS

This section describes the process used to identify and plan the ITS projects for the Dixie Region. The projects are the culmination of a process that considers how effectively they address regional transportation needs, technology maturity, and interdependence of projects. Projects are then sequenced, with those projects that address high-priority needs being considered for the earliest deployment. Cost is not considered in the project sequencing at this stage, however, estimates are included.

10.1 Project identification Process

Some ITS deployments exist or are underway in the Dixie Region. They include emergency vehicle tracking, closed-circuit television (CCTV) cameras for traffic surveillance, and centralized signal control and coordination. However, the existing ITS does not fully address the transportation management needs of the Region. During this project, a more comprehensive list of ITS projects has been developed that further address the Region's needs.

In this step of Regional ITS Architecture development, the Architecture is defined as a list of implementable ITS projects. There is an emphasis in the project list on corridor projects that may include several types of ITS deployed along a segment of roadway. That is largely a product of the Region's road development and the anticipated growth in traffic on specific roadways.

Development of the ITS projects list for the Dixie Region was performed in an iterative manner. The first step was to review existing regional plans, programs and studies collected in earlier activities of the project, to find those ITS projects already planned and/or programmed to ensure they are included in this plan. Then, the Dixie Regional Stakeholders helped define a list of prioritized transportation needs that could be addressed through ITS. This list was reviewed with the Steering Committee to better refine the priority of needs.

The needs and existing ITS were mapped to the National ITS Architecture User Services and Market Packages. As previously discussed, Market Packages are deployable subsets of ITS that provide specific functions. In most cases, the projects identified for the Region are comprised of one or more Market Packages. Following this project identification stage was project sequencing, described in the following section.

10.2 Project Sequencing Process

To move forward in the sequencing of projects, each identified project has been assigned a relative timeframe, designated as Short-term, Medium-term and Long-term. Short-term is defined as recommended for deployment in the next zero to five years, and these projects generally address the highest priority needs in the Region. Medium-term is

defined as five to ten years from the present. Long-term is defined as projects recommended for deployment in ten years and beyond.

The result is groups of short-, medium- and long-term projects, instead of attempting to establish a specific decreasing priority ranking for all identified projects. This approach is preferable because it does not discretely recommend "Project A" as being more important than "Project B," thus potentially pitting one project or agency against another when competing for funding. This method of sequencing projects also brings structure to the planning process and gives focus to eventual project selection and deployment without establishing a "pre-defined" funding priority for specific projects.

The projects sequence rankings have been assigned to the respective projects based on two primary factors. The first factor considered is the need for a particular ITS function for the Region as outlined in Section 5 of this Final Report. Information on High, Medium and Low priority needs identified in Section 5 have been carried forward in the project sequencing process. The second factor is the logical ordering of projects based on interdependence and maturity of the underlying technology. For example, in order for many of the corridor projects to be implemented it is likely that a comprehensive Communications Plan be developed in order to define and address their communication requirements. Similarly, a Regional Traffic Control Center will enhance the Region's ability to control and monitor corridors that cross-jurisdictional boundaries. Other projects may address high priority needs, but rely on a technology whose benefits have not been proven in real-world applications. As a result, a lack of reliability or information about a technology may push a project to a later position in the project sequence.

The sequencing of projects should be used as a guide and not a prescription. Some of the projects should be considered longer-term efforts because short-term deployment may represent an unacceptable risk or cost. Some medium- and long-term projects may be sequenced as such because they are dependent on the deployment of other short-term projects in order to be effective. However, in some cases an early opportunity to deploy a medium- or long-term project in the Region, with relatively low risk, may present itself. Or, perhaps a technology or system may advance more quickly than was originally anticipated in the development of the ITS Implementation Plan. Neither of these scenarios should preclude implementation of a medium- or long-term project before a short-term project, if it makes sense.

The act of project sequencing also takes into account deployment timelines and dependencies. Project dependencies were used to identify project elements that must be implemented before other projects can begin. By applying dependencies, an efficient sequence can be developed so that projects incrementally build on the elements deployed before them, saving money and time as the Region invests in future ITS deployments.

The actual deployment of ITS projects may also be dependent on other factors including the data or policy decisions that support the projects. For example, the transit automated vehicle location (AVL) system may benefit from the development of AVL capabilities

for emergency vehicles in the Region by using the same digital maps and tracking software. Other system integration projects may require waiting for a ratified national standard for data exchange. These types of dependencies should be recognized not just in the sequencing of projects but also at the more detailed project planning stage.

10.3 ITS Project List

Table 15 contains the ITS projects identified during the ITS Architecture Process. The table provides a project name, description including identification of other dependent projects, key Stakeholders, relevant Market Packages where applicable, the project timeframe, and an estimated budget. Following Table 15 is **Table 16**, which estimates the deployment budget of all projects by time period. Following the two tables is **Figure 7**, a diagram that shows the approximate location of each Corridor Project.

The estimated budget is based on UDOT costs for devices and communications, estimates from similar projects in other regions, and existing costs for already implemented systems. The medium- and long-term projects factor in an estimated three percent annual inflation rate, however are considered to be rougher estimates because of potential changes and potential unknowns. For example, the Transit Operation Upgrade project is highly dependent upon the number of transit vehicles used and types of services to be provided in ten years, and those are not known at present. Similarly, costs for the Regional Traffic Control Center and Emergency Operations Center should be viewed as estimates only, because the actual cost depends on the extent of involvement by multiple agencies.

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Dixie Regional Traffic Control Center (TCC)	A new, expanded Traffic Control Center is proposed to replace the existing interim TCC, currently located in St. George City Hall. The new facility will be more technologically advanced and sufficiently large to provide traffic management capabilities for the City of St. George as well as for other cities in the Region, if desired. It is envisioned that the Dixie Regional TCC will have space to accommodate emergency operations, media, meeting facilities and other agencies. Staff would be provided tools to manage the increasing number of traffic signals, increased complexity of traffic control, monitor more traffic cameras, manage incidents, disseminate traveler information and perform other traffic management functions. In addition, the new Center will allow for better information coordination with other agencies, and dissemination to other agencies and the traveling public. The Dixie Regional TCC would be the communication nerve center for the Dixie Region and traffic data collection warehouse. This data could be readily shared with other regional partners and with the UDOT CommuterLink System.	• St. George Public Works • UDOT • Other Cities	Short-term	Regionwide	$6,000,000
Communications Plan	A communications plan will be developed for the Dixie Region. The plan will identify the existing and planned communications that are available for ITS use, and also identify the future needs for communications that are not addressed by the current systems. The plan will provide a blueprint that ensures ITS can be fully utilized as it is deployed.	• Dixie Metropolitan Planning Organization • City of St. George	Short-term	Regionwide	$50,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Emergency Automated Vehicle Location	This project is already underway and in testing. It will equip the Region's emergency vehicles with global positioning system (GPS) equipment that allows them to be tracked and located at the St. George Dispatch Center. The dispatch center will view emergency vehicle locations through their computer-aided dispatch, and be able to use vehicle location as a criteria in selecting responding vehicles. In addition, the dispatch center will be able to direct vehicles based on their location and other traffic information it collects. This project will enhance and be enhanced by the *Dixie Regional Emergency Operations Center Project*, which will give dispatchers and emergency management staff more control and monitoring functionality. It is also dependent upon the *Dixie Regional Traffic Control Center* for traffic images and information.	• City of St. George Police • City of St. George Fire • Washington County Sheriff • Local Public Safety • Dixie Ambulance	Short-term	Regionwide	$1,200,000
Emergency Vehicle Preemption	In this project, emergency vehicles will be equipped with transmitters that allow for direct communication with traffic signal controllers to preempt signals and give approaching emergency vehicles priority. Traffic controllers will be modified or enhanced to allow for signal preemption, and selected intersections will be equipped with receivers to detect approaching emergency vehicles. Key locations for signal preemption are to be determined and a data collection system will be used to monitor usage.	• St. George Fire • Washington County Fire • Local Public Safety • Dixie Ambulance	Short-term	Corridors and Specific Intersections	$1,000,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Trailblazers	Trailblazer signs will be deployed at several I-15 interchanges and other key locations in the Region. The electronic LED signs would normally be blank and fixed messages will be displayed as needed to provide travelers with en-route detour instructions to avoid congestion or incidents. The signs will be controlled by operators at the *Dixie Regional Traffic Control Center* and possibly by UDOT from the Regional or Salt Lake City offices. The trailblazers may also be automatically controlled by field sensors or by traffic controllers, which detect changes in traffic. When lit, the signs give directions or limited information about recurring conditions.	• St. George Public Works • UDOT	Short-term	Regionwide	$470,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
100 South Corridor	This project will enhance the 100 South Street Corridor with the addition of ITS applications to replace the current wireless traffic signal communications and provide additional tools to monitor and detect problems along this important alternate route to St. George Blvd. Fiber optic communications can be installed along the entire route between River Road and Bluff Street, or intersections can be connected to the fiber that has been installed along St. George Blvd. ITS devices may include: CCTV cameras at key intersections, emergency preemption, and trailblazer signs to direct traffic during detours. Cameras will be used for traffic monitoring, incident detection and to allow images to be disseminated to the traveling public. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* It will also later benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• City of St. George Public Works	Short-term	Corridor	$380,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Bluff Street Corridor - Phase 1	Landline communications will be installed along Bluff Street to fill in the communication gaps and provide capability to interconnect all traffic signals within the corridor. This project will enhance the Bluff Street Corridor, from I-15 to north of Snow Canyon Drive, with the addition of ITS applications similar to those described for *100 South Street*. The project includes Landline (fiber optic in conduit) communications, traffic signal interconnect, trailblazer signs, and CCTV surveillance cameras. In particular, ITS elements are needed at or near the Bluff Street / I-15 interchange. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* It will also later benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• City of St. George Public Works • UDOT	Short-term	Corridor	$750,000
Bluff Street Corridor - Phase 2	Communications and ITS devices will be extended north from the end point of Phase 1 and continue to approximately the north boundary of the Dixie Urbanized area. ITS devices expected are similar to those in *Bluff Street Corridor – Phase 1* with CCTV cameras, signal interconnect and, potentially, the addition of a DMS sign.	• City of St. George Public Works	Short-term	Corridor	$1,500,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Southern Parkway Corridor – Phase 1	This project will enhance the planned Southern Parkway from Mile post 2 of I-15 to approximately 3 miles east. Fiber-optic communications will be installed to interconnect traffic signals and communicate with ITS devices. ITS devices could include interconnecting the existing traffic signals, a DMS at the I-15 intersection, and at least two CCTV cameras. Cameras could be used for traffic monitoring, incident detection and to provide images, which can be disseminated to the traveling public via CommuterLink web. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* It will also later benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• St. George Public Works • UDOT	Short-term	Corridor	$1,260,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Southern Parkway Corridor – Phase 2	This project will enhance the planned Southern Parkway from the eastern end of *Southern Parkway Corridor – Phase 1* northeast approximately 12 miles to the intersection with State Route 9. Fiber-optic communications will be installed to interconnect traffic signals and communicate with ITS devices. ITS devices could include interconnecting the existing traffic signals, trailblazer signs, and several CCTV cameras. Cameras could be used for traffic monitoring, incident detection and to provide images, which can be disseminated to the traveling public via CommuterLink web. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* It will also later benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• St. George Public Works • UDOT	Short-term	Corridor	$3,710,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
State Route 9 Corridor	This project will enhance the SR9 Corridor with the addition of ITS applications. Fiber optic or other wireless communications will be installed along the route from the interchange at I-15 at Mile Post 16 to approximately twelve miles east. ITS devices may include: several CCTV cameras at key intersections, traffic sensors, and two DMS to provide travelers with traffic and tourist information. Cameras will be used for traffic monitoring, incident detection and to allow images to be disseminated to the traveling public. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* It will also later benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• UDOT	Short-term	Corridor	$3,400,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Sunset Boulevard Corridor	This project will enhance the Sunset Boulevard Corridor with the addition of ITS applications. Fiber-optic communications is needed between Valley View Drive, near SR-18 and Canyon View Drive (Santa Clara City) to interconnect traffic signals and communicate with ITS devices. ITS along this corridor could include: interconnect of existing traffic signals, trailblazer signs, and CCTV cameras at key intersections. Cameras will be used for traffic monitoring, incident detection, traffic signal monitoring and to generate images of road and travel images that can be disseminated to the public, via CommuterLink or other traffic websites. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* It will also later benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• St. George Public Works • UDOT	Short-term	Corridor	$520,000
CommuterLink Marketing	This project will provide marketing and outreach resources to assist UDOT and Dixie MPO to inform and educate the public, agencies and media on the availability of ITS tools and traveler information. A key component of this project will be ensuring that Dixie-Region traveler information is available through Commuterlink. This project is dependent on the *Computer Aided Dispatch Integration with CommuterLink* project and will benefit from being deployed in conjunction with it.	• Media • St. George Public Works • SunTran • UDOT	Medium-term	Dixie Region	$30,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Computer Aided Dispatch Integration with CommuterLink	This project will provide capabilities for the St. George Dispatch Center to exchange traffic data and incident information with Commuterlink for the Dixie Region. A communication link and software integration will be required for the Dispatch Center to exchange incident data. Commuterlink can then disseminate incident information via 511, a web site and potentially other mediums.	• City of St. George Police • UDOT	Medium-term	Dixie Region	$85,000
Dixie Regional Emergency Operations Center (EOC)	A new, expanded Emergency Operations Center will serve the existing function of call-taking and dispatching and tracking regional emergency vehicles. The facility will provide space to adapt to the Region's anticipated population growth. That growth is expected to increase the types and complexity of response for incidents, threats and disasters. This project will also provide enhancements to the computer-aided dispatch (CAD) system to enable better incident response through improved information collection and exchange. The new facility would have increased space for meetings, media and co-location by other entities. The EOC may potentially be located in the same physical structure as the *Regional Traffic Control Center* in order to enhance information sharing and coordination, and to jointly utilize space for media and meetings.	• City of St. George Police • City of St. George Fire • Washington County Sheriff • Local Public Safety • Utah Highway Patrol • Media	Medium-term	Regionwide	$6,000,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Incident Management Strategies	This project will improve the ability of local agencies to respond to incidents and emergencies through a series of ITS strategies. The strategies include improved information sharing among agencies to plan incident response and coordinate resources. Response plans include managing emergencies, evacuation and emergency information dissemination. This project will benefit from the deployment of the *Dixie Regional Traffic Control Center* and the *Dixie Regional Emergency Operations Center* and should be planned for deployment in conjunction with the latter.	• St. George Public Works • St. George Police • St. George Fire • St. George Maintenance • Local Maintenance • Local Emergency Services • Suntran • UDOT • Utah Highway Patrol • Washington County Maintenance • Washington County Sheriff	Medium-term	Regionwide	$320,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Incident Response Vehicles	This project will deploy mobile units that are able to quickly respond to incidents on the roadways. Typically, the vehicles are equipped to quickly help stranded motorists and move them off roadways so that normal traffic flow can resume. Vehicles may also be equipped with virtual traffic control systems or direct interfaces with the Traffic Control Center that allow them to control signals at an incident location. They may also be equipped with DMS, Highway Advisory Radio and other devices to help disseminate incident information to en-route vehicles. Vehicles may rove or be dispatched to incidents.	• Utah Highway Patrol	Medium-term	Regionwide – state-maintained highways	$250,000
ITS Architecture Update	Due to the rapid growth of the Dixie Region, it is likely that needs and priorities will change in the medium-term. The ITS Architecture Update will reassess the needs of the Region and the progress made in deploying the ITS projects identified in this Plan. It will add, delete and modify the project list and Architecture to reflect the current priorities of the Region.	• Dixie Metropolitan Planning Organization • UDOT	Medium-term	Dixie Region	$75,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Maintenance Coordination	This project will improve the coordination of maintenance activities among stakeholders by creating a system for sharing maintenance and operation schedules. The purpose will be to help each stakeholder better understand the activities in other areas of the Region, and to have the opportunity to coordinate or comment on the schedules of other agencies. It will also provide a coordinated maintenance and construction schedule for transit and travelers. Transit will benefit from this project by having advanced notice of maintenance and construction plans and being able to plan accordingly.	• St. George Maintenance • UDOT • Local Maintenance • Washington County Maintenance • Media • Suntran	Medium-term	Dixie Region	$120,000
700 South Corridor	This project will enhance the 700 South Street Corridor with the addition of ITS applications similar to those described for *100 South Corridor*. The 700 South project, between Bluff Street and River Road, would include fiber-optics to replace the wireless infrastructure and improve reliability and performance of communications to existing traffic signals. Wireline communication would provide additional bandwidth to allow real-time traffic signal monitoring, deployment of CCTV cameras, trailblazer signs, and traffic monitoring sensors. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* It will also later benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• City of St. George Public Works	Medium-term	Corridor	$450,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
I-15 ITS – Phase 1	This project will expand the use of ITS on I-15, primarily between Exits 4 and 10, but could include expansion of ITS beyond these limits. ITS along I-15 would provide tools to monitor traffic conditions, manage incidents and provide timely traveler information to drivers. To accomplish this, fiber optic communications would need to be installed along I-15 in the St. George Metropolitan area and beyond as needed. The fiber communication would provide sufficient bandwidth to transmit real-time video, communicate with Dynamic Message Sign (DMS), and provide real-time traffic conditions from traffic monitoring sensors. South of Bluff Street, fiber optic cable will be installed to allow for signal interconnect at the interchanges. ITS devices that can be installed may consist of DMS, CCTV surveillance cameras and traffic monitoring sensors. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* The UDOT Traffic Operations Center in Salt Lake City and Regional Traffic Operations Center in Richfield will also be directly involved in this project.	• St. George Public Works • UDOT	Medium-term	Interstate Corridor	$3,560,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
I-15 ITS – Phase 2	This project will expand ITS deployment beyond the Corridor of Exit 4 to 10 as described in Phase 1. as in Phase 1, fiber optic communications will need to be installed along I-15 as needed. ITS devices planned for the second phase include CCTV cameras and DMS, potentially including one north of the St. George area, and one near the Arizona border. Other devices may include traffic monitoring sensors and highway advisory radio. This project will benefit from being deployed in conjunction with, or after, the *I-15 ITS – Phase 1*, *Dixie Regional Traffic Control Center* and the *Dixie Regional Emergency Operations Center*. The UDOT Traffic Operations Center in Salt Lake City and Regional Traffic Operations Center in Richfield will also be directly involved in this project.	• St. George Public Works • UDOT	Medium-term	Interstate Corridor	$5,050,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Northern Parkway Corridor – Phase 1	This project will enhance the planned Northern Parkway from Mile post 16 of I-15 to approximately 3 miles west. Fiber-optic communications will be installed to interconnect traffic signals and communicate with ITS devices. ITS devices could include interconnecting the existing traffic signals, a DMS at the I-15 intersection, and at least two CCTV cameras. Cameras could be used for traffic monitoring, incident detection and to provide images, which can be disseminated to the traveling public via CommuterLink web. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* It will also benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• St. George Public Works	Medium-term	Corridor	$1,500,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Red Hills Parkway	This project will provide ITS devices along this important alternate route from SR-18 to Green Spring Drive (near I-15 Exit 10) Fiber optic will be installed in the Corridor. CCTV camera surveillance, a DMS and traffic sensing equipment will be deployed as this route is expanded and as drivers utilize it to avoid congestion in other corridors. Red Hills Parkway is now the primary route to destinations east of St. George for many residents located west of the City. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center*. It will also benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• St. George • UDOT	Medium-term	St. George	$1,630,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Red Cliffs Drive Corridor	This project will incorporate ITS for the approximately two-mile section of Red Cliffs Drive, parallel to I-15 between Exits 8 & 10. ITS elements would be extended from St. George Blvd to Telegraph Street. Traffic signal interconnect, CCTV, traffic sensors, trail blazer signs and pre-emption equipment may be deployed along this route. Potentially, communications along I-15 could be used to link ITS elements on Red Cliffs Drive, since they are located in close proximity to each other. The current time-based signal timing of the traffic signals could be replaced with real-time monitoring and control through interconnect to central traffic control system. TCC staff would have ability to implement incident timing plans, if and when I-15 is closed due to incidents and other capacity reducing events. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* It will also benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• St. George • UDOT	Medium-term	Corridor	$660,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
River Road Corridor	This project will enhance the River Road Corridor with the addition of ITS applications between Riverside Drive and St. George Blvd. Fiber-optic communications should be installed to interconnect traffic signals and communicate with ITS devices. ITS devices could include interconnecting the existing traffic signals, trailblazer signs to direct traffic during detours, and CCTV cameras at key intersections. Cameras could be used for traffic monitoring, incident detection and to provide images, which can be disseminated to the traveling public via CommuterLink web. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center.* It will also benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• St. George Public Works	Medium-term	Corridor	$450,000
Snow Canyon Parkway Corridor	This project will incorporate ITS along Snow Canyon Drive from Bluff Street (SR-18) to the City of Ivins. Some conduit is already in place and additional conduit is included in a current federally-funded project. Altogether, approx. 1.5 miles of conduit will be in place after current projects are completed. This corridor will require remaining conduit and fiber to be installed, installation of CCTV for surveillance, placement of DMS at strategic locations and traffic sensing equipment.	• Ivins • St. George • UDOT	Medium-term	Corridor	$1,780,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Western Parkway Corridor – Phase 1	This project will incorporate ITS for the short section of the Western Parkway between Snow Canyon Parkway and Sunset Boulevard. The project will include fiber optic connection of traffic signals, traffic sensors and at least one CCTV camera. This project will benefit from being deployed in conjunction with, or after, the *Dixie Regional Traffic Control Center*. It will also benefit from coordination with the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• St. George	Medium-term	Corridor	$620,000
Western Parkway Corridor – Phase 2	This project will incorporate ITS for the section of the Western Parkway from Sunset Boulevard south to I-15 at Exit 2. The project will include fiber optic connection of traffic signals, traffic sensors, DMS at the I-15 interchange, and several CCTV cameras. This project will benefit from being deployed in conjunction with, or directly after, the *Dixie Regional Traffic Control Center* and the *Dixie Regional Emergency Operations Center* in order to feed data and images to traffic control and emergency responders regarding on-street conditions.	• St. George • UDOT	Medium-term	Corridor	$940,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Weather Warning System	This project would enhance the communications and weather monitoring systems needed to provide early warning of road and bridge flooding to the *Dixie Regional Traffic Control Center*s and emergency response agencies. Enhanced flood monitoring and other meteorological sensors, such as precipitation gauges, wind speed and temperature can be strategically placed to provide accurate, real-time information for traffic operations, meteorologists and other emergency response personnel. Some sensor data could be used to automatically trigger alarms or warning signs.	• St. George • UDOT • Local Emergency Services	Long-term	Corridor	$130,000
Northern Parkway Corridor – Phase 2	This project will expand ITS deployment on the planned Northern Parkway from the western endpoint of *Phase 1* approximately three miles to the intersection of Red Hills Parkway. Fiber-optic communications will be installed to interconnect traffic signals and communicate with ITS devices. ITS devices could include interconnecting the existing traffic signals and at least two CCTV cameras. Cameras could be used for traffic monitoring, incident detection and to provide images, which can be disseminated to the traveling public via CommuterLink web. This project will benefit from being deployed after *Phase 1*, the *Dixie Regional Traffic Control Center* and the *Dixie Regional Emergency Operations Center*.	• St. George Public Works	Long-term	Corridor	$935,000

Table 15: Potential Dixie Regional ITS Projects

Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cost
Regional Traveler Information	This project will improve the ability of the Region to disseminate traveler information to commuters and visitors about all available modes. It will improve information regional collection for both local and state roads, such as traffic congestion, delays, maintenance and construction plans, recreational facility availability transit schedules, traffic images and speeds. The project will identify means for consolidating the information and disseminating it through a variety of regional and statewide methods, including 511, web sites, DMS and kiosks. The project is intended to improve traffic flow by providing travelers with better information and to simplify travel decisions for visitors. This project will benefit from the prior deployment of the *Dixie Regional Traffic Control Center*.	• St. George Public Works • UDOT • Media • Suntran	Long-term	Regionwide	$450,000
Telegraph Street Corridor	This project would incorporate ITS along Telegraph Street (SR-212) from I-15 to beyond 300 East. This is another corridor where traffic volumes are increasing, creating a need for improved signal coordination. An environmental assessment is currently being prepared for a section of Telegraph Street between 500 West and 300 East. This project includes traffic systems management strategies, such as ITS. Conduit, fiber-optic communications, CCTV surveillance, DMS, HAR and traffic sensing equipment are all ITS elements that are applicable for this project.	• Washington • St. George • UDOT	Long-term	Corridor	$450,000

Table 15: Potential Dixie Regional ITS Projects

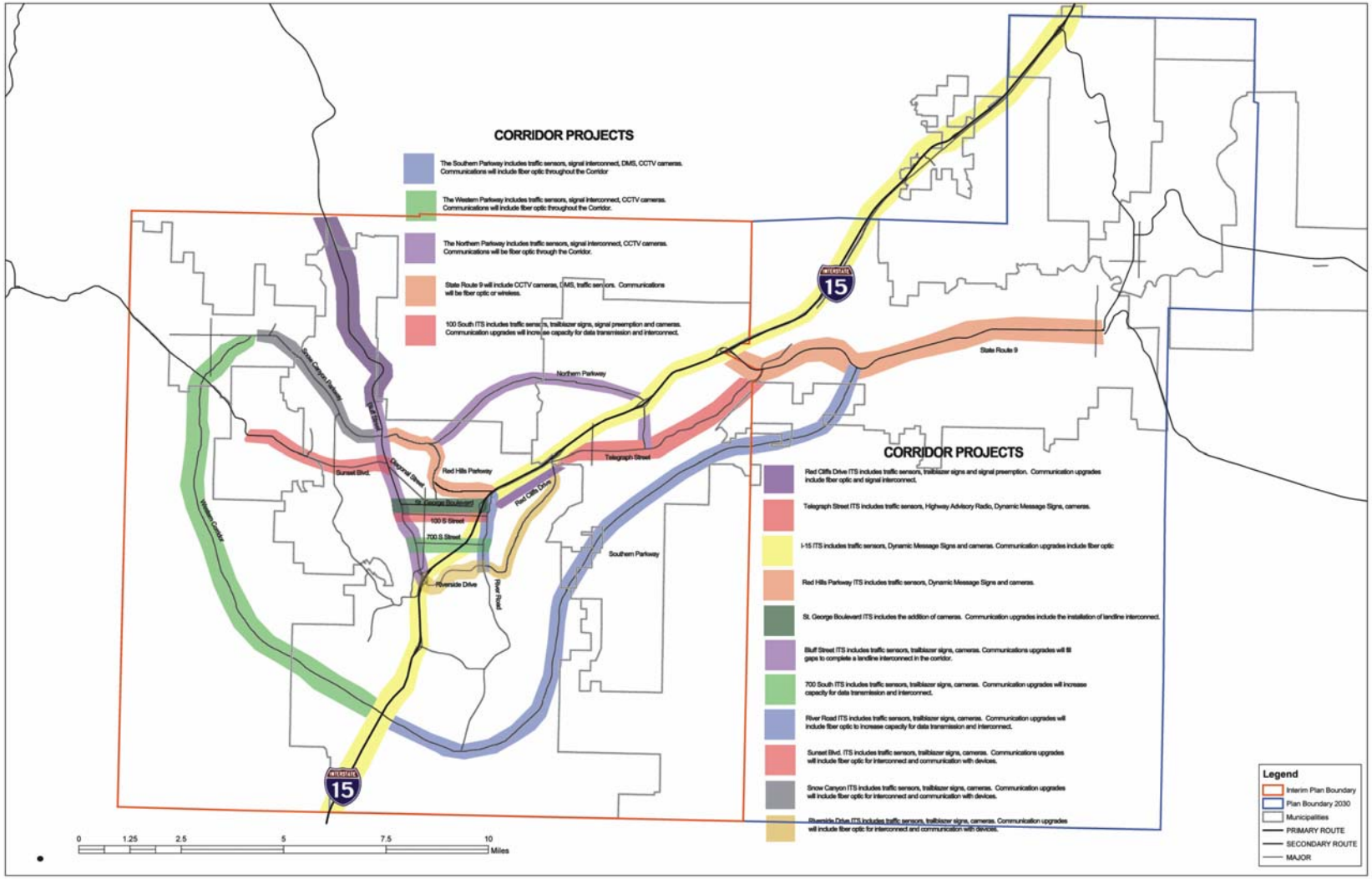
Project Name	Description	Stakeholders	Timeframe	Geographic Scope	Estimated Cos
Transit Operations Upgrade	This project provides the capability to track vehicle location and improve the ability to develop routes and schedules. For paratransit, upgraded software allows for more efficient scheduling that can reduce vehicle miles traveled and increase the number of trips provided. Upgrades may also include improved reporting functions that automate many accounting and national reporting requirements, which will reduce administrative staff efforts in those areas. This project will also provide SunTran the ability to track transit vehicle locations. The location data may be used to determine schedule adherence and update the transit system's schedules in near-real-time for both fixed route and paratransit service. For paratransit, the information may also be used to do dynamic trip routing by identifying the location of vehicles relative to newly requested trips. Other transit ITS services that may be developed during this project are enhanced transit security via monitoring and tracking, and fare management using "smart" card technology.	• SunTran	Long-term	St. George	$1,200,000

The total estimated cost for ITS deployment in the Dixie Region is $46,925,000. **Table 16** summarizes the total cost by time period.

Table 16: Estimated ITS Project Costs by Time Period

Time Period	Estimated Total Budget	Number of Projects
Short- term (0-5 years)	$20,240,000	12
Medium-term (5-10 years)	$23,520,000	17
Long-term (10+ years)	$3,165,000	5

Figure 7: Corridor ITS Projects in the Dixie Region



11.0 PROJECT FUNDING

ITS projects may be eligible for funding from a variety of sources, including some specifically for the deployment of advanced technologies. ITS projects should also compete for existing transportation funds with other transportation projects, such as road-widening and expansion. **Table 17** lists the ITS projects identified for the Dixie Region, and summarizes the funding resources they may qualify for. For each project, a black dot (●) indicates a funding source that may be available to fund at least a portion of the project. However, the available funding sources may be limited in their eligibility for a specific project.

For example, The *Regional Traffic Control Center* project indicates a number of different funding sources. Local emergency funds may be used to the extent that the center assists in incident and emergency management by providing images, incident detection and is able to disseminate emergency traveler information. Local emergency funds are not expected to be a source of funds for functions that do not directly benefit the local emergency community.

Following **Table 17** is a brief description of each potential funding source.

Table 17: Potential Project Funding Sources

Project Name	Locally Administered			State Administered		Federally Administered		
	Local Transportation Funds	MPO STP Funds	Local Emergency Funds	UDOT STIP Funds	ITS Earmark Funds	Homeland Security	Federal Highway Funds	Federal Transit Funds
Dixie Regional Traffic Control Center (TCC)	●	●	●	●	●		●	
Emergency Automated Vehicle Location			●			●		
Emergency Vehicle Preemption	●		●					
Bluff Street Corridor - Phase 1	●	●			●			
Bluff Street Corridor - Phase 2	●	●			●			
100 South Corridor	●	●			●			
State Route 9 Corridor				●	●			
Sunset Boulevard Corridor	●	●		●	●			
Southern Parkway Corridor – Phase 1	●	●			●			
Trailblazers	●	●		●	●			
Southern Parkway Corridor – Phase 2	●	●			●			
Communications Plan	●	●	●		●			
Dixie Regional Emergency Operations Center (EOC)	●	●	●		●	●		
700 South Corridor	●	●			●			
I-15 ITS – Phase 1				●	●		●	
Red Hills Parkway	●	●			●			

Table 17: Potential Project Funding Sources

Project Name	Locally Administered			State Administered		Federally Administered		
	Local Transportation Funds	MPO STP Funds	Local Emergency Funds	UDOT STIP Funds	ITS Earmark Funds	Homeland Security	Federal Highway Funds	Federal Transit Funds
I-15 ITS – Phase 2				●	●		●	
Incident Management Strategies	●	●	●		●			
Incident Response Vehicles				●	●		●	
River Road Corridor	●	●			●			
Computer Aided Dispatch Integration with CommuterLink		●	●	●		●		
CommuterLink Marketing	●	●		●	●			●
Maintenance Coordination	●	●			●			
Northern Parkway Corridor – Phase 1	●	●			●			
Snow Canyon Parkway Corridor	●	●			●			
Western Parkway Corridor – Phase 1	●	●			●			
Red Cliffs Drive Corridor	●	●			●			
ITS Architecture Update	●	●		●	●		●	●
Northern Parkway Corridor – Phase 2	●	●			●			
Western Parkway Corridor – Phase 2	●	●			●			

Table 17: Potential Project Funding Sources

Project Name	Locally Administered			State Administered		Federally Administered		
	Local Transportation Funds	MPO STP Funds	Local Emergency Funds	UDOT STIP Funds	ITS Earmark Funds	Homeland Security	Federal Highway Funds	Federal Transit Funds
Regional Traveler Information	●	●	●	●	●	●	●	●
Transit Operations Upgrade	●	●						●
Telegraph Street Corridor	●	●			●			
Flood Warning	●	●	●		●			

Local Transportation Funds – These funds are administered for transportation projects, including maintenance and operations, at the local level. The funds may come from a range of sources, including local tax revenue, but are administered at the discretion of local agencies such as the cities and Washington County.

MPO STP Funds – The Dixie MPO conducts and manages long-range plans and TIPs. Federal Funds are appropriated annually, by formula, to Urbanized Areas such as the Dixie Region, including Surface Transportation Funds, and Public Transit Funds. The MPO manages an approved project development process for the metropolitan area and calls for submittal of proposed projects annually. Those project concept reports are reviewed and prioritized by the Dixie MPO and incorporated by the State Transportation Commission as part of their STIP.

Local Emergency Funds – These funds are administered at the local level for emergency management projects, including ongoing maintenance and operations. Similar to local transportation funds, they may come from a range of sources but are administered at the discretion of local agencies.

Utah STIP Funds – The STIP is a five-year plan of highway and transit projects for the state of Utah. The STIP is published every year and includes transportation projects on the state, city, and county highway systems, as well as projects in the national parks, national forests, and Indian reservations. These projects use various federal and state funding programs. The STIP serves two basic purposes:

1. The STIP documents Utah's compliance with the requirements of the Transportation Equity Act for the 21st Century (TEA-21) and it is the basis for approval of federal-aid highway and transit funds by the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA).
2. The STIP is UDOT's official work plan for the development of projects from conception through environmental studies, right of way acquisition, planning, and advertising for construction.

ITS Earmark Funds – Earmarks are federal funds that are administered by UDOT, and applied for by UDOT. Local agencies work with UDOT to apply for earmark funds. Earmark funds may be subject to limitations, such as the purpose and project defined in the federal application, and matching local or state funds. Some Short-term projects may not be eligible for earmarks because they are planned for deployment sooner than an earmark can be applied for and designated.

Homeland Security – Homeland Security funds are administered by the Federal Department of Homeland Security. To date, they have infrequently been disbursed to regional transportation projects. However, as security and transportation management become more integrated in Traffic Control Centers and Emergency Operations Center, it is possible that more funds will be used to support coordinated emergency management.

Federal Highway Funds – Federal Highway Funds are comprised of several potential sources that are administered at the national level. They may include matching funds, grants, and other sources, such as operational test or model deployments. In order for these funds to be used for ITS, an Architecture must be in place. This project addresses the federal Architecture requirement.

Federal Transit Funds – Transit funds administered by the Federal Transit Administration (FTA) can come in the form of grants, matching funds, disbursement of other transit funds, or special monies for specific projects. In recent history, the FTA has made rural and small urban transit systems a priority and allocated significant funds for transit technologies through grant applications and model deployments. Similar to FHWA funds, an ITS Architecture must be in place before FTA funds can be spent on transit ITS projects.

12.0 AGENCY AGREEMENTS

Agreements among the various Stakeholder agencies and organizations in the Dixie Region are required to fully achieve the ITS integration proposed in the Regional ITS Architecture. Each interconnection between systems owned by different Stakeholders represents a potential requirement for an agreement, whether it is a simple handshake or a more formal agreement.

Typically, existing Stakeholder agreements that support information sharing, funding, or specific ITS projects are reviewed and assessed to determine if they can be extended and used to support the cooperative implementation and operation of additional ITS in the Region. A list of needed agreements is provided later in **Table 19**.

Documented agreements will aid the Dixie Regional Stakeholders in planning their operational costs, understanding their respective roles and responsibilities, and in building relationships for future projects. Formal agreements are necessary where funding or financial arrangements are defined or participation in large regionally significant projects is required.

The list of required ITS-related agreements was developed based on the regional operational concepts (roles and responsibilities), the types of ITS existing or planned for the Region, and the information that needs to be exchanged in order to operate those systems.

12.1 Types of Agreements

There is considerable variation between regions and among Stakeholders regarding the types of agreements that are created to support ITS integration. The types of agreements used will be determined by the "lead agency" for a given project. The lead agency is the organization that is overseeing and/or managing the implementation of a specific service or project in the Region. That agency's policies and procedures will usually dictate the types of agreements used for implementing various projects.

The FHWA Regional ITS Architecture Guidance Document presents some common types of agreements, as described in **Table 18**.

Table 18: Agreement Types

Type of Agreement	Description
Handshake Agreement	• Early agreement between one or more partners. • Not recommended for long term operations.
Memorandum of Understanding (MOU)	• Initial agreement used to provide minimal detail and usually demonstrating a general consensus. • Used to expand a more detailed agreement like an Interagency Agreement which may be broad in scope but contains all of the standard contract clauses required by a specific agency. • May serve as a means to modify a much broader Master Funding Agreement, allowing the master agreement to cover various ITS projects throughout the Region and the MOUs to specify the scope and differences between the projects.
Interagency Agreement	• Between public agencies (e.g., transit authorities, cities, counties, etc.) for operations, services or funding. • Documents responsibility, functions and liability, at a minimum.
Intergovernmental Agreement	• Between governmental agencies (e.g., Agreements between universities and State DOTs, MPOs and State DOTs, etc.).
Operational Agreement	• Between any agency involved in funding, operating, maintaining or using the right-of-way of another public or private agency. • Identifies respective responsibilities for all activities associated with shared systems being operated and / or maintained.
Funding Agreement	• Documents the funding arrangements for ITS projects (and other projects). • Includes at a minimum standard funding clauses, detailed scope, services to be performed, detailed project budgets, etc.
Master Agreements	• Standard contract and / or legal verbiage for a specific agency and serving as a master agreement by which all business is done. These agreements can be found in the legal department of many public agencies. • Allows states, cities, transit agencies, and other public agencies that do business with the same agencies over and over (e.g., cities and counties) to have one Master Agreement that uses smaller agreements (e.g., MOUs, Scope-of-Work and Budget Modifications, Funding Agreements, Project Agreements, etc.) to modify or expand the boundaries of the larger agreement to include more specific language.

12.2 Agreement Focus

Rather than focus on a specific technology, an agreement's focus usually is on the scope-of-service and specific agency responsibilities for various components of the service. The agreement should also describe the high-level information that each agency needs to exchange in order to meet the goals and expectations of the other, rather than attempting to define precisely how the delivery of that information will occur.

A simple handshake agreement may be enough for some Dixie Regional ITS activities and in many instances this has been an effective agreement for operations between/among agencies. However, if there is a Federal grant or earmark for funds, there

will be agreements between the FHWA and UDOT that will administer the funds. There are also agreements between the UDOT and whichever lead agency develops, implements and/or oversees the implementation of a particular project. Once interconnections and integration of systems begins, agencies may want to develop more detailed agreements in order to document how operations will occur, who will maintain the system, and other issues regarding the management of the integration and data sharing.

12.3 Potential Agreement Issues To Consider

There are a number of concerns and / or issues that typically arise when developing agreements between / among public agencies. Challenges associated with development of any agreement in a region; even a Memorandum of Understanding (MOU) can extend the timeframe for building consensus and eventual deployment. There are institutional issues that cannot be solved by technology and therefore may take more energy and a focused approach to address. Some common issues are:

- Often, each agency has its own boilerplate standard agreement that is unique to its own organization. When combining signatures of numerous agencies into one agreement, there is always the question of whose standard agreement should be used – if any – from the participating Stakeholders.

- Typically, each agency's standard agreement has been reviewed and approved by its own legal counsel. So, all other participating agencies, other than the originating agency, must have their own legal counsel review new contracts. This can often take several months.

- Busy schedules. The level of management that has the authority to execute an agreement on behalf of an agency is usually very high in the organization. The workload for such a manager is usually substantial and he or she may have many and varied responsibilities, – not just the one overseeing traffic operations. There have been instances in other parts of the country where a draft agreement has sat on the desk of a reviewing manager or attorney for more than a year. Meanwhile, without a formal agreement or guidance for the project, technologies, personnel and project strategies change and the draft agreement is no longer reflective of the original operational intent of the project. New roles and responsibilities may have been conceived. After delays, the scope of work portion of the agreement may have to be developed again from scratch.

- Change in agency management and/or elected officials. If an agreement takes a long time to get through legal counsel and management review a project can lose momentum, or worse, the support of new managers and elected officials.

- Development of agreements must be closely coordinated between/among multiple departments within each agency. For example, a procurement

department may be charged with developing an agreement for public works. These two departments must have smooth and open communications to coordinate and execute a well-written, concise agreement.

There are other challenges in developing agreements but these are the most common. Following are some keys to success that can be followed to efficiently develop solid agreements between/among agencies:

- Carefully consider the organizational level of management that will be required to execute the agreement. Obviously, the knowledge and blessing of upper-level management is highly recommended to achieve full success within the organization. However, if gaining the attention of upper-level management for agreement approval is problematic it may be wise to keep the level of signature authority needed for an agreement at a lower level of management. Especially for agreements that govern the initial development of project concepts and operational concepts.

- Closely related to the level of manager required to execute an agreement, is the selection of the type of agreement itself. Typically, the type of agreement selected will dictate the signature authority required to execute the agreement. Using an MOU for developing consensus is usually a much easier path than a more formalized Interagency Agreement – less authority but documents agreement. This is especially true, again, for developing those initial agreements that direct the initial development of project concepts and operational concepts.

- Strong, focused leadership. Most issues can be resolved by having a strong, compact overview team or committee that works together to develop and circulate agreements. This committee needs to have representative(s) from each Stakeholder. If there is a strong consensus building team and the leader of that team has the ability and the access to management at high enough levels within each Stakeholder agency to get the task of agreements successfully executed; regional integration can be more efficiently obtained.

12.4 List of Agreements

The Dixie Region has limited ITS integration and, therefore, limited agreements covering data exchange among ITS elements. However, there is a substantial amount of trust and interaction among Stakeholders that built from the mutual cooperation and experience of agencies working together. The trust and existing relationships are a firm foundation that ITS integration agreements can be formed upon.

Table 19 presents a list of agreements assumed and needed for implementation of existing and planned projects. Each entry is first categorized by the ITS project. Then the involved Stakeholders, the type of agreement that is anticipated, and a description of

the purpose of the agreement are identified. It should be noted that projects with only a single Stakeholder are not included.

Table 19: List of Agreements

ITS Project(s)	Involved Stakeholders	Type of Agreement(s)	Agreement Description
Regional Traffic Control Center	• City of St. George • UDOT • Other cities	• MOU	An MOU will be necessary in the planning and development stage of this project to verify the roles of various agencies, and to document the interest of other cities to participate in a Regional TCC. During the specific project planning, other agreements may be required, including interagency, funding and master agreements.
Communications Plan	• Dixie MPO • City of St. George • UDOT	• Handshake Agreement	A handshake agreement will effectively address the need for sharing plans and needs for communication infrastructure during this planning project.
CommuterLink Marketing	• Media • St. George Public Works • SunTran • UDOT	• Handshake Agreement – or – • MOU • Interagency Agreement	UDOT may have a standard agreement in place for the use of--and importing information into--CommuterLink. If so, that agreement should be reviewed by local agencies and modified as needed to suit local requirements.
Computer Aided Dispatch Integration with CommuterLink	• City of St. George Police • UDOT	• Handshake Agreement – or – • MOU • Interagency Agreement	UDOT may have a standard agreement in place for the use of and importing information into CommuterLink. If so, that agreement should be reviewed by local agencies and modified as needed to suit local requirements.
Corridor Projects	• St. George Public Works • UDOT • Other Cities	• MOU • Interagency Agreements	The agreements necessary for corridor planning and deployment may also be covered under the Traffic Control Center agreements. Corridor agreements will define how each Stakeholder expects the corridor to be operated and maintained, as well as, defining the hierarchy of control of devices in the corridor. Interagency Agreements will be used for corridors that cross jurisdictional boundaries, or have devices from more than one agency with shared control within them.

Table 19: List of Agreements

ITS Project(s)	Involved Stakeholders	Type of Agreement(s)	Agreement Description
Dixie Regional Emergency Operation Center (EOC)	• City of St. George Police • City of St. George Fire • Washington County Sheriff • Local Public Safety • Utah Highway Patrol • Media	• MOU	Similar to the Regional Traffic Control Center, an MOU will be required initially to define the roles, responsibilities and requirements of all EOC Stakeholders. During the design and detailed planning for a center, additional agreements should be identified. They may include interagency, funding and master agreements.
Emergency Automated Vehicle Location	• City of St. George Police • City of St. George Fire • Washington County Sheriff • Washington County Fire • Local Public Safety • Dixie Ambulance	• Interagency Agreement • Operational Agreement	The agreements required for this project will likely be between the City of St. George Police and the other entities, because each will utilize the tracking services established at the St. George Dispatch, but will potentially own their own equipment aboard vehicles. Existing agreements used by the Dispatch Center may be modified.
Emergency Vehicle Pre-emption	• City of St. George Public Works • UDOT • City of St. George Fire • Washington County Fire • Local Public Safety • Dixie Ambulance	• MOU	The agreement will clearly define the roles and responsibilities of each agency, as well as what constitutes proper use or abuse of signal preemption, and the potential penalties for abuse.
Weather Warning System	• City of St. George Public Works • UDOT • Local Emergency Services	• MOU	The roles and responsibilities for Flood Warning will most likely be covered by the agreements created for other projects. In particular, the CommuterLink Marketing Project will address the relationship between St. George and UDOT, while Incident Management Strategies should address the required agreements among local agencies.

Table 19: List of Agreements

ITS Project(s)	Involved Stakeholders	Type of Agreement(s)	Agreement Description
Incident Management Strategies	• City of St. George Public Works • City of St. George Police • City of St. George Fire • City of St. George Maintenance • Local Maintenance • Local Emergency Services • Suntran • UDOT • Utah Highway Patrol • Washington County Maintenance • Washington County Sheriff	• MOU • Operational Agreement	During planning and design, an MOU can help to solidify the roles of each Stakeholder. During deployment and operation, an Operational Agreement will clearly define the roles and responsibilities of each agency, including the relationship between the operator of the central system that houses incident and resource information and the other agencies.
ITS Architecture Update	• Dixie MPO • UDOT	• Handshake Agreement	The updating of the ITS Architecture can be funded by a single source, and a handshake agreement will suffice to define the roles and responsibilities of local agencies in the update process.
Maintenance Coordination	• St. George Maintenance • UDOT • Local Maintenance • Washington County Maintenance • Media • Suntran	• MOU	Similar to Incident Management Strategies, an MOU will serve the purpose of defining each Stakeholder's role in the planning and design of ITS systems to coordinate maintenance activities. An Operational Agreement may be needed once a system is deployed and in use.
Regional Traveler Information	• City of St. George Public Works • UDOT • Media • Suntran	• MOU	The MOU can be used to more clearly define the relationship of UDOT and local entities in using CommuterLink to broadcast traveler information for the Region. In addition, it can be used to define the role of media in collecting and broadcasting traveler information.

13.0 ARCHITECTURE MAINTENANCE

The Dixie Regional ITS Architecture should be modified as plans and priorities change, ITS projects are implemented, and the region's ITS needs and services evolve. The Architecture was developed with a time horizon that extends somewhere beyond ten-years. With ITS planning it is difficult and unnecessary to be more exacting beyond the ten year time frame due to the inherent uncertainty of advancing technology. As the Architecture is updated, this timeframe will be extended appropriately as planned projects are deployed and new projects are identified. The goal of maintaining the Architecture is to keep an up-to-date Regional ITS Architecture accessible as a guide for deploying ITS in the Dixie Region.

The key aspects of the ITS Architecture maintenance process that will modify and change the Architecture in a consistent manner are defined in this section:

- Maintenance responsibility
- Maintenance elements
- Update frequency
- Identifying needed Architecture changes
- Change Management Process

13.1 Responsibility for Maintaining the Regional ITS Architecture

Just as a group of Stakeholders helped develop the ITS Architecture, Stakeholders play a role in the on-going maintenance. Changes can arise from many sources, and it is likely that some may come from sources outside the agency responsible for maintaining the Architecture. For these reasons, it is recommended that a group of Stakeholders representing a range of areas and technological expertise be involved in the Architecture maintenance. Agency representatives on this Architecture Maintenance Team would be responsible for facilitating Architecture updates, either by making use of technical expertise at one agency or another or by contracting for that expertise.

The Maintenance Team should make decisions together with input from other regional Stakeholders, as needed. Resulting changes to the Architecture should be made on a consensus basis. Within the Maintenance Team, it is recommended that one agency be identified to take the lead responsibility for maintaining the Regional Architecture. The proposed candidate for lead agency is the Dixie MPO, within the Five County Association of Governments. The MPO has informally agreed to assume this role, however, this assignment should be formally agreed upon by the Architecture Steering Committee.

13.2 What is Maintained in the Architecture

The parts of a Regional ITS Architecture to be maintained are collectively referred to as the "baseline" Architecture. This section considers the different parts of the Regional ITS Architecture and whether they should be a part of the maintained baseline.

Description of Region. This description includes the geographic scope, functional scope and Architecture timeframe, and helps frame each of the following parts of a Regional ITS Architecture. Geographic scope defines the spatial boundaries that determine what ITS elements are in the Region, although additional ITS elements outside the Region may need to be described if they communicate ITS information to elements inside the Region. Functional scope defines the services that are included in a Regional ITS Architecture. Architecture timeframe is the duration (in years) into the future that the Regional ITS Architecture considers. It is anticipated that the Dixie Urbanized Area will change significantly as a result of population growth, and the resulting description in the Architecture should reflect that change.

List of Stakeholders. Stakeholders are critical to the definition of the Architecture. Within a region, they may consolidate, grow or separate, and such changes should be reflected. Also, different projects under the purview of a single agency may necessitate that the agency be represented as more than one Stakeholder. In addition, Stakeholders that have not been engaged in the past may be approached through outreach to be sure that the Regional ITS Architecture represents their ITS requirements as well. The Stakeholders are described in the Architecture documentation and are also listed in the Turbo database representing aspects of the Regional ITS Architecture. Their listings and descriptions should be part of the baseline and, as such, should be reviewed and updated in the maintenance process.

Operational Concepts. It is important that the operational concepts (which are represented as roles and responsibilities) in a Regional ITS Architecture accurately represent the consensus vision of how the Stakeholders want Regional ITS to operate for the benefit of surface transportation users. These should be reviewed and, if necessary, changed to represent what has been deployed (which may have been shown as "planned" in the earlier version of the Regional ITS Architecture). Many of the remaining maintenance efforts will depend on the outcome of the changes made to the operational concepts. They are contained in the documentation and Turbo database and should be considered part of the baseline.

List of ITS Elements. The ITS inventory is an important part of the Regional ITS Architecture. Changes in Stakeholders as well as operational concepts may impact the inventory of ITS elements. Furthermore, recent implementation of ITS elements may change the individual status (e.g. from planned to existing). The list of elements is contained in the Architecture documentation and the Turbo database. The list of ITS elements should be part of the Architecture baseline.

List of Agreements. One of the greatest values of a Regional ITS Architecture is to identify where information crosses agency boundaries, which may indicate a need for a formal agreement between the respective agencies. An update to the list of agreements typically and most logically follows an update to the operational concepts and/or interfaces between elements.

Interfaces between Elements (interconnects and information flows). Interfaces between elements are the details of the Architecture. They describe how various ITS elements are or will be integrated throughout the timeframe of the Architecture. These details are contained in the Turbo database. They are a fundamental part of the Architecture baseline, and one that will likely see the greatest amount of change during the maintenance process.

System Functional Requirements. High-level functions are allocated to ITS elements as part of the Regional ITS Architecture. These can serve as a starting point for the functional definition of projects that map to portions of the Regional ITS Architecture. These details are contained in the Architecture documentation and Turbo database and should be part of the baseline.

Applicable ITS Standards. The selection of standards depends on the information exchange requirements. The maintenance process should consider how ITS standards may evolve and mature since the last update, and consider how any change in the national standards development process may impact previous regional standards choices (especially where competing standards exist). For example, if eXtensible Markup Language (XML) based Center-to-Center standards reach a high level of maturity, reliability and cost-effectiveness, then a regional standards technology decision may be made to transition from other standards to XML. The description of the standards environment for the Region, as well as the details of which standards apply to the Architecture, are in the Architecture documentation as well as the Turbo database, and should be part of the baseline.

Project Sequencing. While project sequencing is partly determined by functional dependencies (e.g. “surveillance” must be a precursor to “traffic management”), the reality is that for the most part, project sequences are local policy decisions. Project sequences should be reviewed to make sure that they are in line with current policy decisions. Furthermore, policy makers should be informed of the sequences, and their input should be sought to bring the project sequences in line with their expectations. This is crucial to avoid having the Regional ITS Architecture become irrelevant. The project sequencing is included in the Architecture documentation and is part of the Architecture baseline.

13.3 Architecture Update Frequency

Minor updates to the Architecture, such as updating a project status from "Planned" to "Existing", or adding CCTV cameras to a roadway project should be done as needed. In

the Dixie Region, the Architecture can be visited approximately once a year to make minor changes.

It is recommended that a more formal and involved update process be linked to the regional transportation budget planning processes. The MPO Long-Range Plan undergoes formal updates every four years, and the Architecture should also simultaneously undergo major modifications. This helps encourage the mainstreaming of the Architecture and ITS into the regional planning process. It also ensures that the ITS Architecture continues to accurately represent the Region.

The operational concepts, system functional requirements, project sequencing list, and the list of agency agreements represent high-level views of the Architecture and do not necessarily need to be modified each time a revision is made. However, these documents will be modified as the Architecture broadens to address new needs and services, add new Stakeholders to the Region, or on an as-needed basis.

In summary, the Architecture Maintenance Team should determine the timing for modifications to be submitted for inclusion into the Regional ITS Architecture but it is anticipated that, based on the schedule for updating planning documents, there will be minor updates annually with a major update to occur in a four-year cycle with the Region's long-range plan.

13.4 Identifying Needed Architecture Changes

The Dixie Regional ITS Architecture is being created as a consensus view of the ITS elements currently implemented in the Region and the systems planned for the future. The Architecture must be updated to reflect changes resulting from project implementation or resulting from the transportation planning process itself. There are many actions that may cause a need to update the Architecture, as described here:

Changes in Project Definition. When formally defined during procurement and deployment, a project may add, subtract or modify elements, interfaces, or information flows from the Regional ITS Architecture. Because the Architecture is meant to describe not only ITS planned for the Region, but also the current ITS implementations, it should be updated to correctly reflect projects as they are deployed.

Changes for Project Addition/Deletion. Occasionally a project will be added, deleted or modified during the planning process. When this occurs, the aspects of the Architecture associated with the project must be added, deleted or modified.

Changes in Project Status. As projects are deployed, the status of the Architecture elements, services, and flows that are part of the project must be changed from planned to existing. Elements, services, and flows are considered to change from "planned" to "existing" when they are substantially complete in that they have been installed, tested and are being used.

Changes in Project Priority. Due to funding constraints, technological changes or other considerations, a project planned in the Region may be delayed or accelerated. Such changes need to be reflected in the ITS Architecture.

Changes in Regional Needs. Over time, the needs in the Dixie Region may change and the corresponding aspects of the Regional ITS Architecture will have to be updated. While the Regional ITS Architecture is being developed with input from many ITS Stakeholders in the Region, not all potential Stakeholders have participated in its development. As ITS deployment increases and the benefits are realized, additional entities may become interested in ITS. The Architecture should be updated to reflect their place in the regional view of ITS. The systems they operate and their interfaces will also have to be added or revised based on actual information sharing gained from their participation.

Changes in Stakeholder or Element Names. An agency's name or the name used to describe its element(s) may change. Transportation agencies occasionally merge, split, or simply rename themselves. In addition, element names may evolve as projects are defined. The ITS Architecture should be updated to use the currently correct names for both Stakeholders and elements.

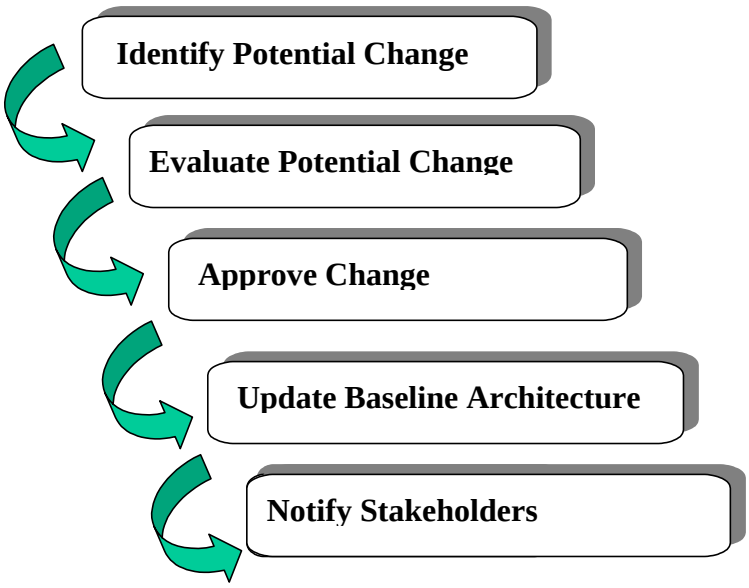
Changes in Other Architectures. The Dixie Regional ITS Architecture covers not only the defined region, but also interfaces to elements in the Utah Statewide Architecture. Changes in these other architectures may necessitate changes in the Regional ITS Architecture to maintain consistency as the two architectures may overlap.

Additionally, the National ITS Architecture itself is a living resource of information. In order to keep a 20-year horizon on the National ITS Architecture, it is expanded and updated to refine existing services or add new user services. With any new user service is the potential for new subsystems, terminators, interconnects, flows, and equipment packages. It is recommended that during major updates the Maintenance Team reviews changes in the National ITS Architecture and determines how they may affect the Region's ITS Architecture.

13.5 Change Management Process

This section recommends a process for maintaining the Dixie Regional ITS Architecture. The process described below and illustrated graphically in **Figure 8** is based upon the discipline of Configuration Management. It is a step-by-step description on how changes are identified, reviewed and implemented.

Figure 8: Architecture Maintenance Process



Identify Potential Change. Any Stakeholder can identify a potential change in the Architecture and submit a request to the Maintenance Team for review and evaluation. It is recommended that a simple change request form be created that contains at least the following information:

- Name of change
- Description of change
- Rationale for change
- Originator name or agency
- Originator contact information
- Date of origination

A sample Change Request Form is included in **Appendix C**.

As part of the Configuration Management process this information should be maintained in a change log (or change database) that would contain the above information with the following additional information by the party responsible for managing the database:

- Change number (unique identifier)
- Change disposition (accepted, rejected, deferred)
- Change type (minor or major)
- Part of baseline affected
- Disposition comment or status
- Disposition date

There are many ways a change request can be made: via a web site, by submittal of formal hard copy, or by submittal of an e-mail containing all relevant information. It is

recommended that the request process be tracked electronically. This approach generates an electronic copy of the request, and therefore an audit trail of all changes considered as well as a record of those approved, those rejected, and those deferred.

On a regular basis (e.g. annually), the Maintenance Team should meet to perform the following steps in the Change Request process.

Evaluate Change Requests. Each change request should be evaluated to determine its impact on the Architecture. If a request has an impact on other Stakeholders, the Maintenance Team should contact the affected Stakeholders to confirm their agreement with the modification. If the issue warrants, a Stakeholders meeting or teleconference to discuss the modification may be held. In the case of a full baseline update, the change evaluation happens through Stakeholder consensus as part of the scheduled update cycle.

Approval. The next step is to approve, defer, or reject the change request. This will be handled through email, the web site and/or through periodic face-to-face meetings. This is dependent upon the complexity of the proposed change(s). If a change request is rejected or deferred, the requester will be notified with an explanation. Approval by affected Stakeholders effectively builds consensus. The result of the approval step will be communicated back to the requester.

Update Baseline. This activity involves updating the Dixie Regional ITS Turbo Architecture and documentation. This requires the same skills and techniques used in developing the initial baseline. The frequency of updating the Turbo Architecture will be established by the Maintenance Team, however minor updates are recommended to be performed once a year. It is recommended that a staff member or outside firm with Turbo expertise perform the Turbo baseline updates. As few individuals as necessary should be authorized to perform Turbo updates to ensure consistency.

Notify Stakeholders. The final part of the maintenance process is to notify Stakeholders of the changes or updates to the ITS Architecture. This can be accomplished by sending an email notification to the Stakeholder list that a change has occurred and then link to more information on a website, or in a document attachment to the e-mail.

If there are no change requests between Maintenance Team meetings, and there are no other issues requiring discussion, the Team may decide to skip its next meeting.

APPENDIX A

Needs Exercise Summary

The following pages are a list of potential transportation needs that may be addressed with ITS in the Dixie Region. The list has been compiled based on an understanding of the Dixie region and based on the Project Team's experience in other similar areas. *At the end of each needs category are new needs identified by the stakeholders. They are listed in italics.*

At the March Workshop, stakeholders were given a budget of twenty "votes" each to prioritize needs as a group. Each stakeholder was allowed to use his or her votes to vote on anywhere from one to twenty needs. They could put all twenty of their votes on a single need if they felt it was critical, or spread them out over several needs if they felt several issues needed to be addressed. The following pages summarize the number of votes placed by stakeholders on each need.

Stakeholders were also asked to rank potential ITS Needs and indicate whether they believed each needs was:

- H = High Priority
- M = Medium Priority
- L = Low Priority
- N = Not a priority

They were asked to respond in the categories directly relevant to them. For example, transit service providers were asked to review and provide input on the Public Transportation Management needs. The summary of all rankings for each need are shown on the following pages as a list of the rankings by all respondents as H, M, L or N. These represent the individual rankings of the stakeholders.

The last column of the following tables is a summary of the priority ranking, as shown in Section 5.2 to 5.9 of this report. The summary priority for each need was derived from the number of votes each received, the average priority ranking, and other information including a Project Team review of other planning documents and discussions with individual stakeholders.

A total of 23 needs surveys were returned. Not all needs have 23 rankings. This is because not all stakeholders felt qualified or interested to rank every listed need. In addition, under advisement from the Project Team and using previous experience, the priorities were manually adjusted to reflect a realistic distribution of High, Medium and Low priority needs.

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Arterial / Traffic Management				
Examples: Signal Coordination, Centralized Control, Vehicle Detection Systems, Video Systems, Adaptive Signal Control, Traffic Management Systems / Centers, Highway Rail Intersection Technologies	Improve system operation monitoring	3	H M H H M H H H H H H	H
	Improve system-wide arterial management strategies	**16**	H H H H M M H H H H H H	H
	Develop access management plans/strategies (signal spacing)	1	H H M H H H H H H M	H
	Improve signal optimization	6	H H H H H M H H H H H M	H
	Improve traffic flow monitoring	4	H M H M H H H H M H H H	H
	Provide more centralized computer control	3	M M H M M M M H H M M	M
	Improve signal control and timing	4	M H H H H M M M H H H H M	M
	Improve/implement ability to remotely modify signal timing	3	H M H H H H H M M M H H	M
	Improve arterial roadway traffic surveillance	3	H M H H H L L H H H M	H
	Better manage congestion at signals	**18**	H H H H H H H H H H H H	H
	Reduce detector failures when pavement “breaks up”	0	L L N M H H M M H H M L	L
	Reduce emergency vehicle delays at signals	**10**	H H H H M M H M H H H H	H
	Reduce transit vehicle delays at signals	0	M H L H M L M M M M M L	M
	Better balance signal timings favoring local traffic over through traffic	0	M M M L M L L H N H M	L
	Upgrade signal hardware	0	M M M M H M M M H H L M	M
	Implement or improve signal coordination	5	H H H H H H M H H M H	H

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Arterial / Traffic Management				
	Better manage periods of high traffic demand in poor roadway conditions	**11**	H H H H H H H H M H L	H
	Provide quality real time congestion information	4	H H M H M H H H H M M H	M
	Remote monitoring of signal system status / operations by public safety agencies	3	H H H M H L M H M M	M
	Deploy network vs. corridor based signal coordination	1	M H L M M M H M L	M

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Freeway Management Systems				
Examples: Vehicle Speed Detection Systems, Video Systems, Ramp Metering, Variable Message Signs, Highway Advisory Radio, Traffic Management Systems/Centers	Perform additional vehicle detection	0	H M M L L H M M N M M	M
	Implement additional field device interconnect	2	M L H M M H H M M M M L	M
	Improve collection of traffic demand data	3	H H H M H M H H M L H H	M
	Improve inter-agency coordination	6	H H H H H H H H H H M L	H
	Improve information exchange between UDOT and local agencies	**9**	H H H M H H H H H H M H M	H
	Improve information exchange between Dixie and neighboring architectures/regions (Five counties, UDOT…)	2	H H M H H H H MH H M M M	M
	Improve incident response, especially in rural areas	5	H L H H M H H H H H H H H H	H
	Improve incident detection	**9**	H H M H H M M M H H H H H M H	H
	Improve incident management in urban areas	3	H H H H M H H H H H H H H H	H
	Improve freeway traffic surveillance	4	H M H L H M M H H H H H M	M
	More timely incident information dissemination (traveler information)	3	H M H M L M H H H H H H H	M
	Better manage periods of high traffic demand in poor roadway conditions	0	H H H H H M H H M H H L H H H	H
	Provide quality construction and maintenance information	1	M L M M M M H M M H H H M H	M
	Provide quality real time congestion related information	6	H H M H H H M M M H H H H	M
	Improve traveler information/directions (suggested routing for travelers not familiar with the region)	**10**	H M H H L M L H H M M M H	M

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Freeway Management Systems				
	Improve exit flow patterns		*H*	
	Reduce congestion		*H*	

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Public Transportation Management				
Examples: Public Transportation Management, En-route Transit Information, Personalized Public Transit, Public Traveler Safety, Traveler Service Information, Ride Matching and Reservations, Smart Card Payment/Transaction Systems	Improve regional and interregional trip planning	3	L H H H M M H M M	M
	Improve patron safety (in-vehicle and at stations / waypoints)	0	L L M H H M M M	M
	Better notification and coordination of special event loads resulting in congestion	0	M M H H H M H M H	M
	Provide transit priority at signals	0	L L L L H M M L M	L
	Implement bus queue jump lanes	0	L L L L M M N M H	L
	Improve transit transfers within and between systems and modes to improve service delivery	0	L M M L M M M M H M	M
	Enable dissemination/display of bus arrival times	0	L L L M M M L M M	L
	Enable transit agencies to locate bus fleet (AVI/AVL)	0	M M L H M M L M M	M
	Improved information exchange between/among transit agencies	0	L M L H M M M M M M M	M
	Improved information exchange between transit agencies and freeway/arterial management centers	2	M M M M H M M M M	M
	Receive and provide quality real time congestion related information	1	M M H M H M M H N	M
	Enable emergency information dissemination to transit operators	3	M M M M M H H H H M M	M
	Improve efficiency of social service transportation providers	1	M M M L H M M N	M
	Improved service planning (scheduling and runcutting)	0	M M M L M M H M M	M
	Remote monitoring of mechanical condition of transit vehicles	0	L M L L M H M M M	M
	Improved “back-office” systems (interface between personnel scheduling systems and payroll systems, etc.)	0	L L L M L M L L	L
	Deploy universal fare payment system(s)	0	L L L L L M L M	L

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Emergency Management				
Examples: Incident Detection, Incident Management, Hazardous Materials Response and Handling, Emergency Notification and Personal Security, Emergency Vehicle Management, Advanced Dispatching and Response Systems	Reduce response delays at signals	**14**	H M H L H M H H M H H H H H N H H	H
	Improve response to adverse weather events	1	H M H H H M M M M H H H M H N L	M
	Provide alternate route plans	**12**	H M H H H H H H H H M H H H M H M	H
	Increase broad understanding of, and implement Standardized Emergency Management System (SEMS)	0	H M H H M M H L M M M M H N M	M
	Better notification of recreational routes closed in winter	0	L L H M L L L M M L M M L M M L	L
	Improve incident response coordination between agencies	7	H H H H H H H H H H M H H H M M M	H
	Improve incident detection	**10**	H H H H M H H H H H H H H M N H	H
	Improve incident response times	**14**	H H H H H H H M H H H H H H H H N	H
	Improve communications in mountain and rural areas of the region	2	H M H H H M M M M H H M M H H	M
	Better information dissemination regarding diversion of trucks	4	M M M H M H H M L N M M M H H	M
	Improve traffic management during wildfires/floods (evacuation, response, suppression, etc.)	**10**	H H L H H N H H M H H M H L H H H	H
	Improve response to hazardous materials spills/incidents (better manage resulting traffic congestion, improve clean-up time)	**10**	H H H H N M M H H H M H H H H	H
	Increase use of portable traffic control equipment (Message Signs, Highway Advisory Radio, etc.)	**13**	H M M H M M H L M H M H M H H H H	M
	Provide quality real time congestion related information	8	H M H H M M M L H M H M H H H H H M	M
	Improve traveler information/directions (suggested routing for travelers not familiar	0	M M H M L M M L M M H M H M N H	M

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Emergency Management				
	with the region)			
	Improve intersection delay and safety for emergency vehicles	***20***		*H*
	Improve ability to detect and warn about floods	*4*		*M*
	Provide rapid mobile response to incidents	***15***		*H*

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Maintenance and Construction Operations				
Examples: Advanced Work Zone Management and Traffic Control, Vehicle Detection Systems, Video Systems, Vehicle / Speed Detection Systems, Variable Message Signs, Highway Advisory Radio, Integration with Traffic Management Systems / Centers, Advanced Dispatching and Routing Systems, Advanced Vehicle Tracking Systems, Fleet Maintenance and Management Systems	Provide automated vehicle location systems for maintenance and construction operations vehicles	0	N M L H M H M L N H M H	M
	Improve/enhance work zone traffic handling plans	3	H H M M M H H H M L H H	M
	Improve detection and removal of falling rocks, snow, mud and trees on roadways	3	L L M M H M H H H H	M
	Provide more data source locations for the National Weather Service	3	M M H H H M M H H H H	M
	Improve coordination on construction notification and information distribution	2	H M H H H H H H M M M H	M
	Improve fleet information / management (maintenance schedules, mileage accumulations, tracking snow removal vehicles w/AVL)	0	N M M L H H M L M M M	L
	Coordinate traffic control plans between jurisdictions	**12**	H H H H H H M H H M H	H
	Increase use of portable traffic control equipment (Dynamic Message Signs, Highway Advisory Radio, etc.)	1	H M M H M M M H H H H	M
	Provide signal preemption for some maintenance fleet vehicles	0	M L L L L M M H L M L	L
	Interagency coordination on most advantageous placement of maintenance vehicles (prior to anticipated need)	2	L L L H H L L M M M	L
	Provide quality real time congestion related information	5	H H H M H L M M H M M H H	M
	Deploy mobile/portable traffic management field equipment (mobile surveillance equipment, mobile ramp metering, mobile Highway Advisory Radio)	1	M M M H H M H M M H	M
	Improved traveler information/directions (suggested routing for travelers not familiar with the region)	0	M M H H L M M M H M H M H	M
	Automated pavement treatment systems	0	N L L M L M H H N N	L

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Regional Traveler Information				
Examples: En-route Traveler Information, Pre-trip Traveler Information, Portable Event Management Systems, In-vehicle Route Guidance, Traffic Information, Variable Message Signs, Highway Advisory Radio, Internet, Media, Tourist Information Systems	Provide quality real time congestion related information	**7**	M M H M H H H M H H H M H	M
	Expand traveler information delivery methods	1	M M H M M L H H M H M M	M
	Improve method of disseminating congestion and incident data from UDOT	4	M M H M N H M H M M M M	M
	Use public access cable television to disseminate traffic and weather information	0	M M H M L L M M M L	M
	Improve quality and timeliness of communications	3	M H H H H H H H H M	H
	Provide timely, accurate information on road conditions	**8**	M H H M H H H H H H M M H	H
	Better manage traffic flow to and from recreation areas	2	M M H M L N L H M H M H M	M
	Improve procedures to get accurate information disseminated in a timely manner	0	M H H H H H N H H M	M
	Develop interstate/inter-region traveler information covering a wide area (targeted to CVO)	0	M M H L H M H N M	M
	Improve targeted traveler information for tourists and recreation travelers at visitor information areas/rest stops, etc.	2	L M H L M L M M M M L	M
	Provide weather and road info access at rest stops/visitor center (could be radar screen video/monitor)	4	L M H H H M M L H H M	M
	Provide information distribution to private/commercial information service providers (ISPs)	0	L M M M M M H M L N	L
	Provide better road construction information and notification	6	M M M M M H H L H H M H M	M
	Provide more timely dissemination of traveler information	4	M M H H M M H H M N	M
	Provide alternate weather and road information	0	M M H H H M M M H M H	M
	Improve traveler information/directions (suggested routing for travelers not familiar with the region)	**9**	M M H L M M M H M M H M	M

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Regional Traveler Information				
	Provide National Park specific entry, parking and shuttle information	*7*		*M*

H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Commercial Vehicle Operations				
Examples: Commercial Vehicle Electronic Clearance, Automated Roadside Safety Inspection, On-board Safety Monitoring, Commercial Vehicle Administration Processes, Hazardous Material Incident Response, Commercial Vehicle Fleet Management, Services to Assist Agricultural Harvesting and Migration	Provide interstate / inter-region traveler information covering a wide area (targeted to CVO)	4	N H M M H M M M L H M	M
	Provide tracking of hazmat vehicles	2	L M L H H M H H M H M H	M
	Provide better information dissemination of winter vehicle restrictions (Chain control issues (ON/OFF))	0	N M H M M H H H M H	M
	Provide quality real time congestion related information	**5**	M M H M H H L H H M M M	M
	Improve truck storage/parking information (during major road closures)	**5**	M M H L H H M M M M H	M
	Disseminate better information regarding limited alternative routes	1	M L H H M H H H L H	M
	Expand weigh-in-motion technologies	3	N M L M M H H H H N H H	M
	Expand automated clearance systems	2	N L L M H H M H H M L	M
	Improve congestion management during seasonal/local events	0	M M M H M H M H H M M	M

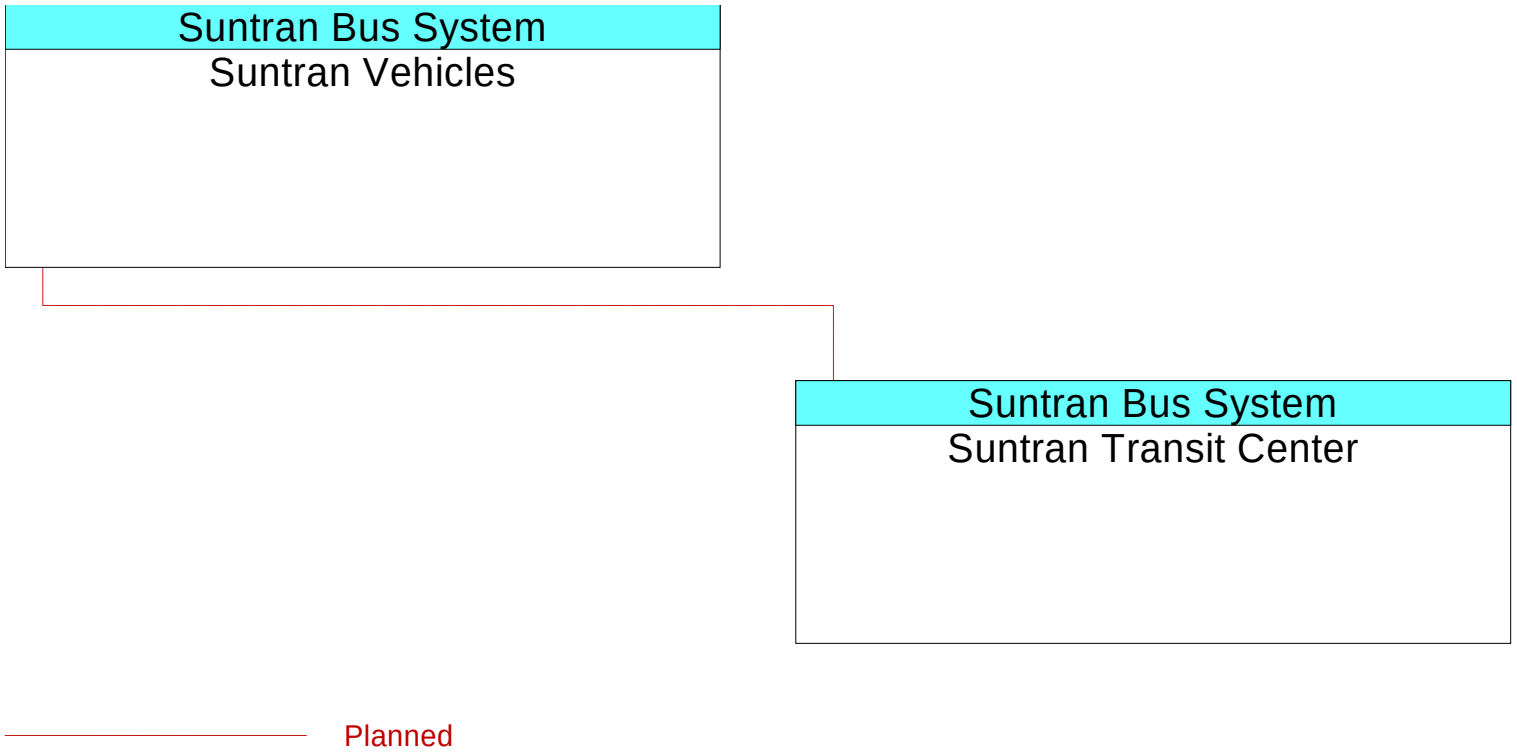
H=High, **M**=Medium, **L**=Low. **N**=Not

ITS Categories	Needs	Workshop Votes	Priority Ranking by Stakeholders	Compiled Priority Ranking
Integration				
Examples: Integration of Systems, Integration With Traffic Management Centers, Central vs. Distributed Control, Communications Infrastructure, Integration of Agencies, Institutional Issues	Improve information sharing among agencies	**15**	H H H H H H H H H M H H H M H	H
	Improve communication limitations	0	H H H H H L M H H H H	M
	Reduce dependency on proprietary systems	2	M H H M H M L M H H M	M
	Improve understanding and capabilities of other agencies	2	M H H M M H M M H H M H	M
	Develop better understanding of needs of other agencies	1	M H H H M M H M M M M	M
	Coordination with schools and Division of Emergency Management	1	H M H L L H L H M L H	L
	Provide central information clearinghouse	1	M M H H M M M H M H	M
	Use common verbiage/terminology across agencies	1	H H H M H H M M H M L	M
	Use common road condition classifications	1	M M H M M H H H M M	M
	Develop an integrated GIS for Region	**16**	H M H H H H H H H M H	H
	Develop interagency governmental agreements (MOUs) that would allow sharing of information, etc.	6	H H H M M H H M M H M	H
	Improve system compatibility	5	H H H M M H M H H M M	M

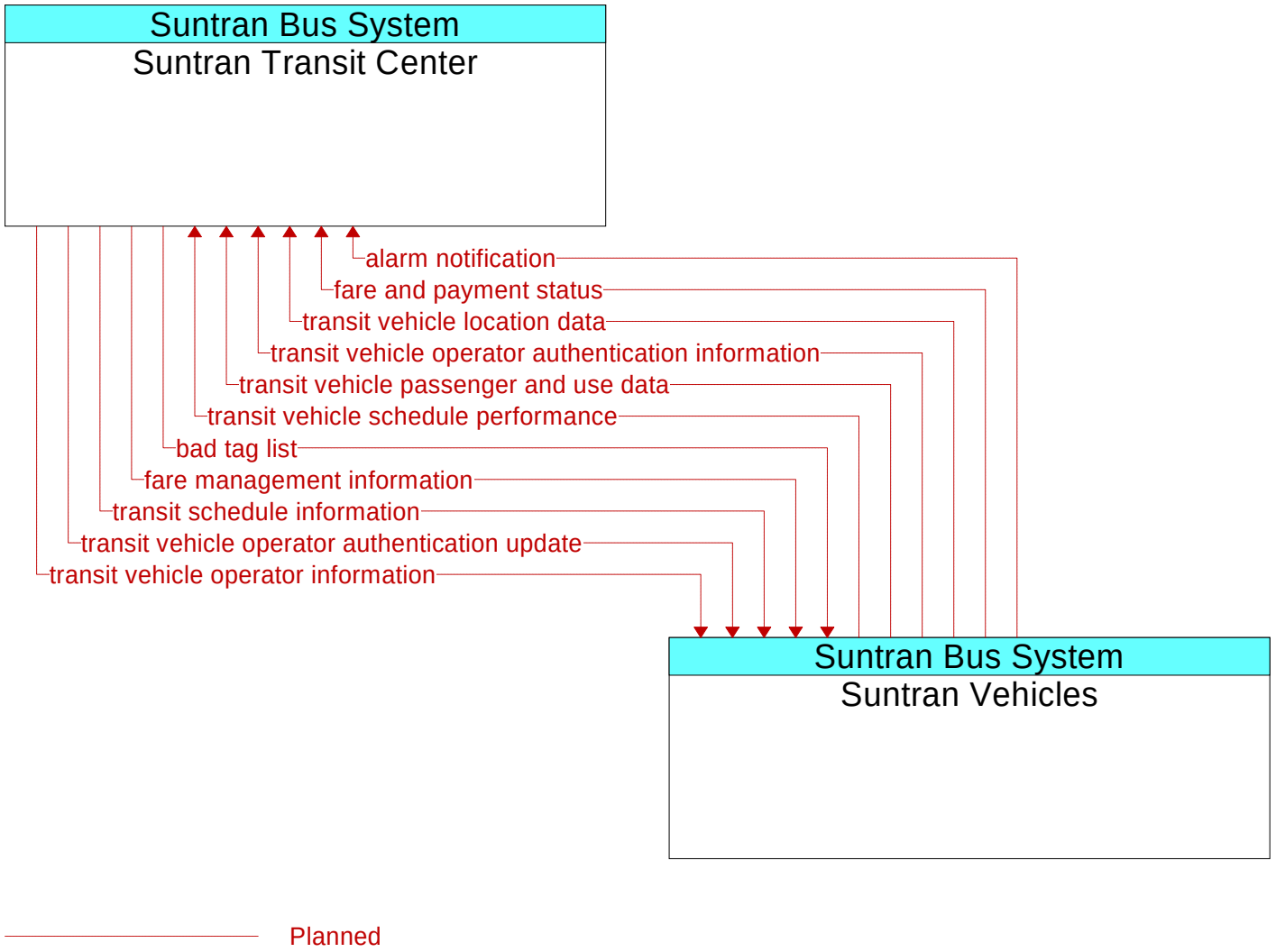
APPENDIX B

Market Package Interconnect and Information Flows Diagrams for the Dixie Region

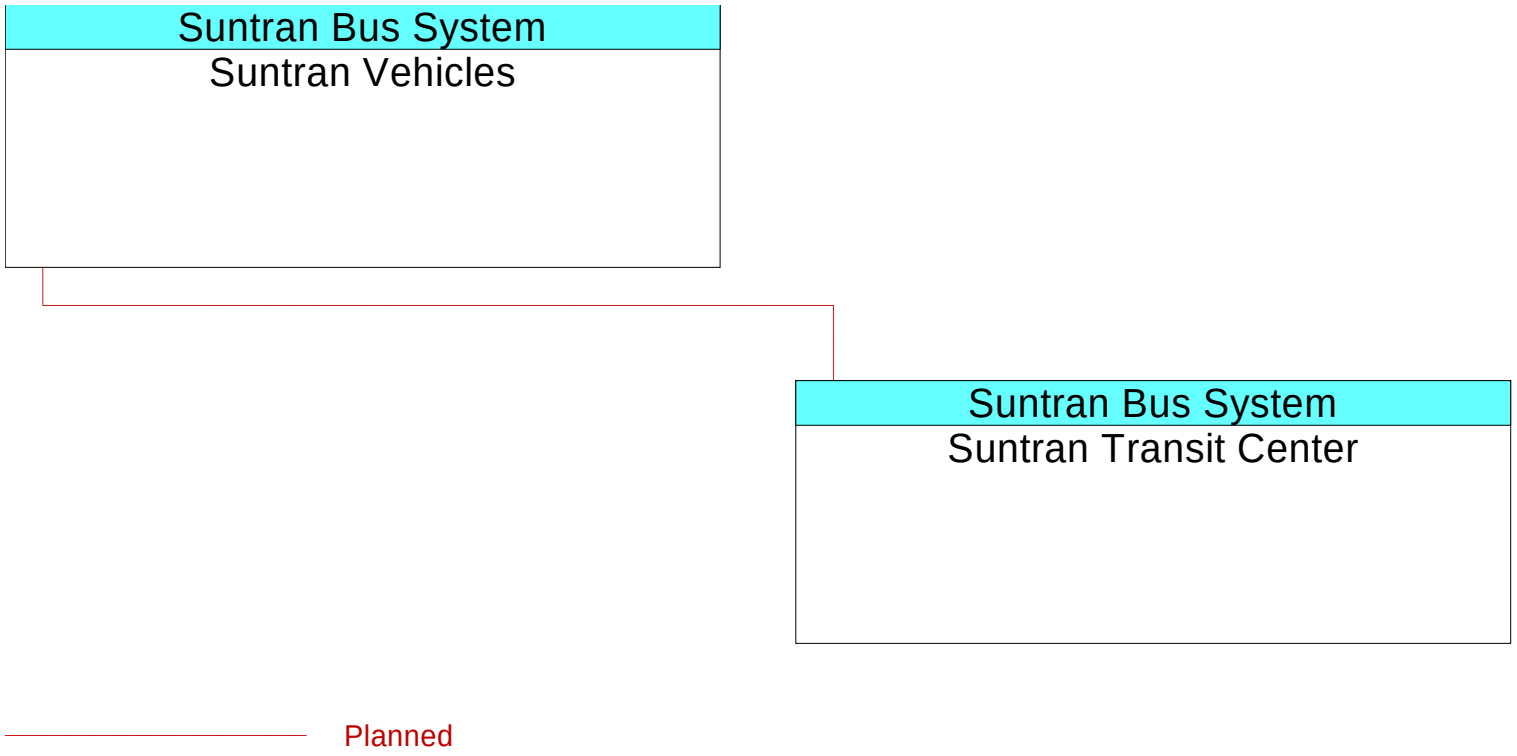
APTS1: Transit Vehicle Tracking - Interconnect Diagram



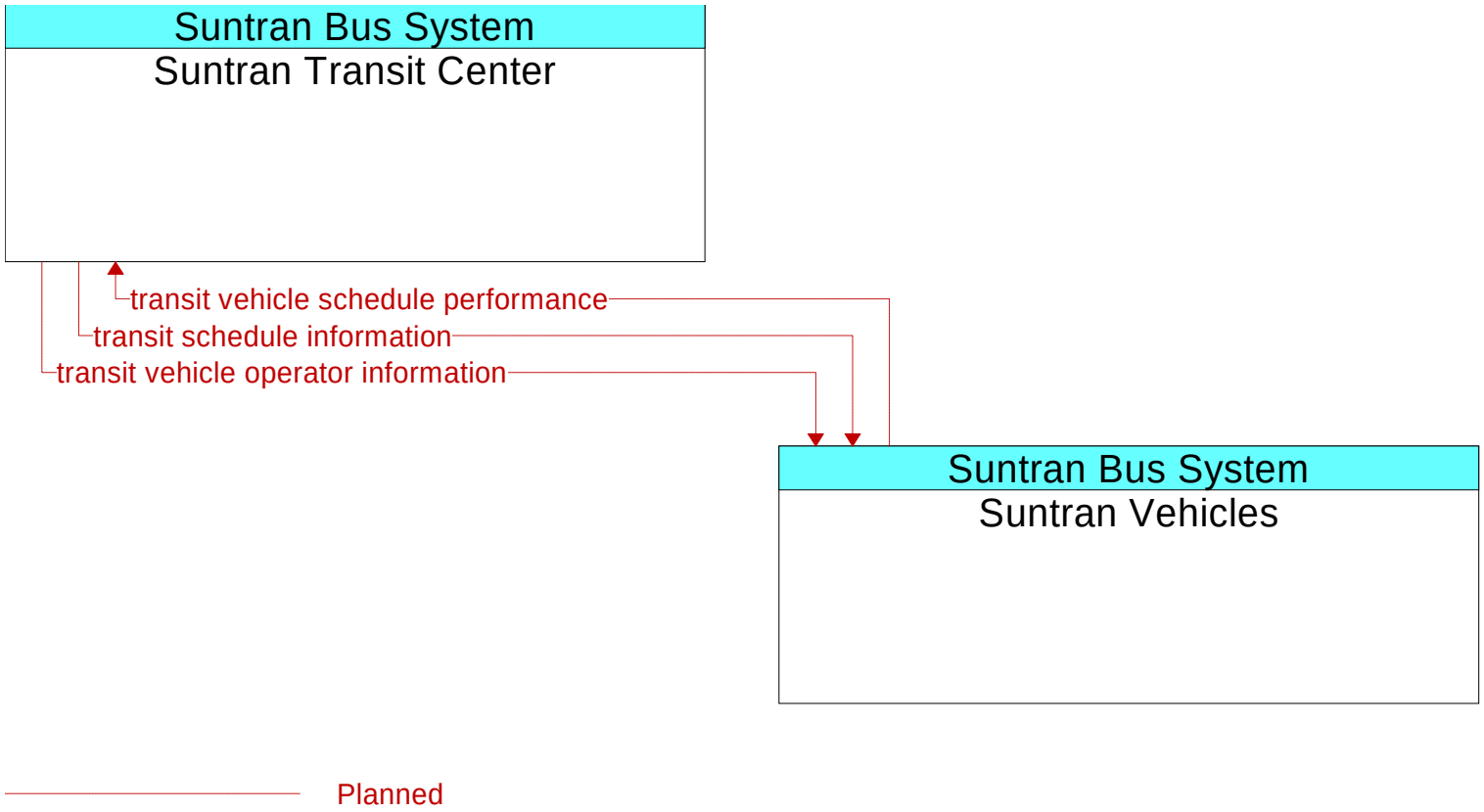
APTS1: Transit Vehicle Tracking - Information Flow Diagram



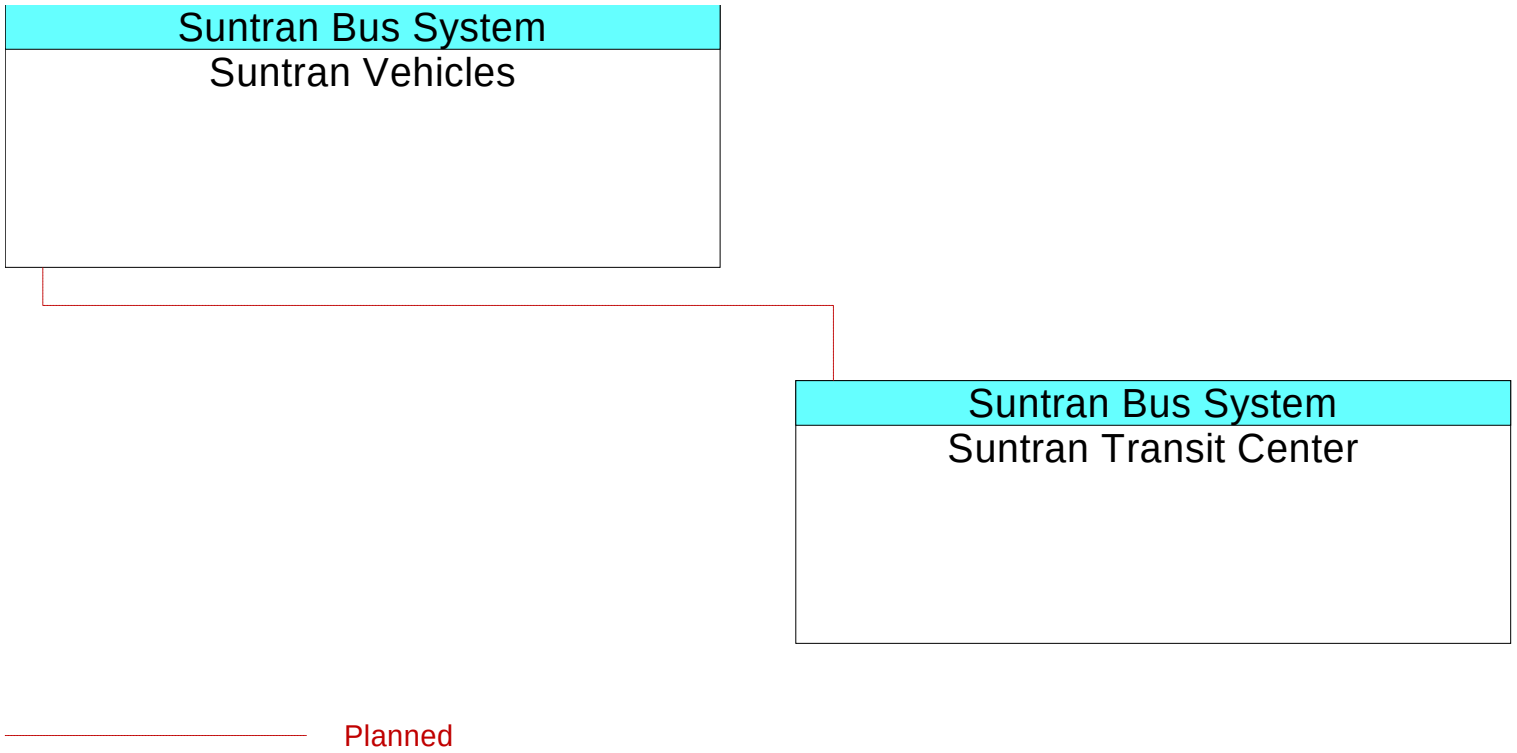
APTS2: Transit Fixed-Route Operations - Interconnect Diagram



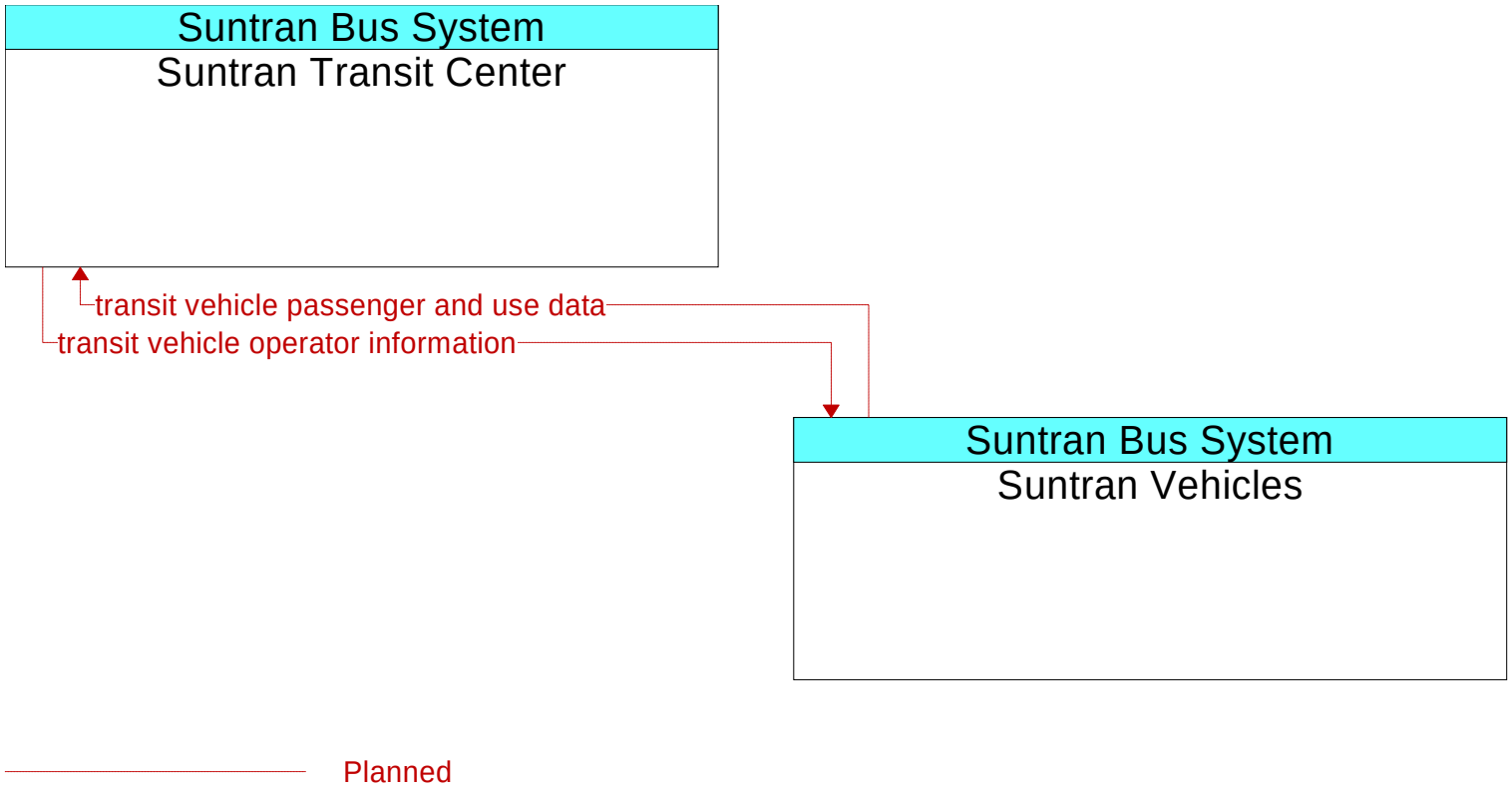
APTS2: Transit Fixed-Route Operations - Information Flow Diagram



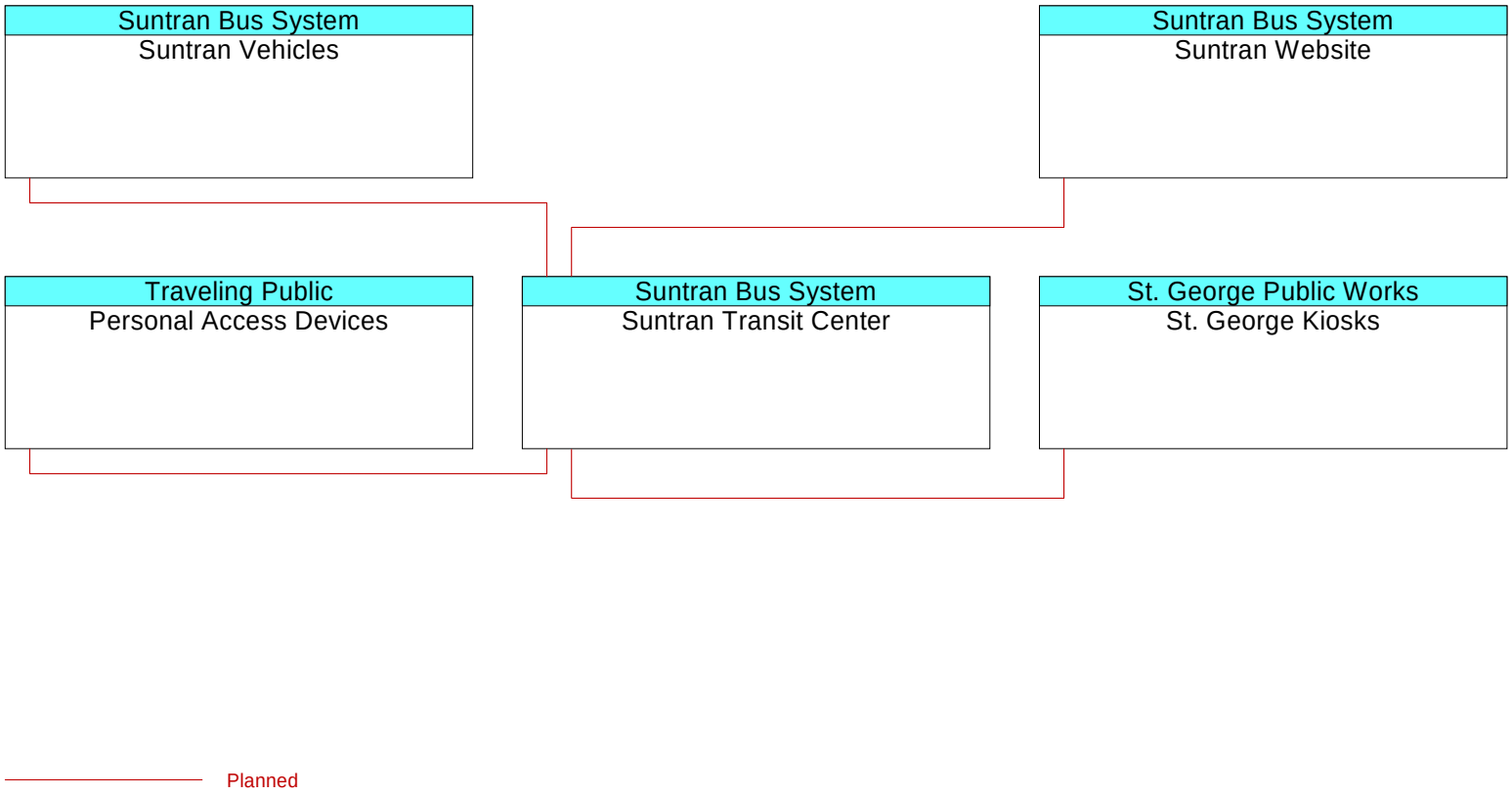
APTS3: Demand Response Transit Operations - Interconnect Diagram



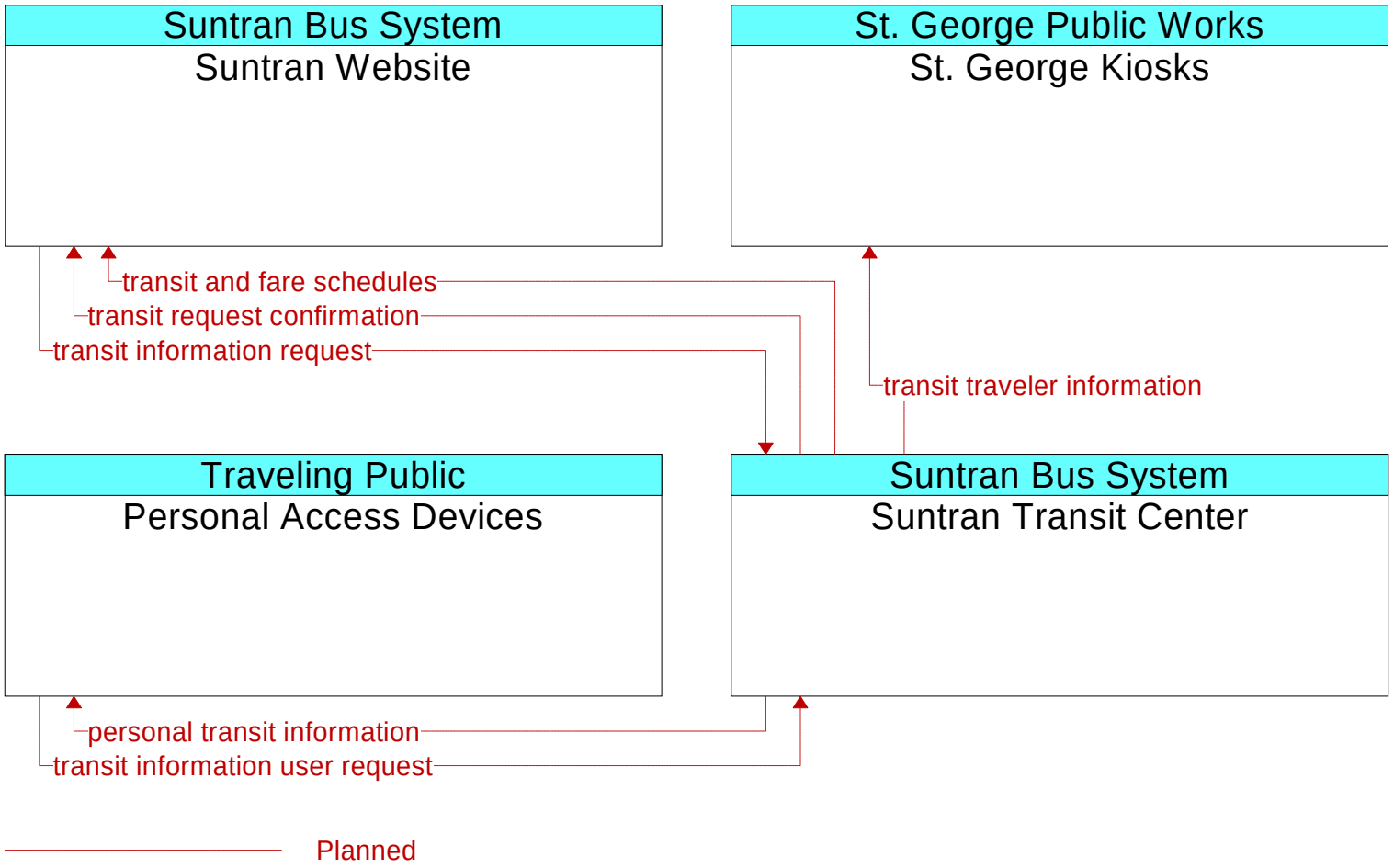
APTS3: Demand Response Transit Operations - Information Flow Diagram



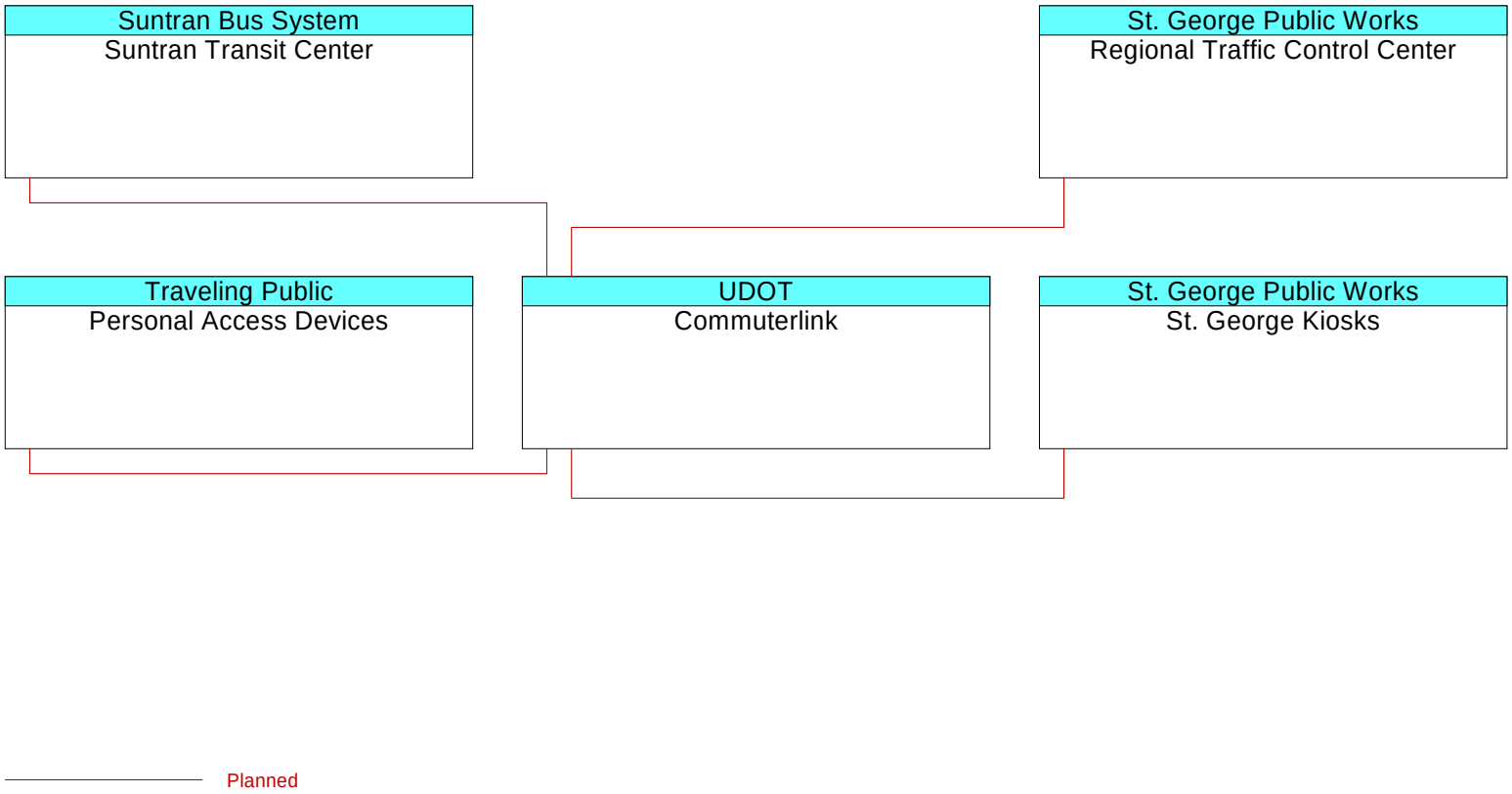
APTS8: Transit Traveler Information - Interconnect Diagram



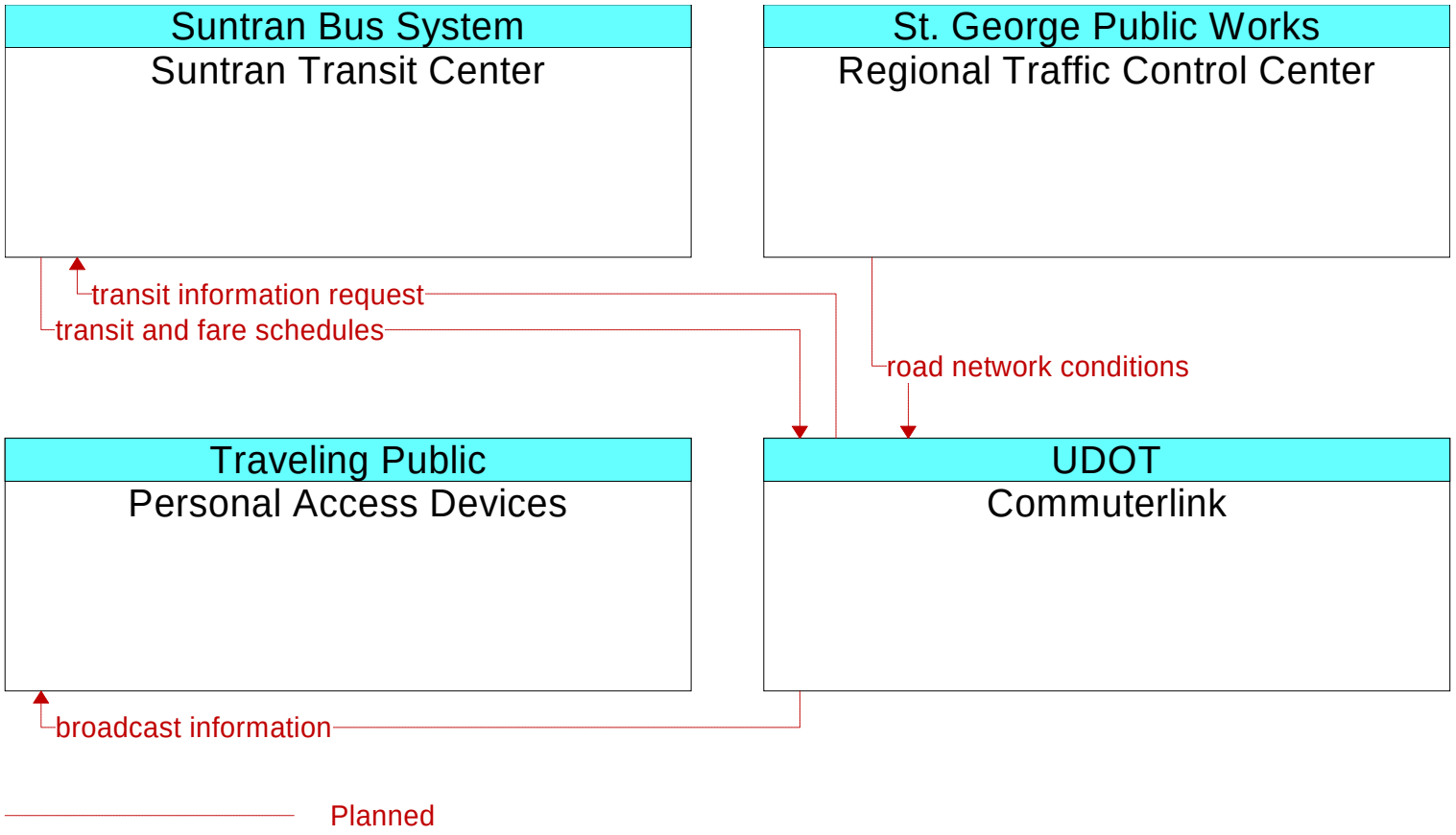
APTS8: Transit Traveler Information - Information Flow Diagram



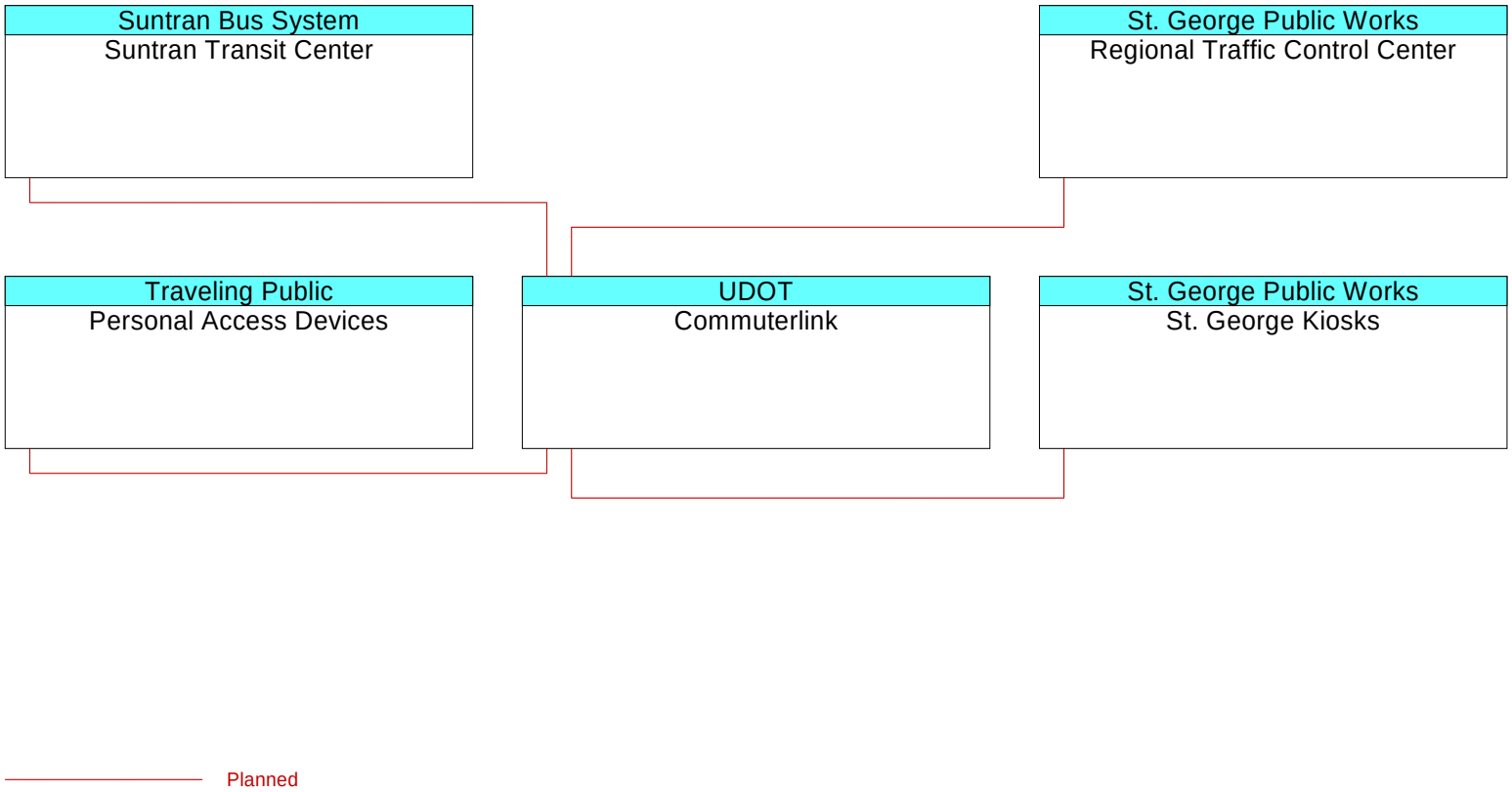
ATIS1: Broadcast Traveler Information - Interconnect Diagram



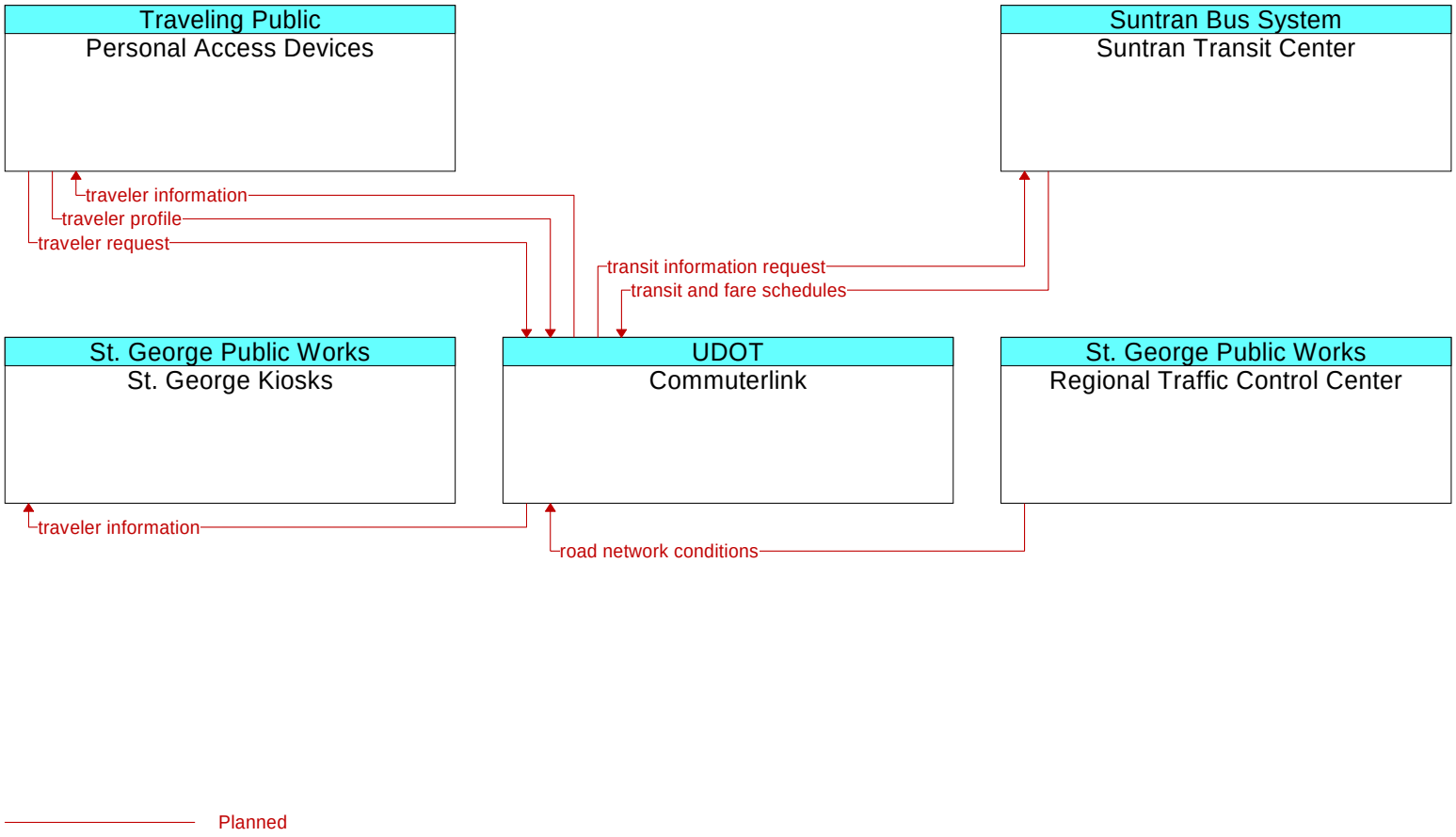
ATIS1: Broadcast Traveler Information – Information Flow Diagram



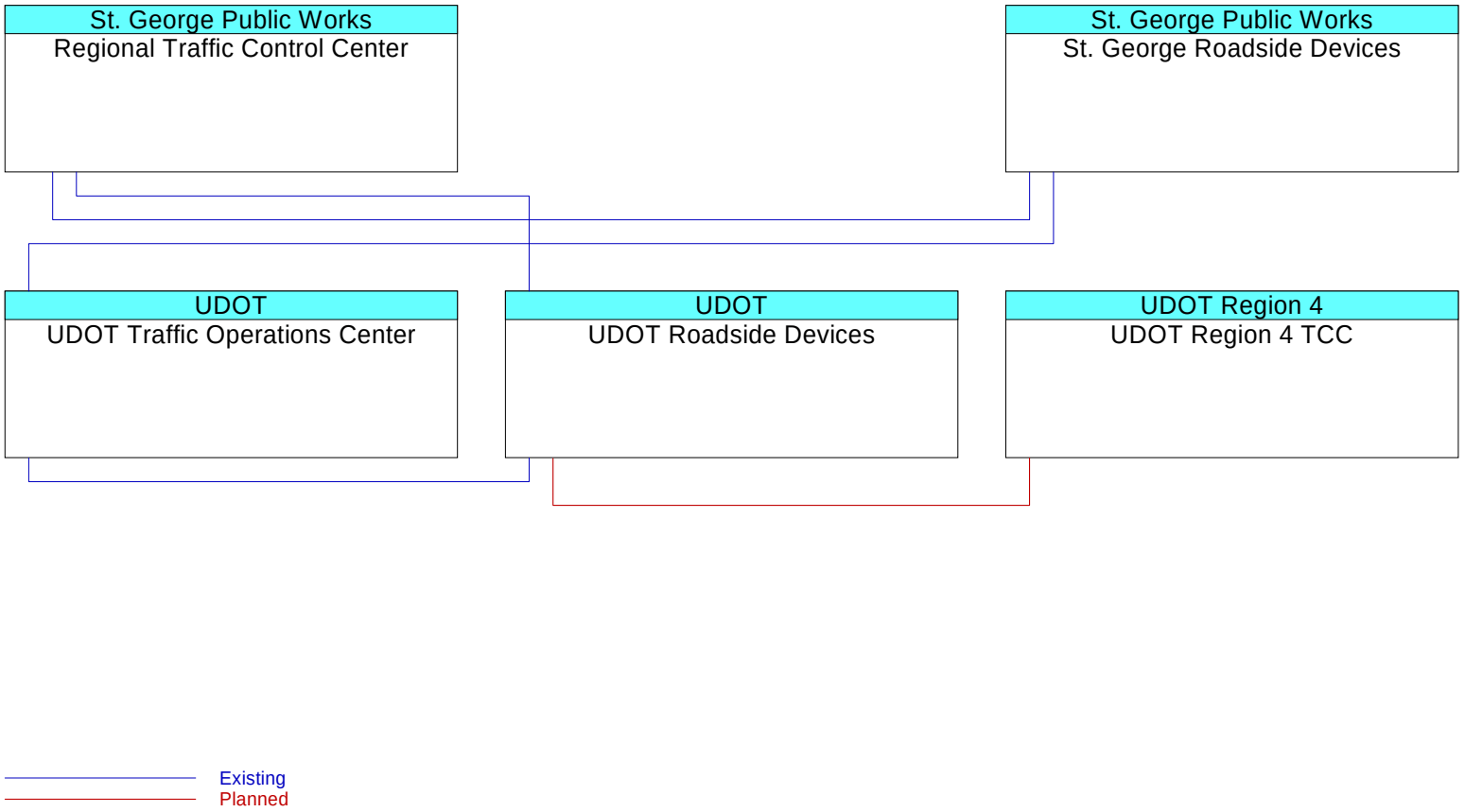
ATIS2: Interactive Traveler Information – Interconnect Diagram



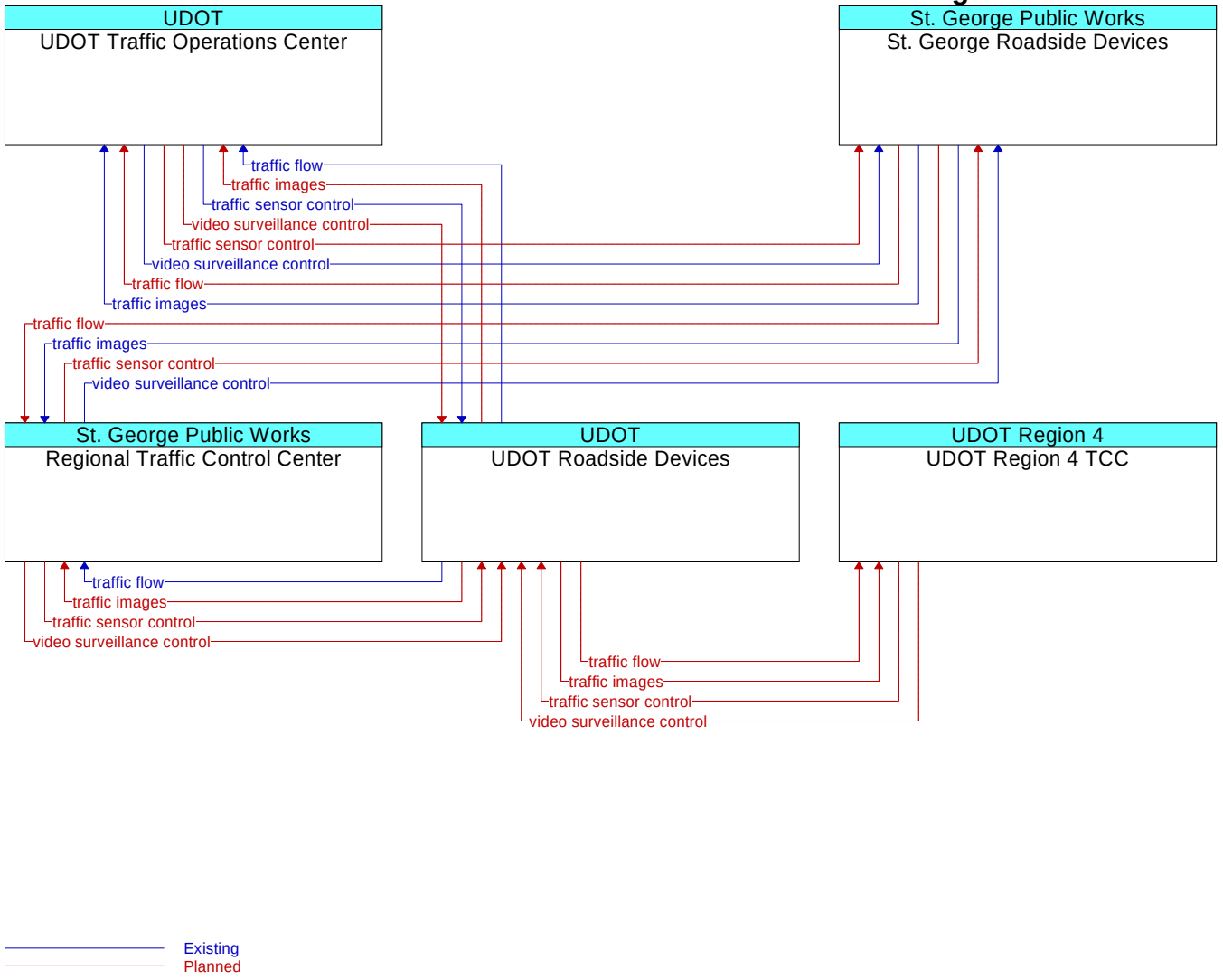
ATIS2: Interactive Traveler Information – Information Flow Diagram



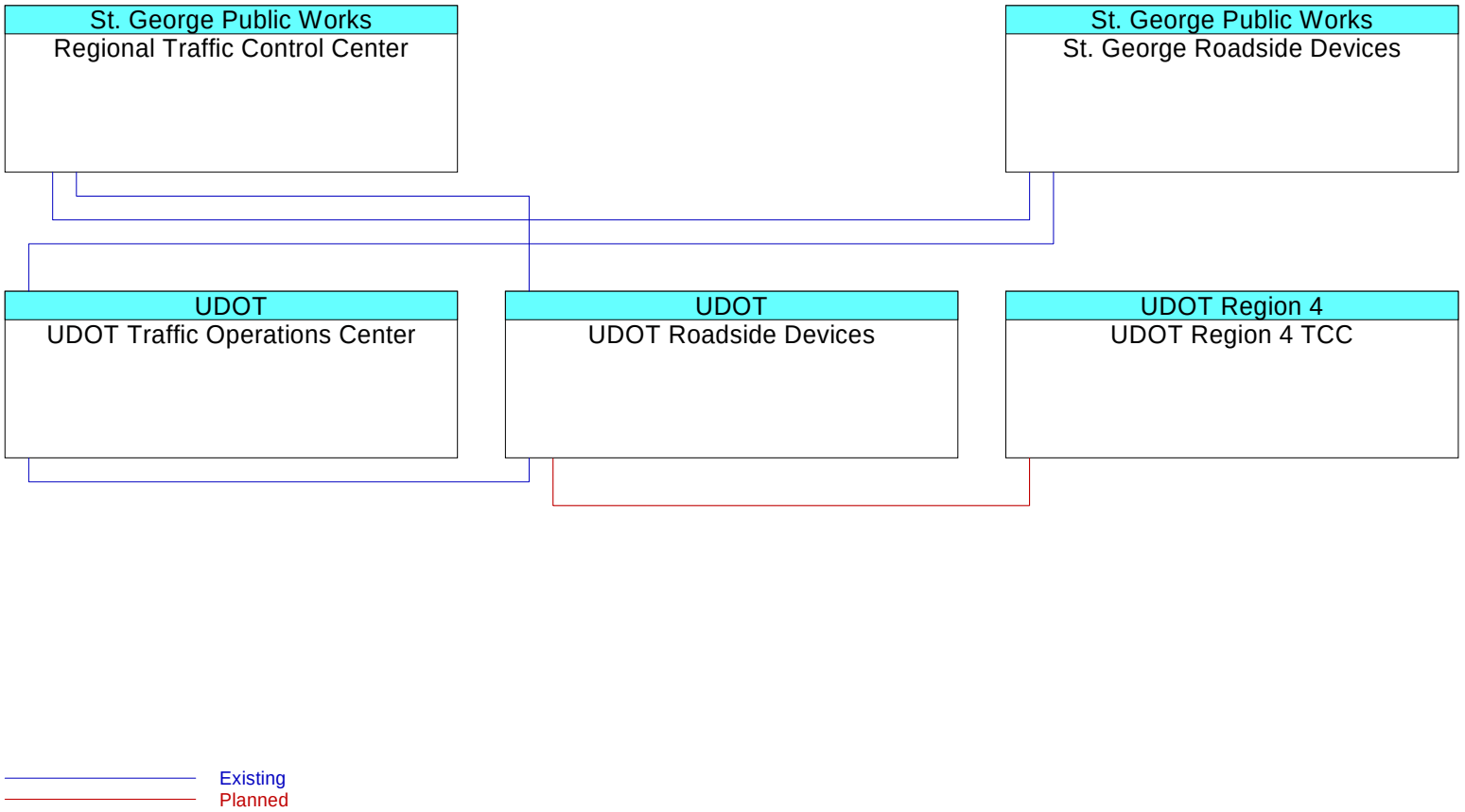
ATMS01: Network Surveillance – Interconnect Diagram



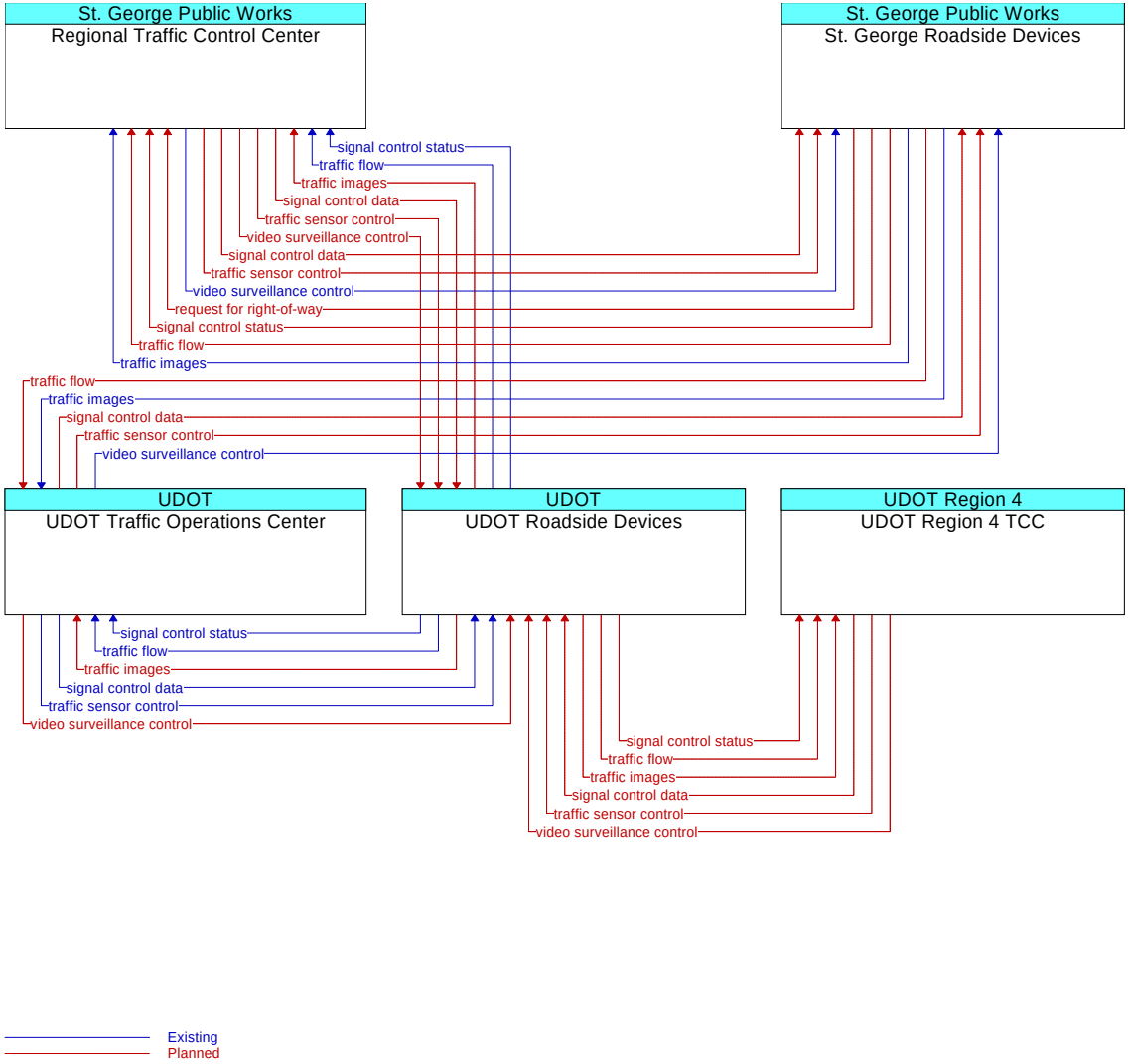
ATMS01: Network Surveillance – Information Flow Diagram



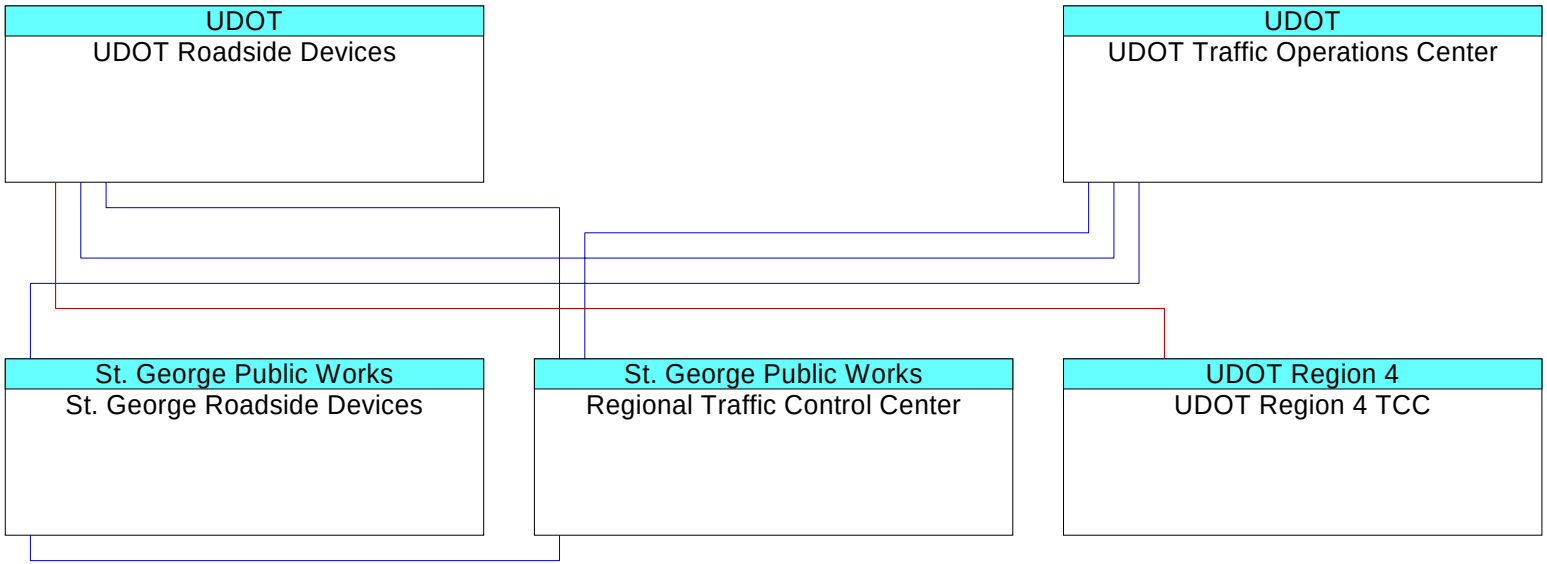
ATMS03: Surface Street Control – Interconnect Diagram



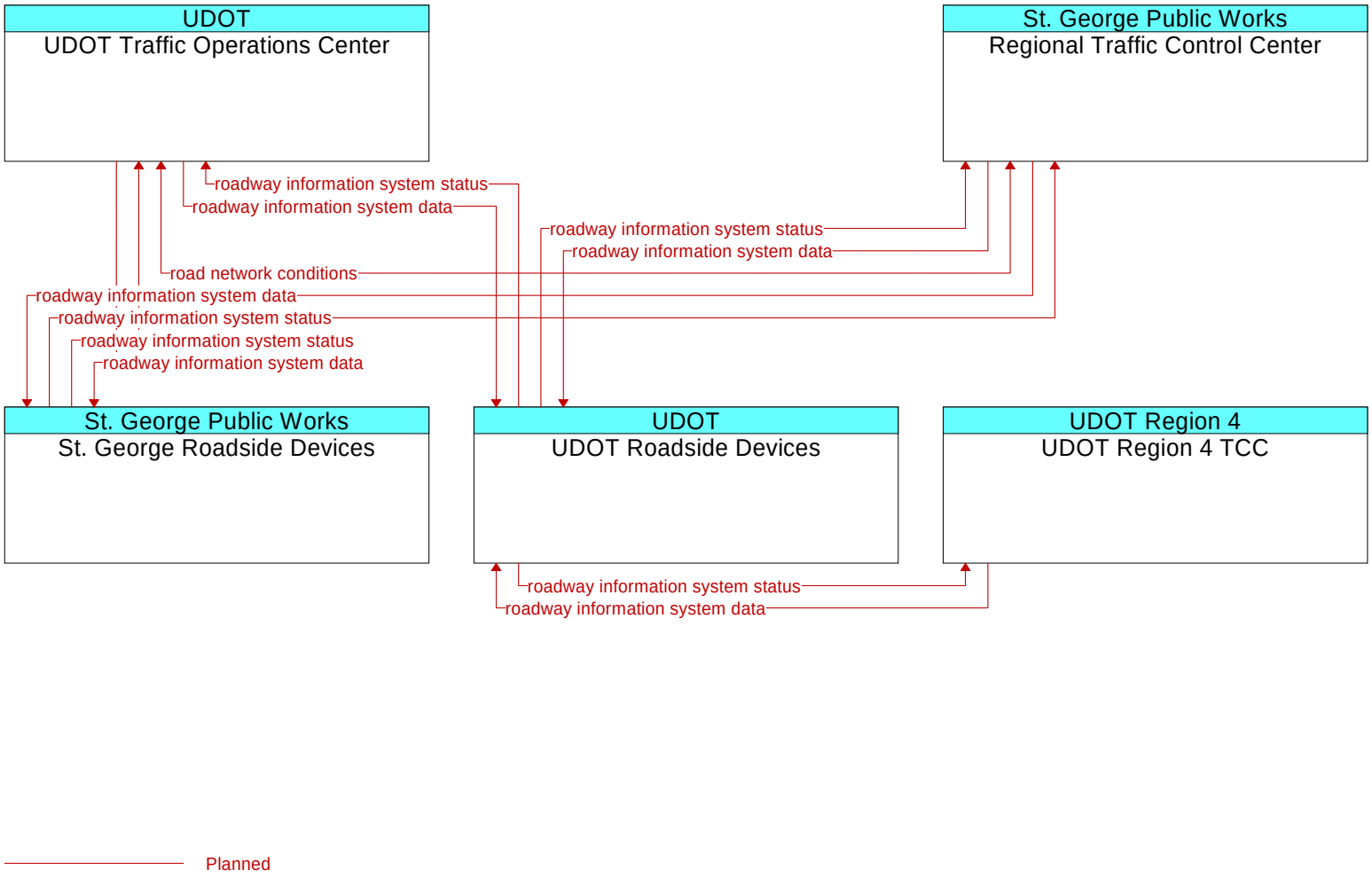
ATMS03: Surface Street Control – Information Flow Diagram



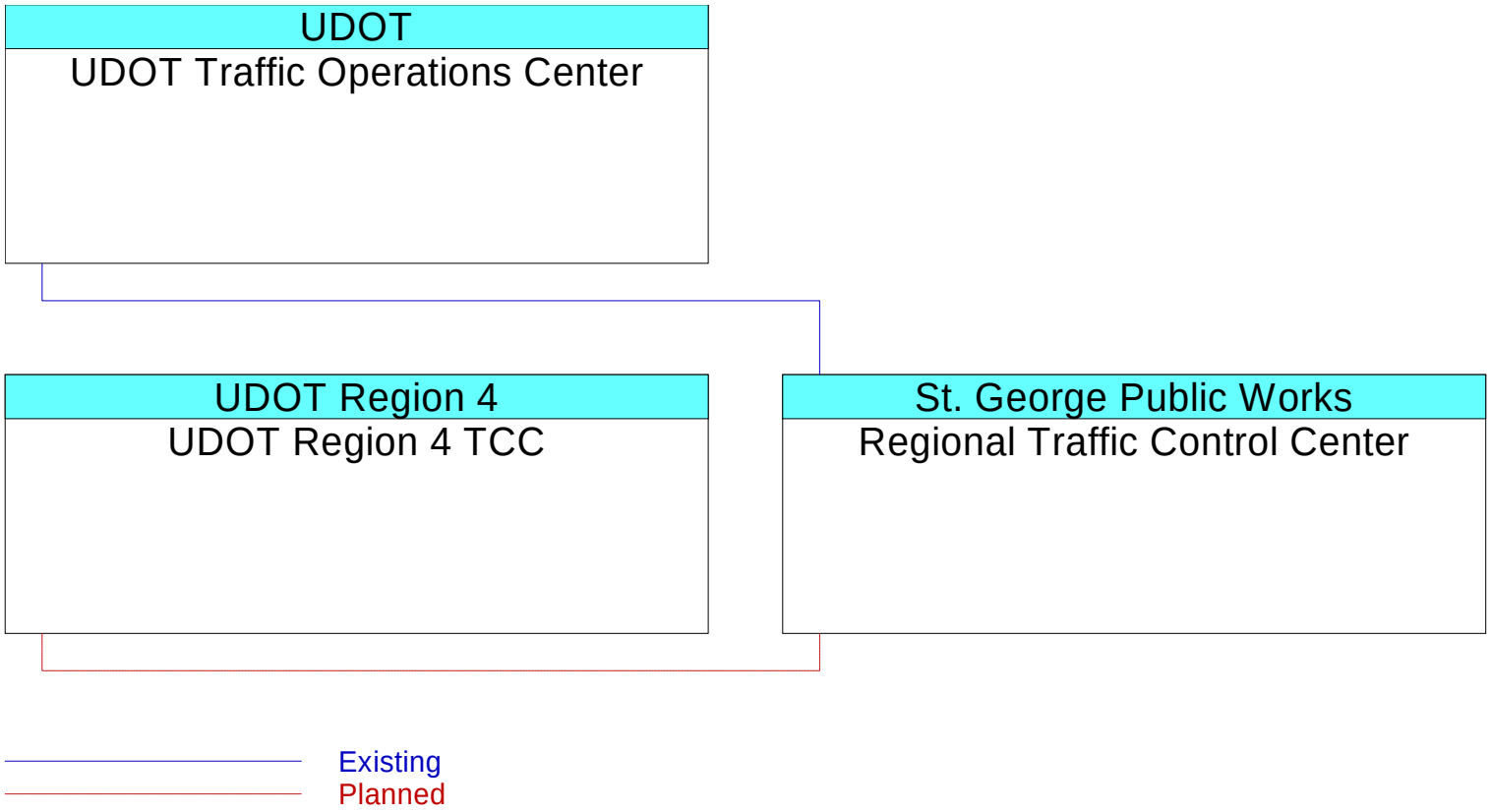
ATMS06: Traffic Information Dissemination – Interconnect Diagram



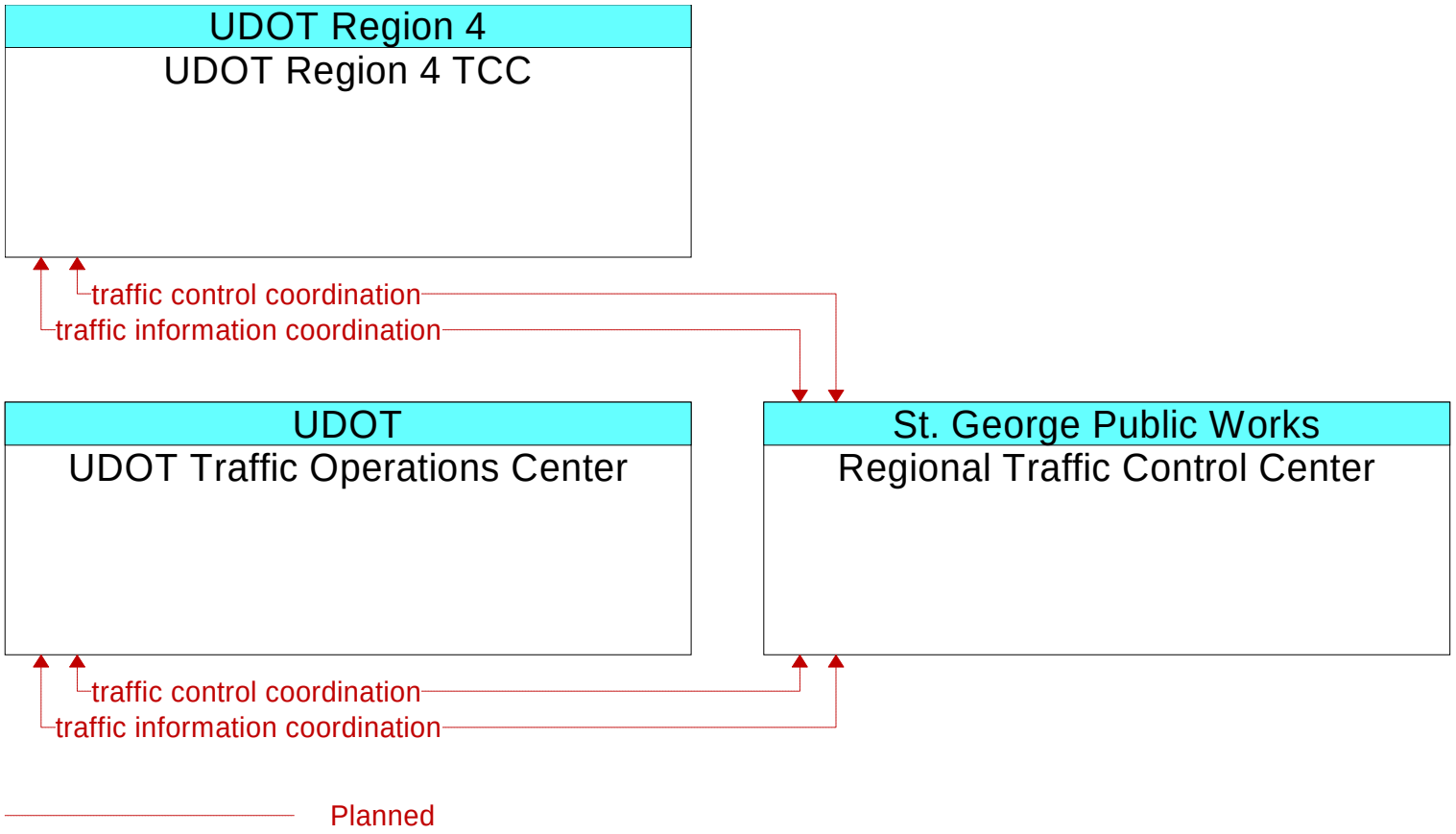
ATMS06: Traffic Information Dissemination – Information Flow Diagram



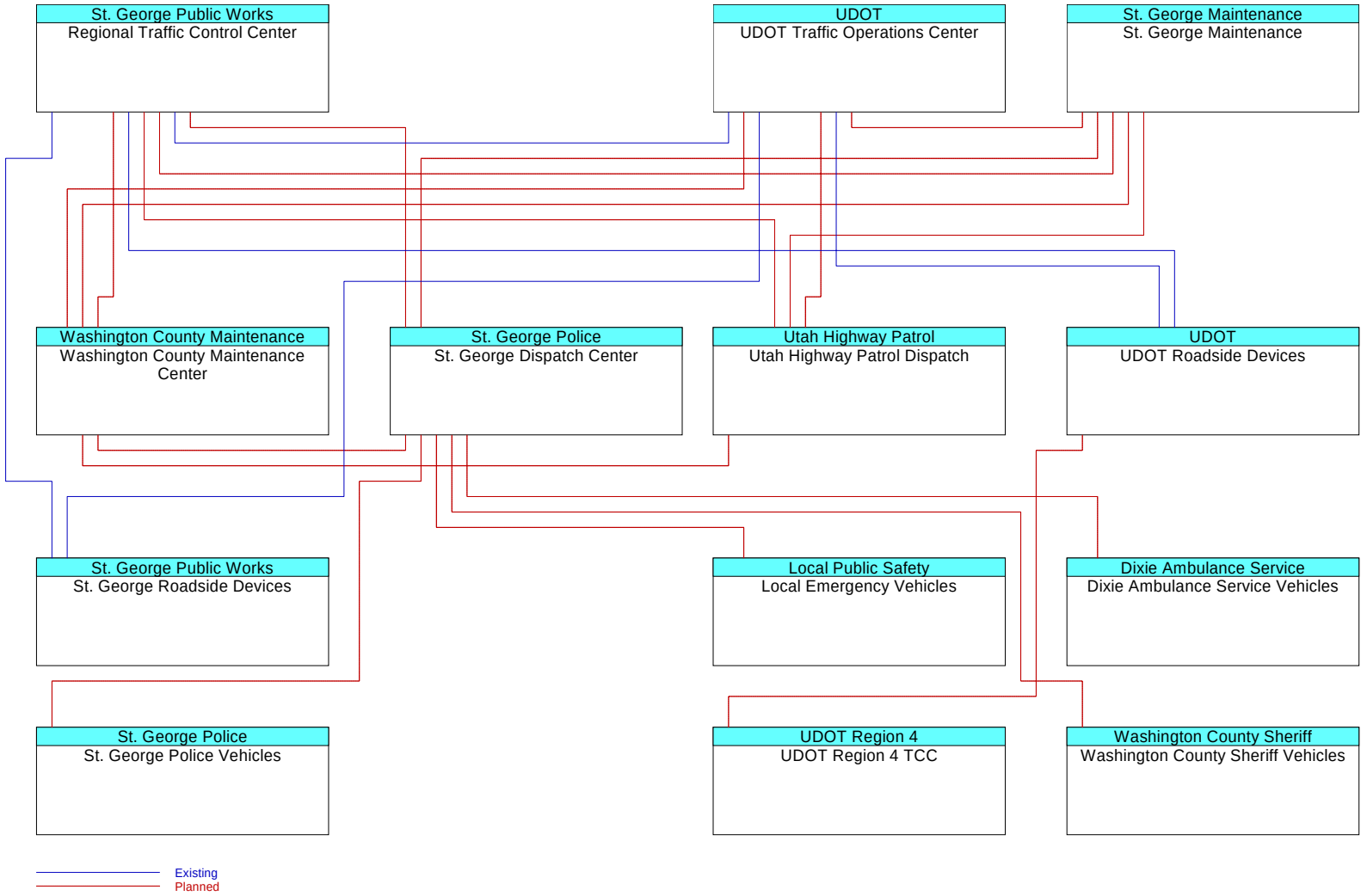
ATMS07: Regional Traffic Control – Interconnect Diagram



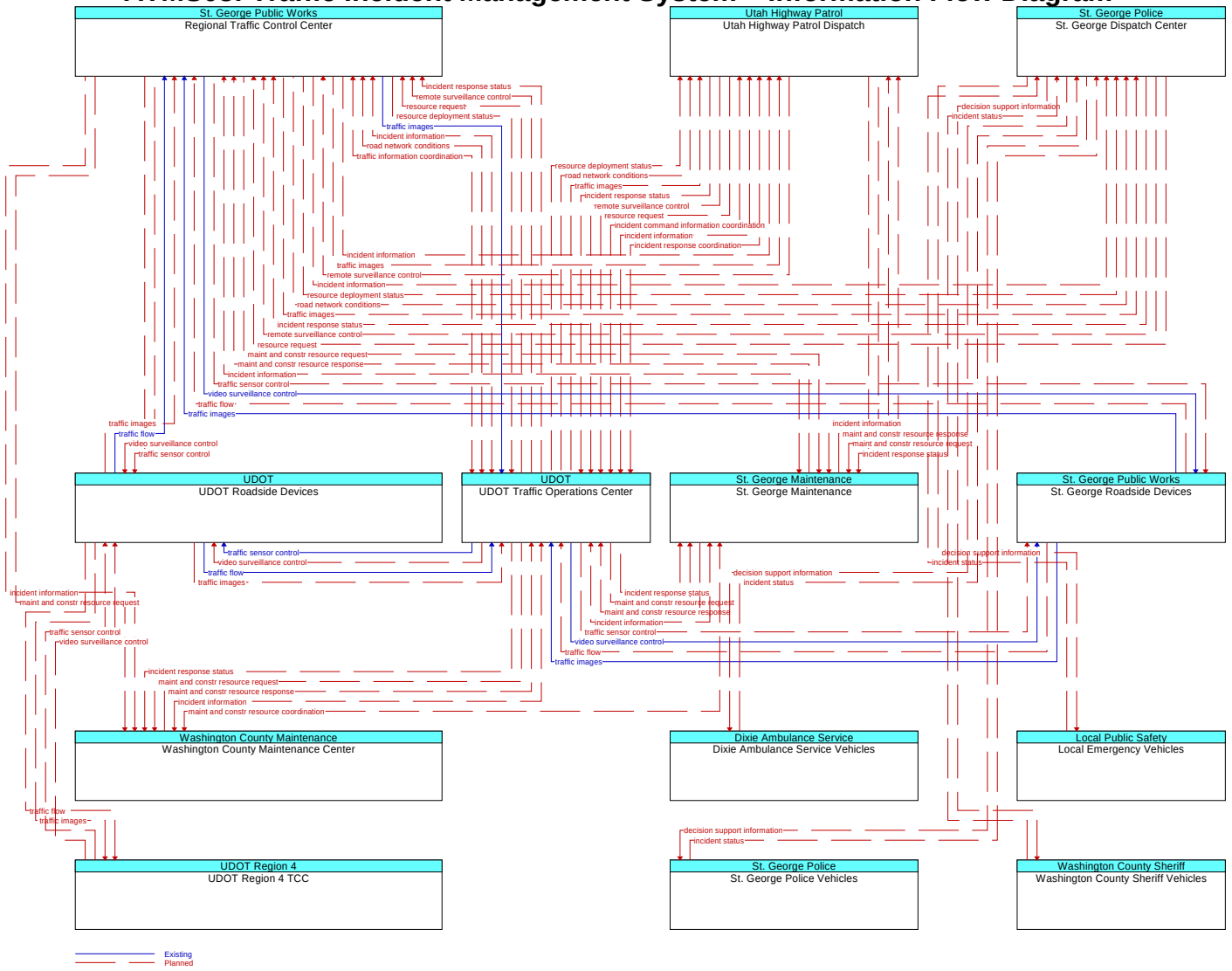
ATMS07: Regional Traffic Control – Information Flow Diagram



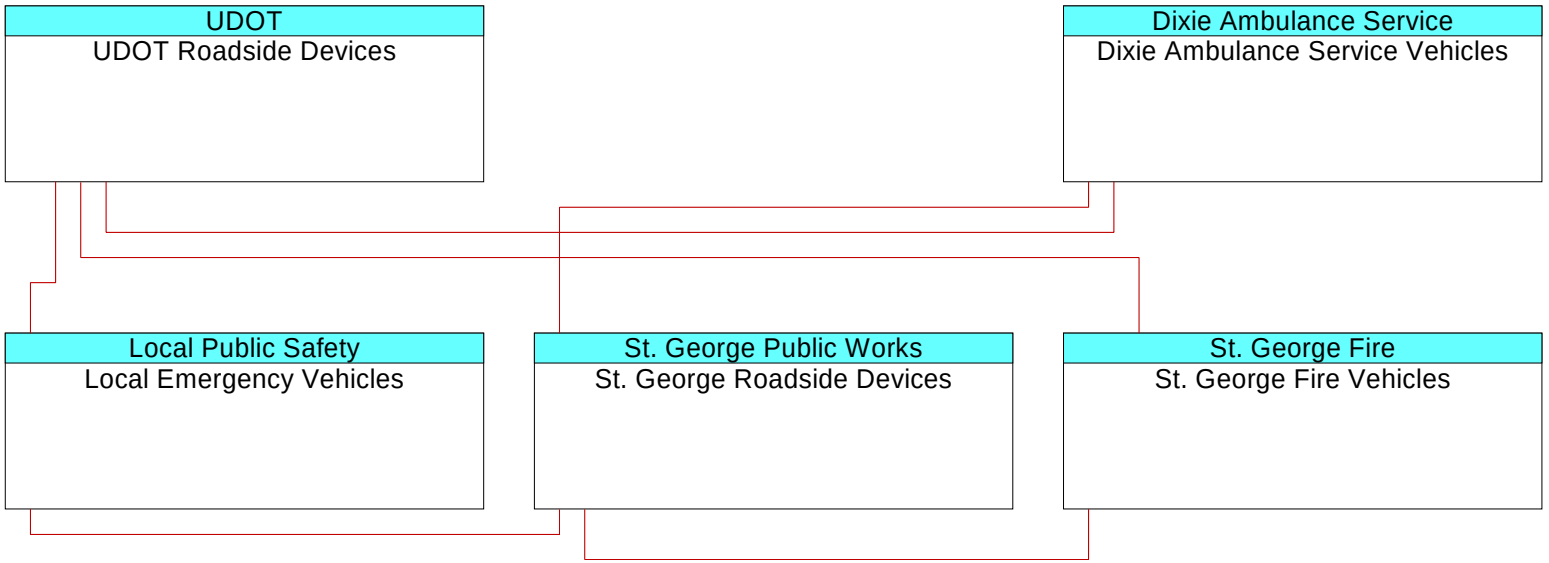
ATMS08: Traffic Incident Management System – Interconnect Diagram



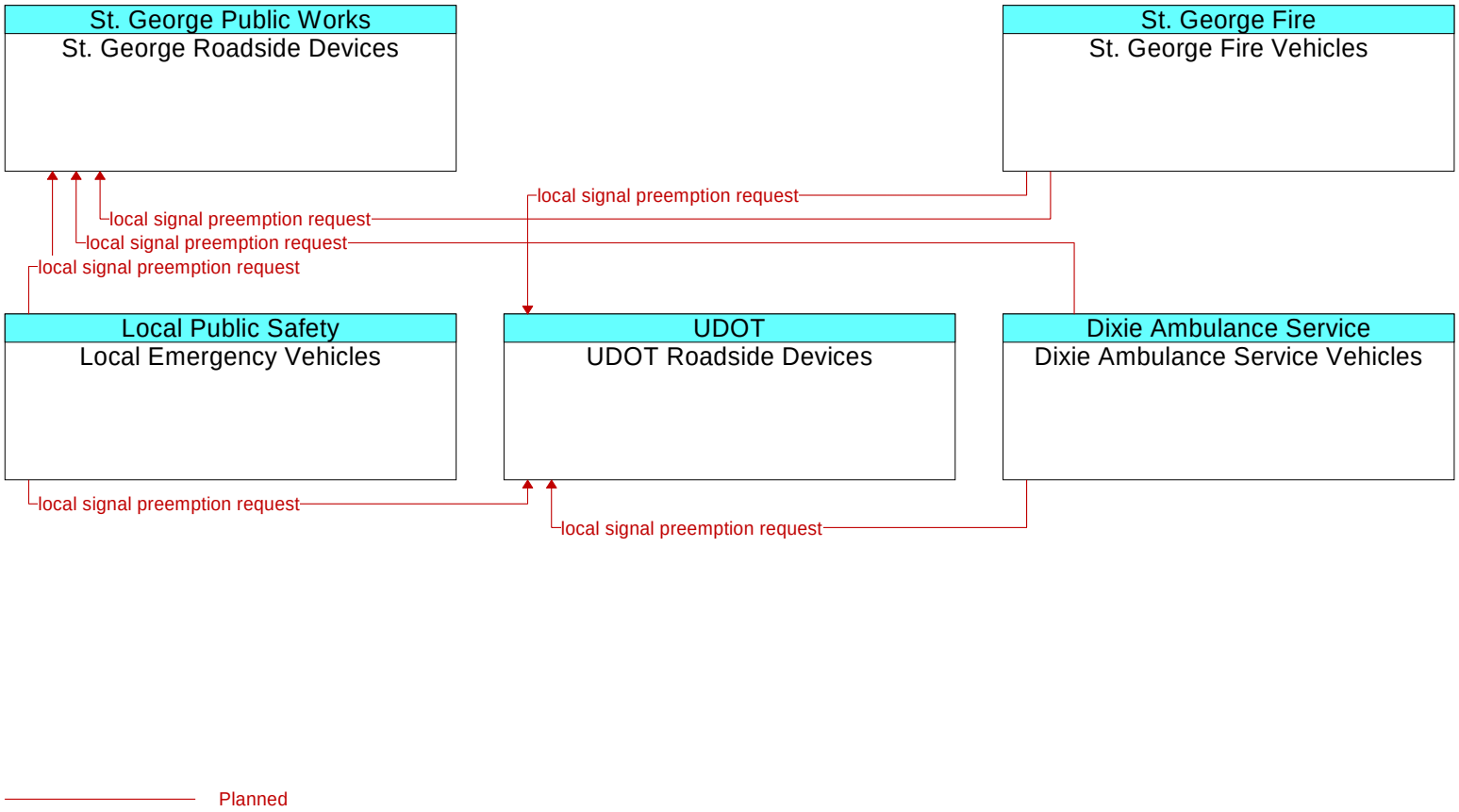
ATMS08: Traffic Incident Management System – Information Flow Diagram



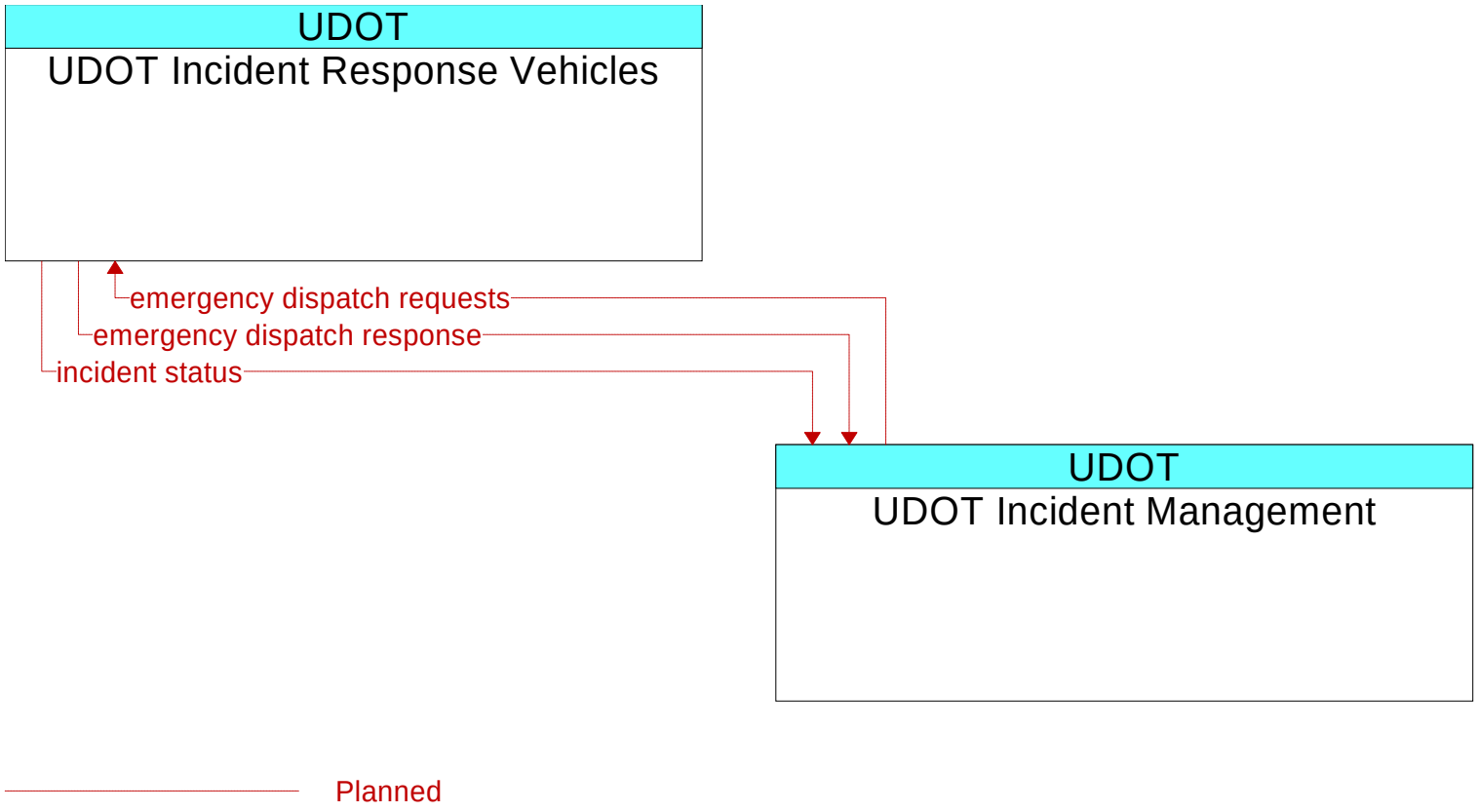
EM02: Emergency Routing – Interconnect Diagram



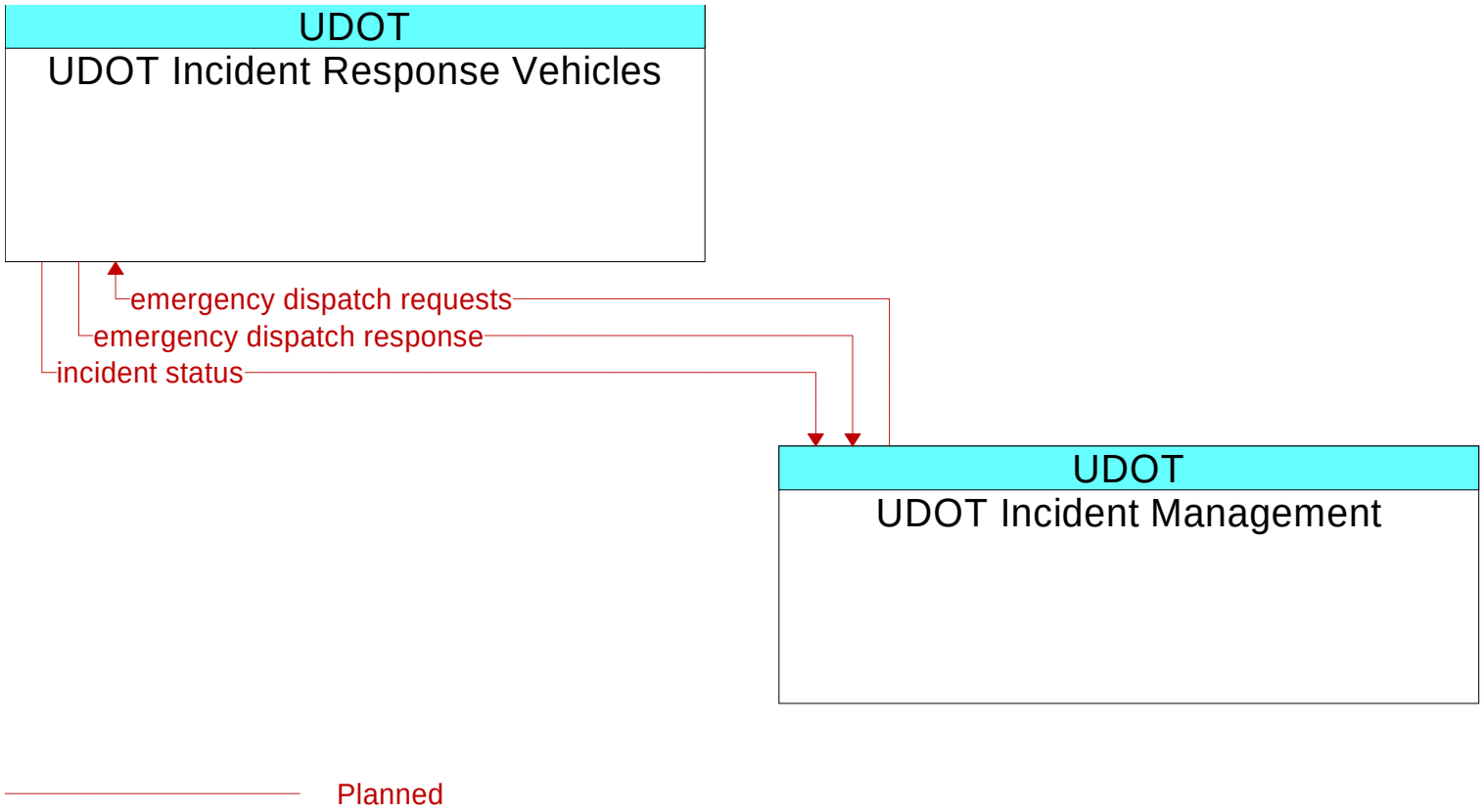
EM02: Emergency Routing – Information Flow Diagram



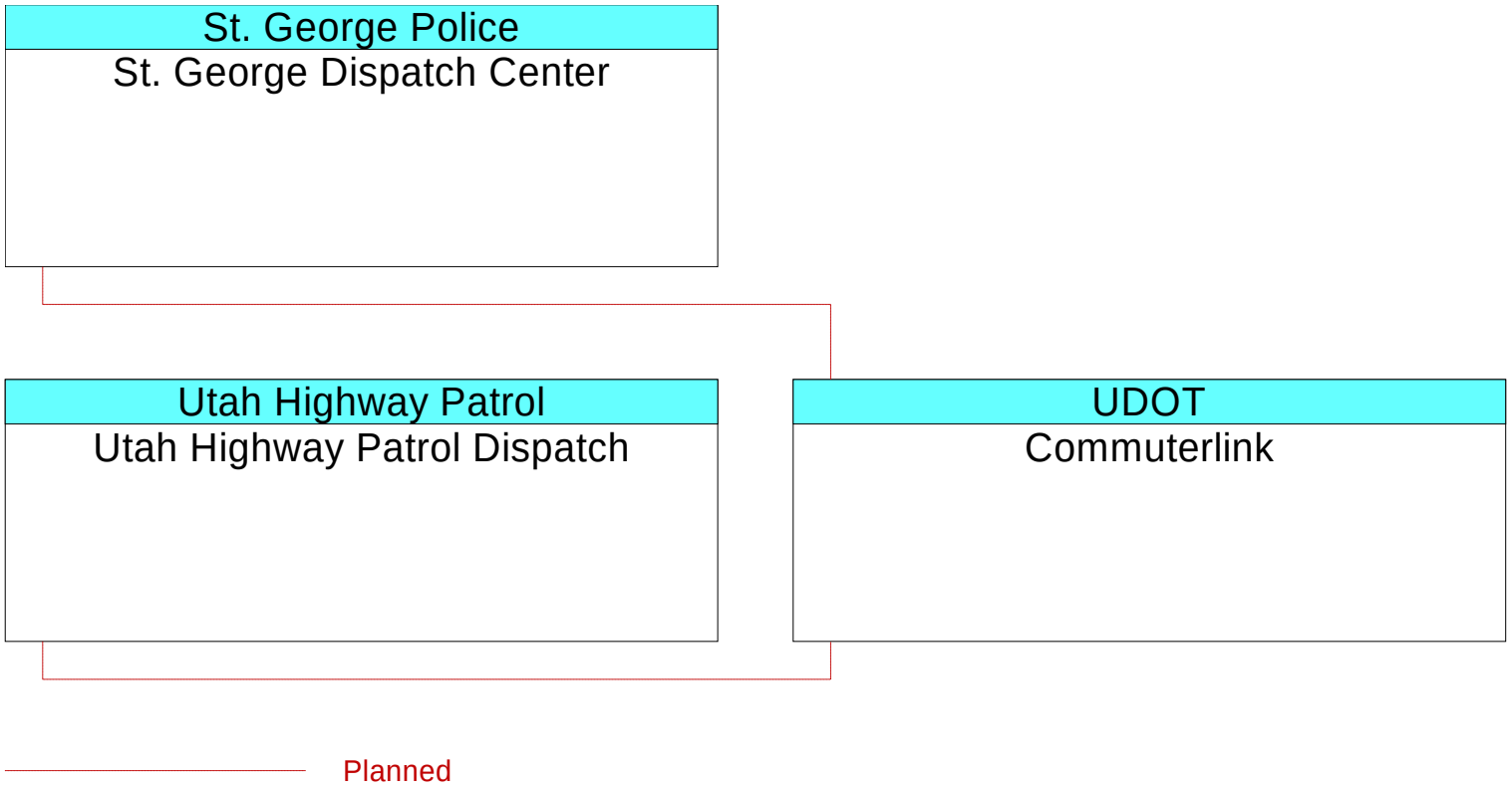
EM04: Roadway Services Patrol – Interconnect Diagram



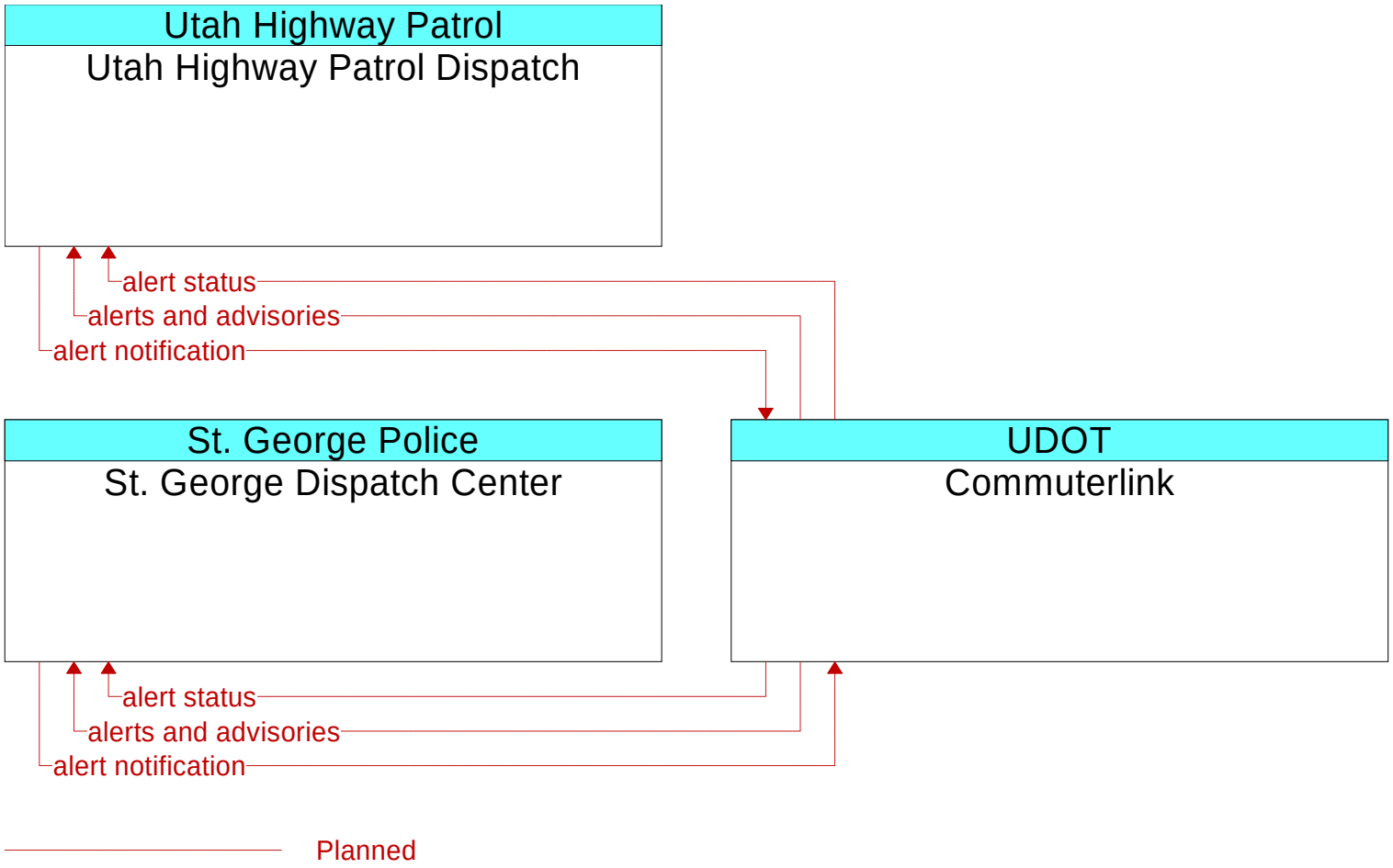
EM04: Roadway Services Patrol – Information Flow Diagram



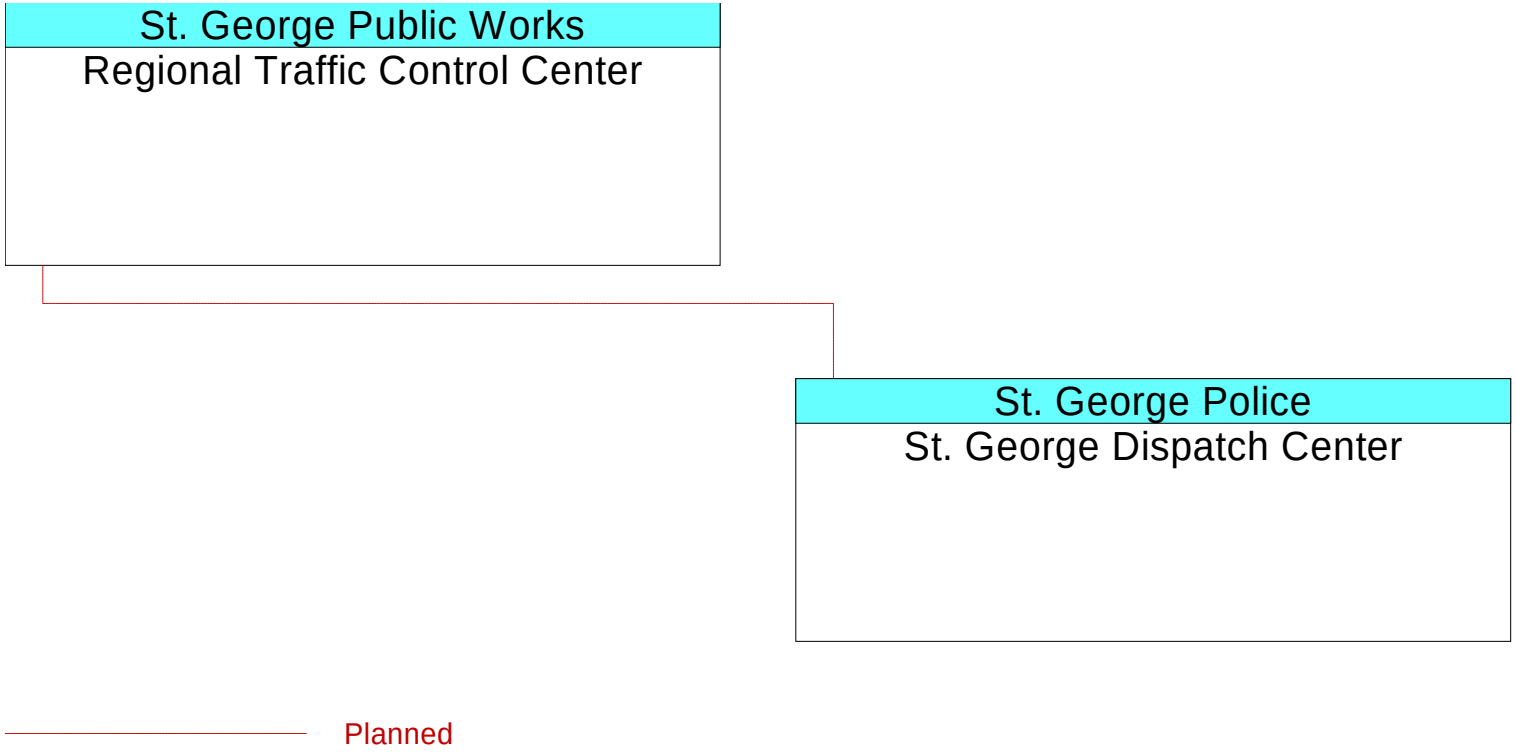
EM06: Wide-Area Alert – Interconnect Diagram



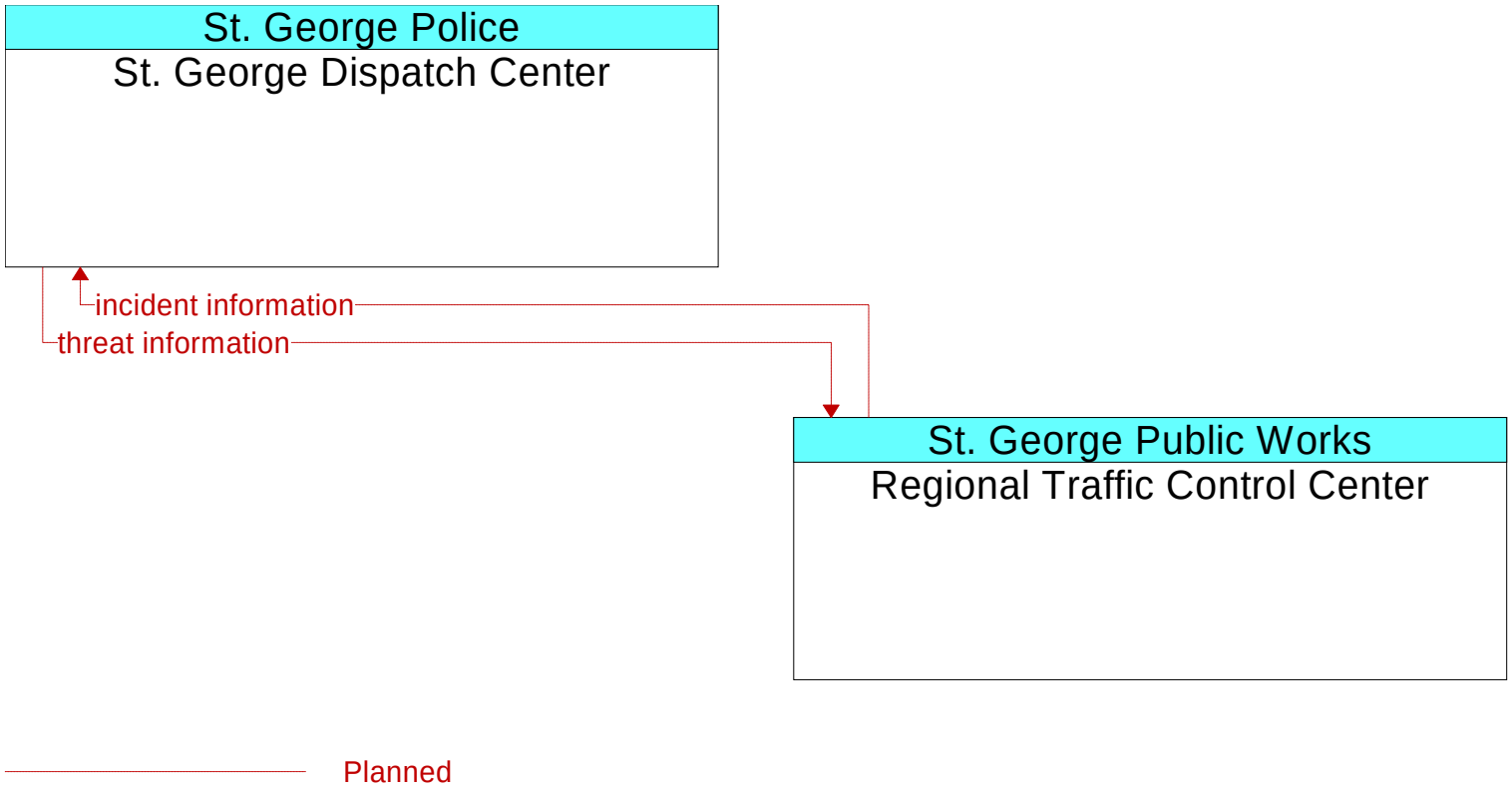
EM06: Wide-Area Alert – Information Flow Diagram



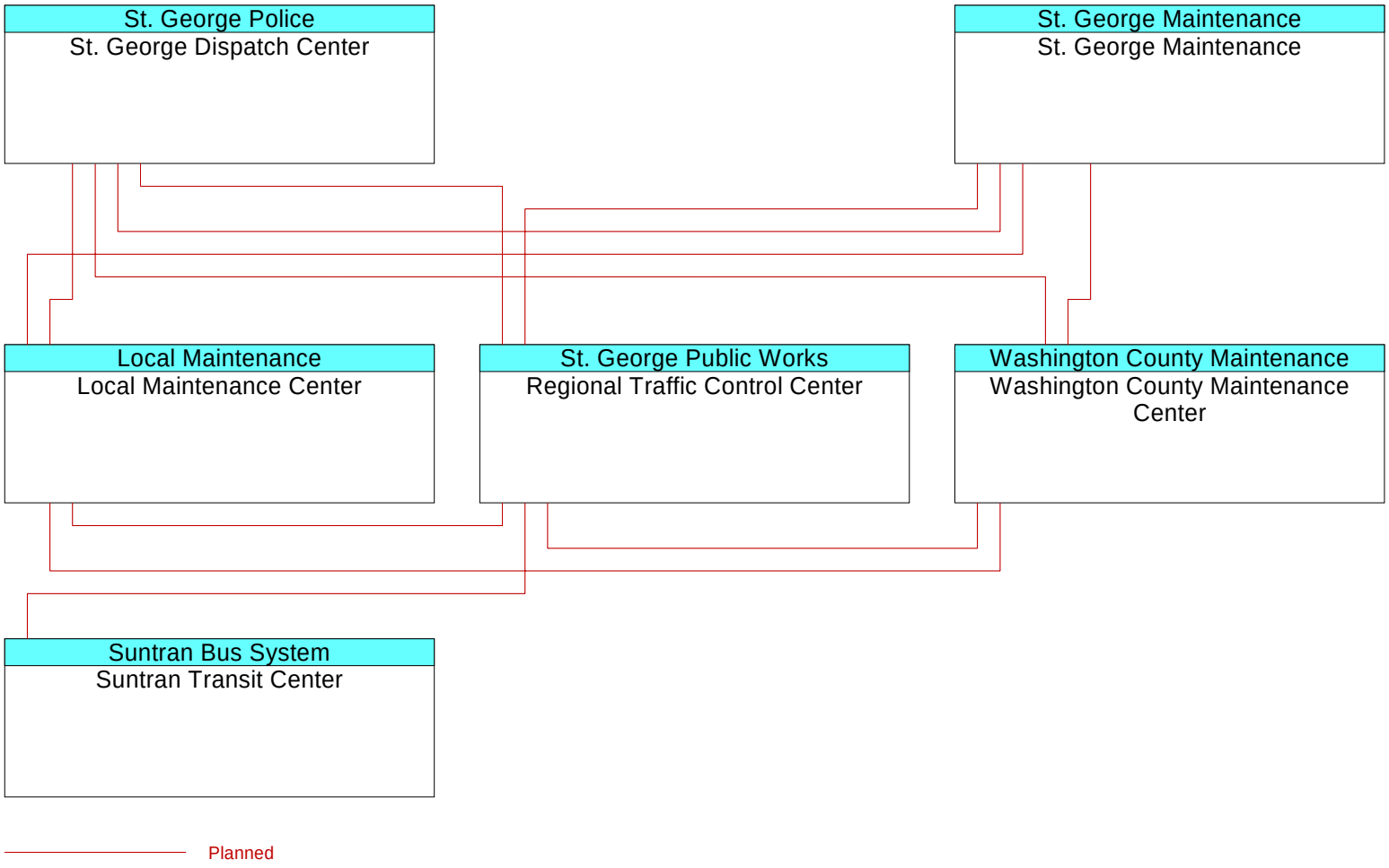
EM07: Early Warning System – Interconnect Diagram



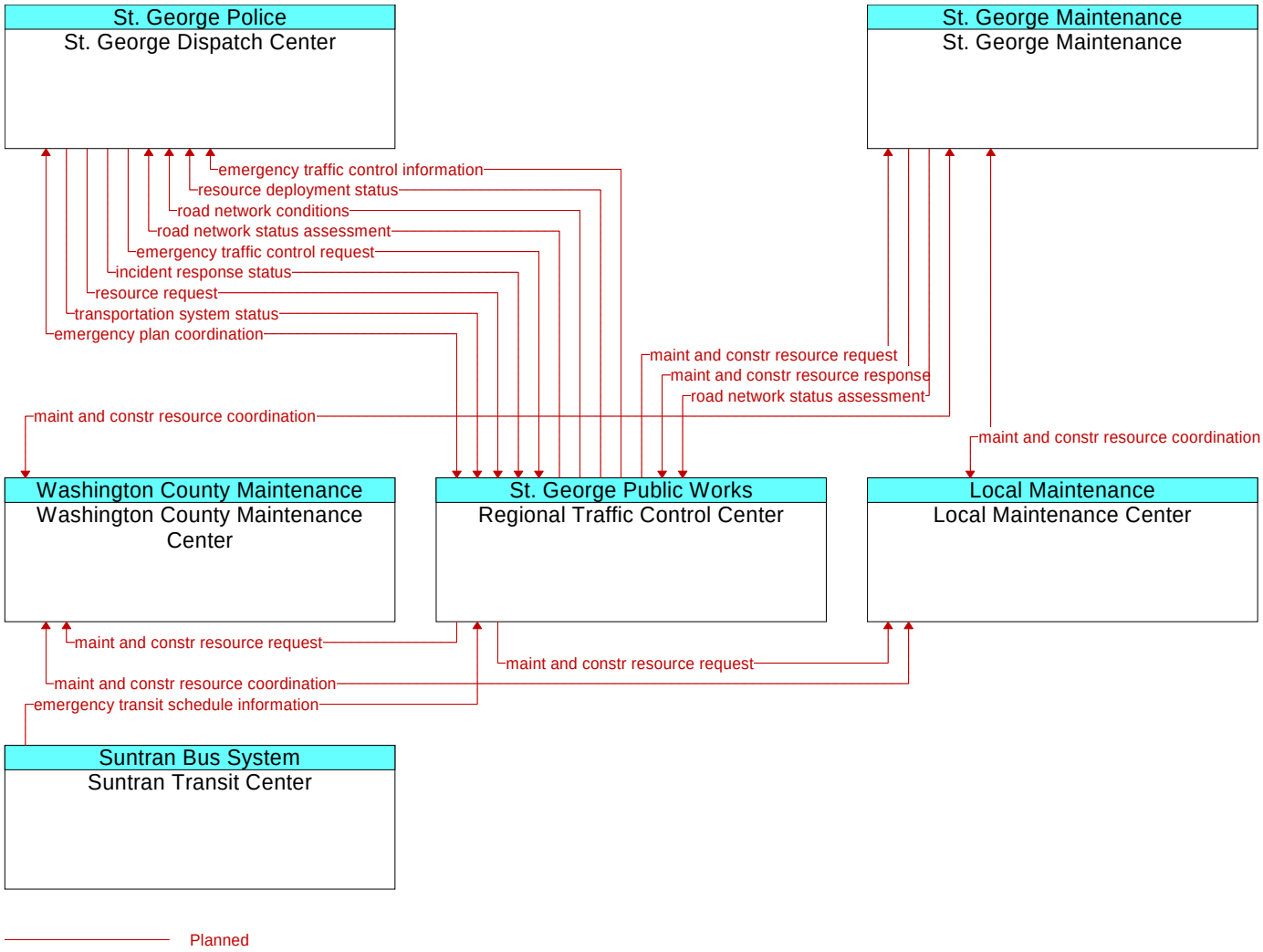
EM07: Early Warning System – Information Flow Diagram



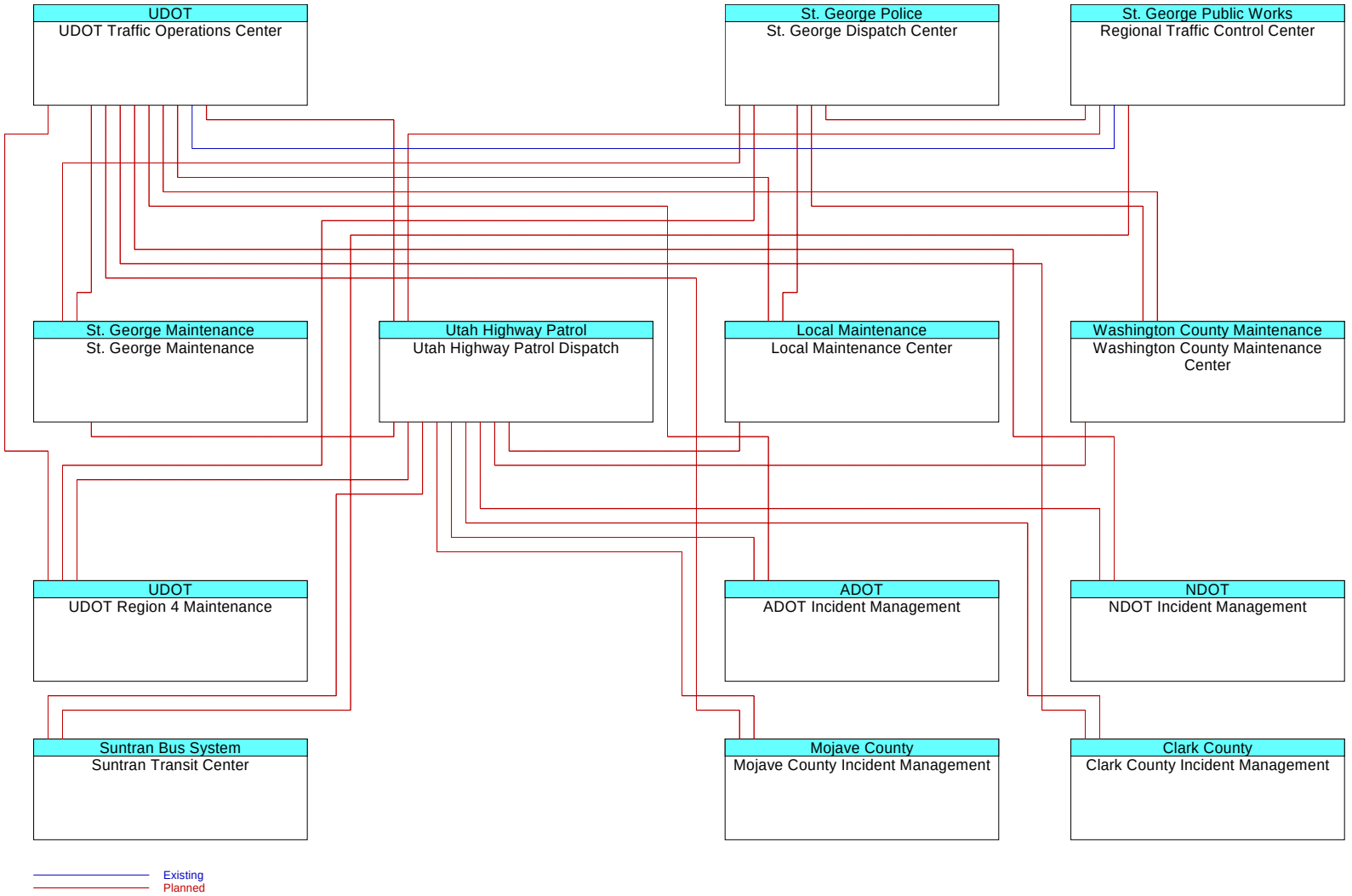
EM08: Disaster Response and Recovery – Interconnect Diagram



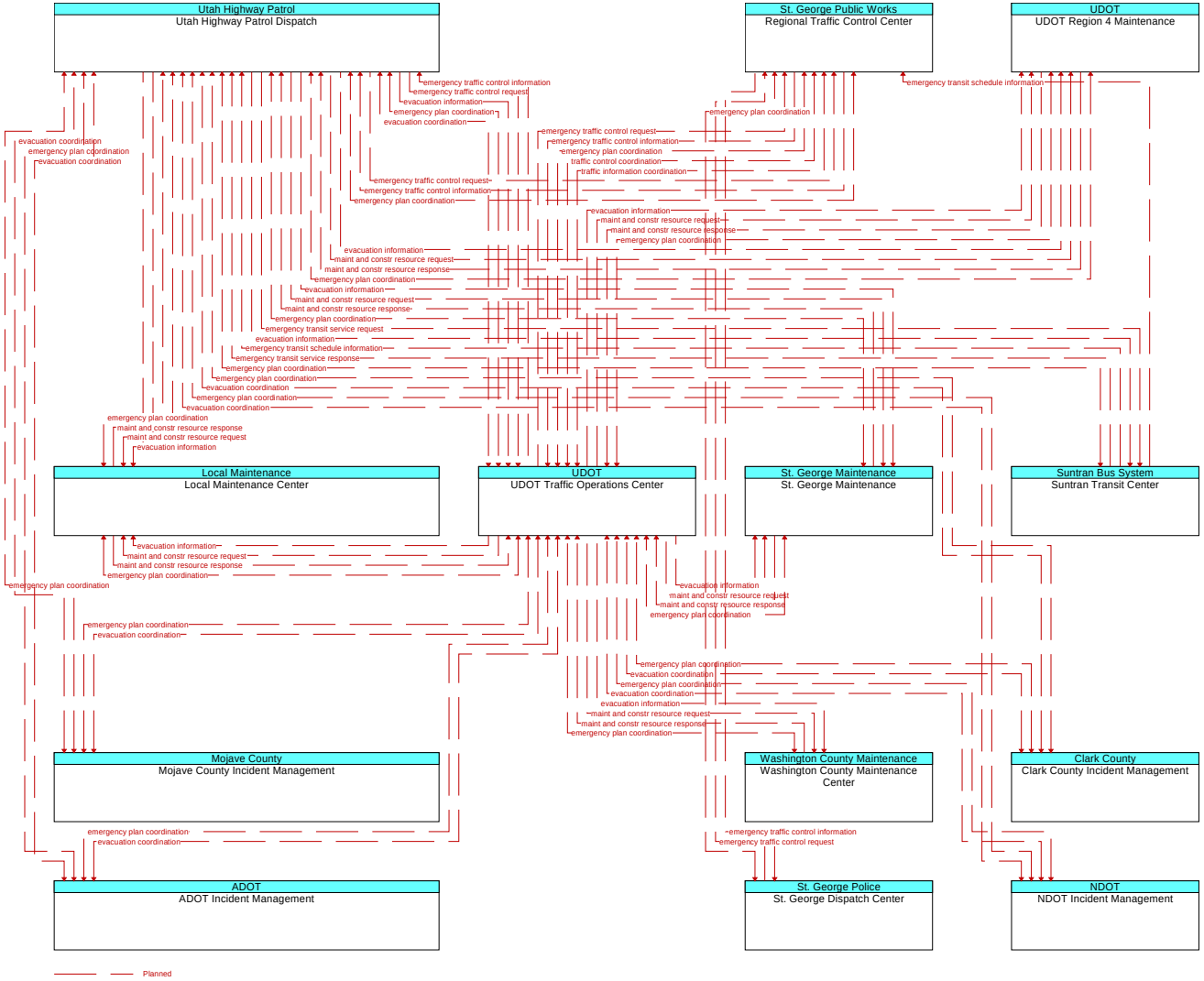
EM08: Disaster Response and Recovery – Information Flow Diagram



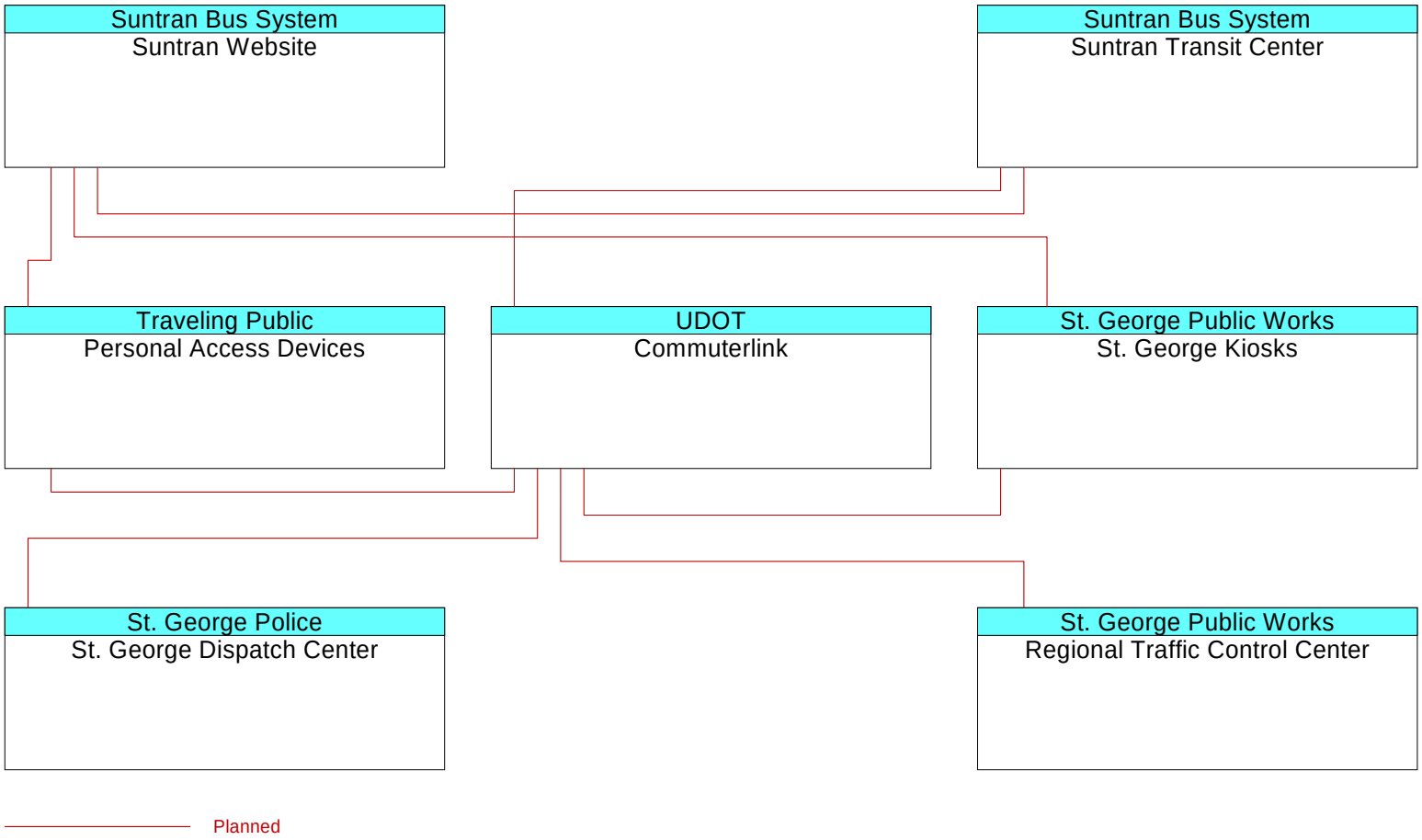
EM09: Evacuation and Reentry Management – Interconnect Diagram



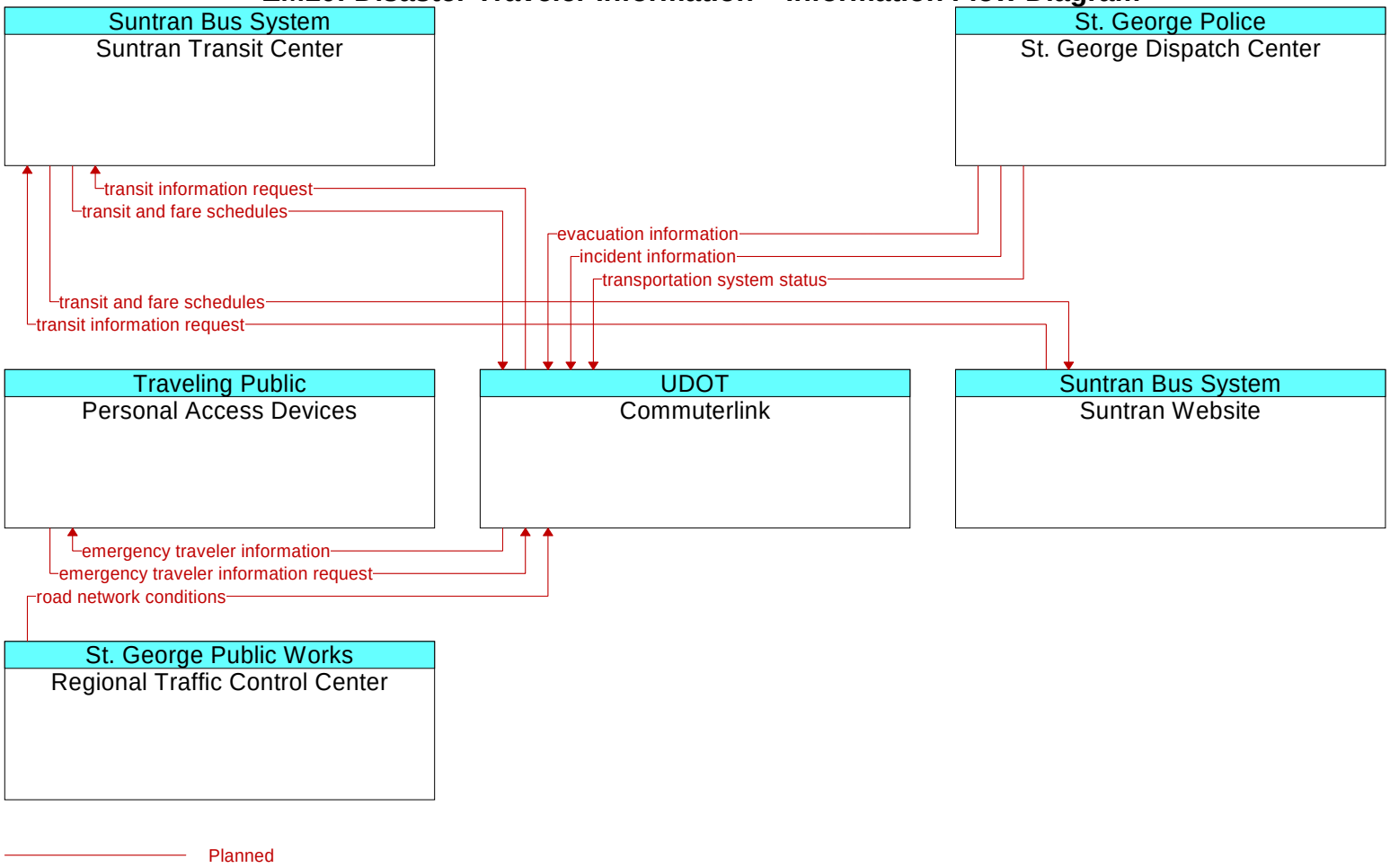
EM09: Evacuation and Reentry Management – Information Flow Diagram



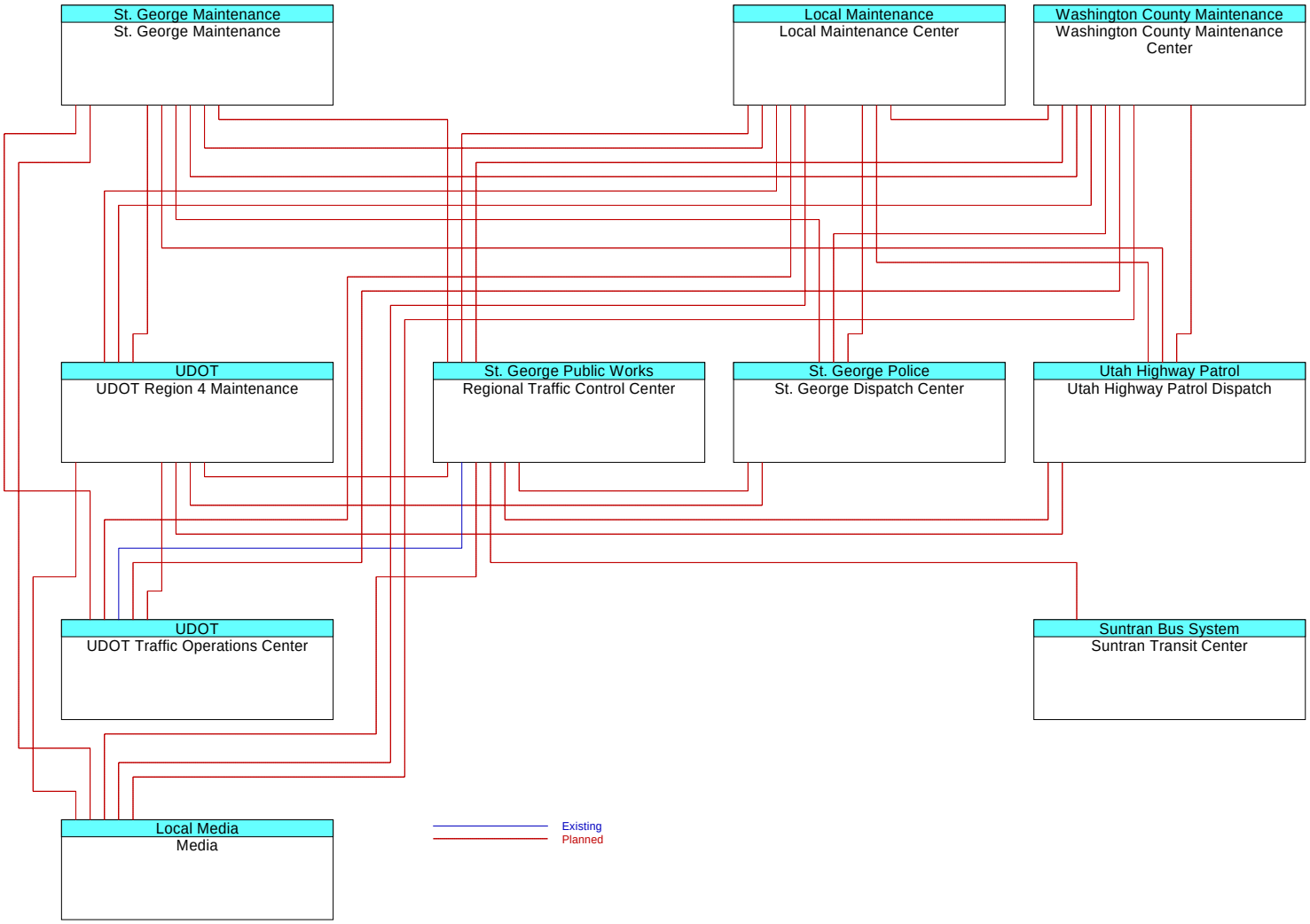
EM10: Disaster Traveler Information – Interconnect Diagram



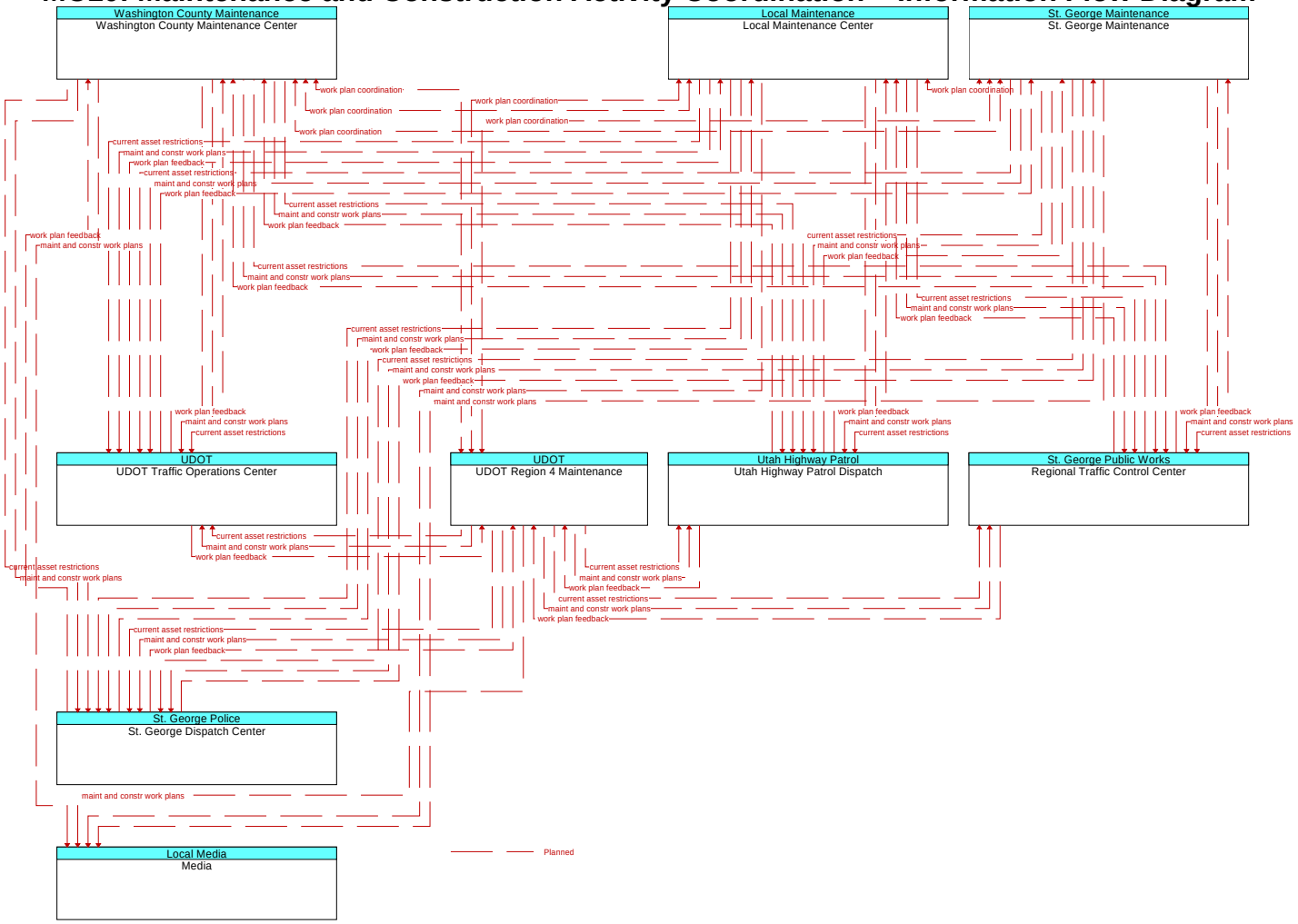
EM10: Disaster Traveler Information – Information Flow Diagram



MC10: Maintenance and Construction Activity Coordination – Interconnect Diagram



MC10: Maintenance and Construction Activity Coordination – Information Flow Diagram



APPENDIX C

Sample Architecture Change Request Form

Stakeholder Proposing Change	Name		Title	
	Agency			
	Email			
	Phone No.		Fax No.	
Date				
Description of Change	Title	*Short Description (up to 25 characters)*		
	Detailed Description	*(What is to be added, deleted or modified? Attach additional documentation, including a project architecture, as necessary)*		
	Type of Change	☐ New Project/System ☐ Deleted Project/System ☐ Modified Project/System	☐ New/Changed Stakeholder ☐ Change in Project Status ☐ Change in Project Priority ☐ Other	
	Systems or Projects	*Name of System(s) or Project(s) being implemented or modified (if applicable)*		
Project Status	☐ PROPOSED (funding not yet secured) ☐ PLANNED (funding secured) ☐ UNDER CONSTRUCTION (stakeholder is currently deploying system/project) ☐ EXISTING			
Additional Notes (submit additional pages if necessary)				