

## **RETROFITTING A CONCEPT OF OPERATIONS INTO AN ESTABLISHED STATEWIDE ATMS**

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Using a proper systems engineering process for implementing ITS is now commonplace. However, mature statewide DOT-managed systems, were not implemented using systems engineering. Georgia's NaviGator ATMS, initially deployed in 1996, is an example. Recently, a Georgia Regional ITS Architecture was developed as well as a Systems Engineering Management Plan. However, GDOT and each State and local agency continued to operate ITS somewhat independently. Each had a working set of policies and procedures to support ITS operations, but had no written unifying operations concept. GDOT recognized that in order to support future growth and expansion of ITS in Georgia, all ITS stakeholders needed to work together to meet common goals. Therefore, a GDOT ITS Concept of Operations was developed to facilitate this need and help GDOT move forward with ITS.

Georgia, NaviGator, ATMS, Atlanta, Concept of Operations, Stakeholders, Interviews, Incident Management, Responsibilities, Systems Engineering

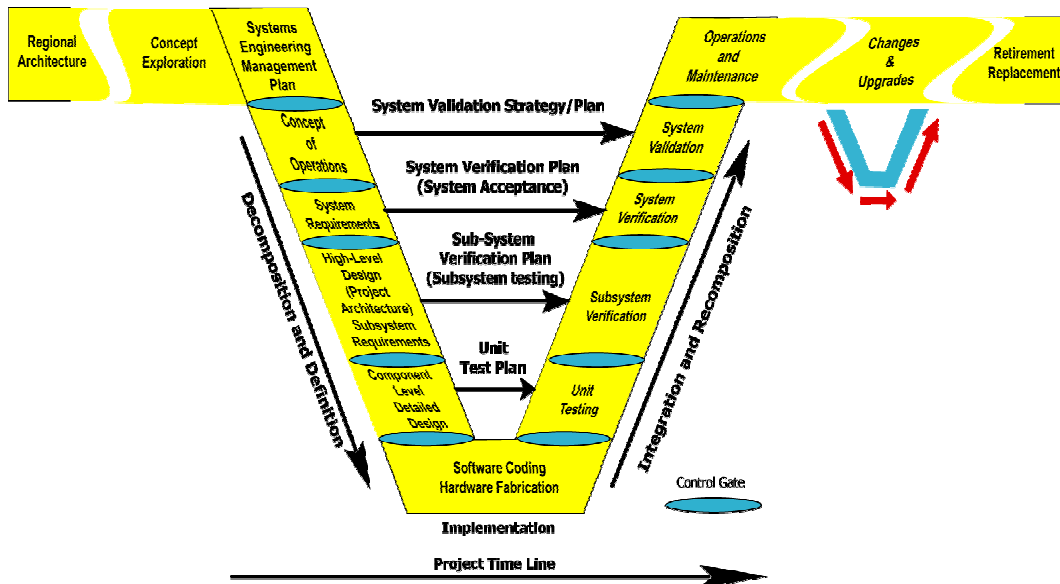
### **INTRODUCTION**

A formal Systems Engineering process was not used by the Georgia Department of Transportation (GDOT) to design the original Georgia NaviGator ATMS, located in Atlanta. Although not the original reason for looking into obtaining an ITS system for Atlanta, the announcement in 1991 that Atlanta would be hosting the Summer Olympic Games led to the lofty goal of having a fully implemented ATMS by 1996. The GDOT NaviGator ATMS went on-line in April 1996. For years after the Olympics, the Georgia NaviGator program continued to grow, expand and achieve a large measure of success and critical acclaim.

#### **Why a Concept of Operations Was Needed**

GDOT and the local MPO, the Atlanta Regional Commission (ARC) recognized that for the Georgia NaviGator and the presence of ITS across Georgia to continue to grow and expand, they needed to adhere to a structured system engineering process and approach to ITS projects. This process and approach is defined by Federal Highway Administration (FHWA) guidelines (1). Figure 1 illustrates the systems engineering process.

The first step, the Georgia Regional ITS Architecture (2), was developed in 2005 and provided a roadmap and a framework for integrating ITS projects. The second step, the Systems Engineering Management Plan (3) was developed in 2006 and defined the process that should be used for any ITS project implemented by GDOT.



**Figure 1 – Systems Engineering Process**

Although a systems engineering process had begun, users of ITS across the state, including GDOT and municipalities in metro Atlanta and throughout the state, lacked a single unifying operations concept. The developed Concept served to document current ITS deployments statewide, direct future ITS deployments and support a planned update to the Georgia NaviGator ATMS. Written as the third step of the systems engineering process, the GDOT ITS Concept of Operations document met this need. This Concept documented the operations of the current GDOT ITS program and addressed GDOT’s roles and responsibilities for the deployment and integration of future ITS services.

### **How the Concept of Operations is to be Used**

The Georgia Department of Transportation (GDOT) ITS Concept of Operations was written to *define* GDOT’s approach to ITS. It provides a high-level description of the major system capabilities, for both the present and the future, by defining the *who, what, where, when, why and how* for GDOT ITS deployment. The Concept of Operations defines the interaction between GDOT and the various stakeholders and end users (*e.g., GDOT District offices, local governments, planning agencies, public safety providers, the media, and most importantly, the public*).

The *purpose* of developing the ITS Concept of Operations was to document the operations of the current GDOT ITS program, as well as to address GDOT’s role and responsibilities for deployment and integration of future ITS services, to be deployed by GDOT and other agencies involved in management of the capacity of the roadways.

The Concept of Operations helped to refine the Mission, Vision and Goals of the NaviGator program. They were tailored by the Steering Committee for this project. Some items that were addressed in tailoring the Mission, Vision and Goals included:

- Interoperability with ITS elements outside of GDOT
- Coordination with ITS elements outside of the NaviGator system

- Expansion of ITS to additional areas of the state outside Metro Atlanta and Macon

In establishing the GDOT ITS Concept of Operations, the above items were goals that were *implicitly* understood by most if not all agencies in Georgia, including GDOT. However these particular goals were not *explicitly* defined in writing nor was there a specific plan in place to be meeting these goals. This is an excellent example of how using a systems engineering process has been helpful to GDOT and the overall NaviGator program.

## **STUDY PROCESS**

The following describes the sequence of activities used to develop the Concept of Operations document:

- Conducted extensive background research to review and summarize the existing ITS elements in Georgia.
- Created a steering committee of GDOT stakeholders to help identify and articulate the content of the Concept of Operations. This committee reviewed the current ITS and NaviGator programs and put considerable thought into how to expand on past successes. Next the committee identified improvements to the Concept to make the NaviGator program work even better in the future.
- Held meetings and conference calls with related stakeholders including GDOT management, local government transportation departments, and other regional and statewide agencies with an interest in ITS. These meetings were conducted to identify ITS efforts implemented by other agencies outside of GDOT and identify GDOT's role in various ITS service areas. Input from each of the stakeholders was collected and organized for deriving the Concept.
- Met with the steering committee to engage in *visioning*, which is a process of forecasting what the future of ITS will be in Georgia. This process helped to organize the input gathered from the stakeholders.
- Presented the final Concept of Operations document to GDOT and the other stakeholders.

### **Existing ITS in Georgia**

Figure 2 provides an overview of the current NaviGator system. There is a Statewide TMC operated by GDOT in Atlanta. The Statewide TMC uses ITS to manage traffic and incidents on the freeways and state routes across Georgia. There are several standalone TCCs managed by local government agencies, which also use ITS tools to help manage their arterial networks. There is also a Regional TMC in Macon that is co-staffed by GDOT and the City of Macon/Bibb County. This joint facility serves as a local TCC for arterial management and as a Regional TMC for freeway management in and around Bibb County.

In addition to the TMCs and TCCs, the NaviGator system includes the physical ITS subsystems that are used to collect and share traffic and incident information. These include several ITS software applications, the associated hardware platform, the communications backbone, and associated field devices on the freeways, all of which are owned and operated by GDOT.

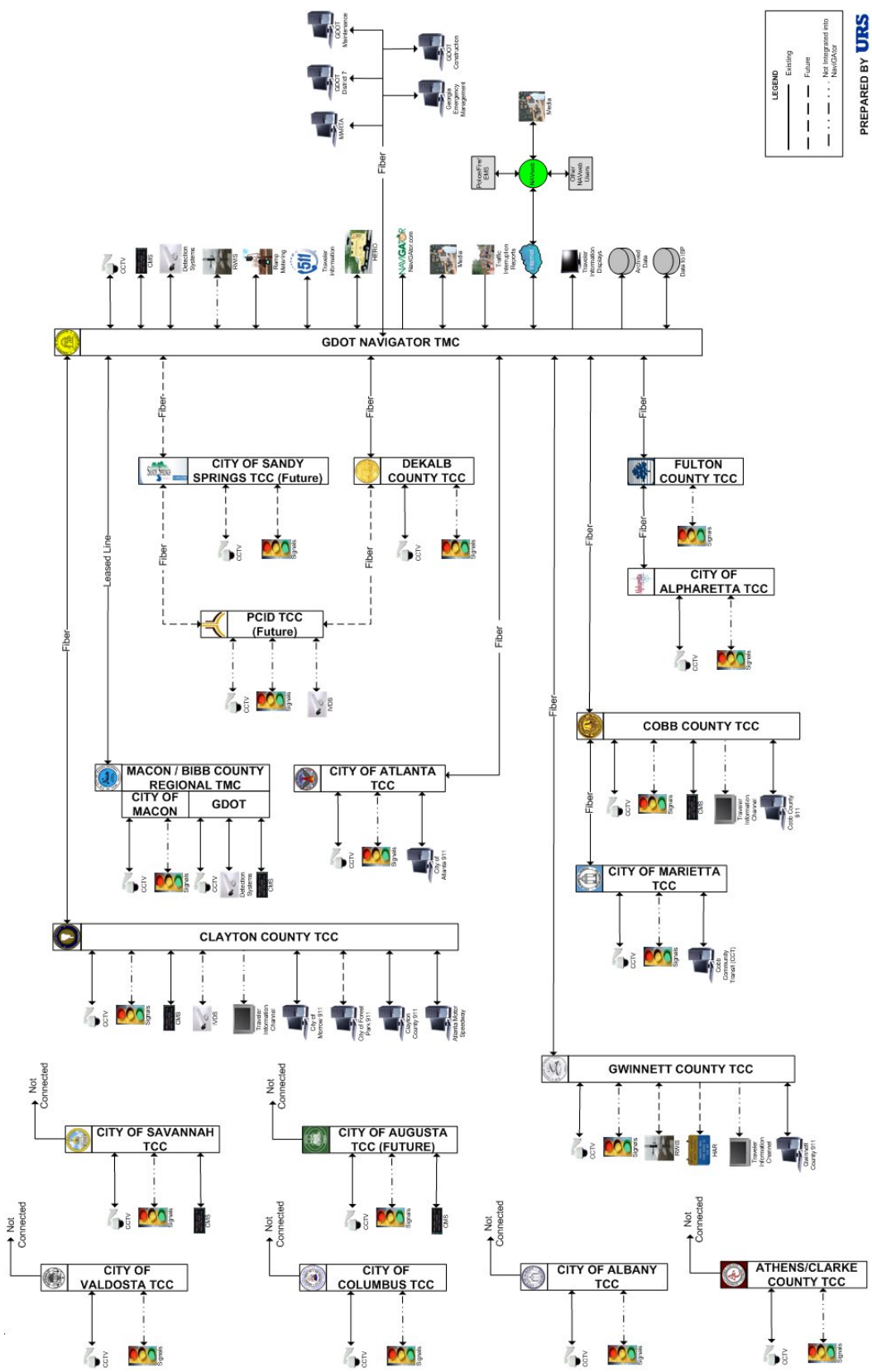


Figure 2 – GDOT Navigator System Overview

## Stakeholder Interview Feedback

An important part of the systems engineering process as it relates to the development of the Concept of Operations was obtaining input from ITS stakeholders. The purpose of the stakeholder input process was to obtain feedback from both internal and external stakeholders as to their viewpoints on:

- Their roles and responsibilities in planning, deploying, operating and maintaining ITS
- Their view of GDOT's role and responsibility in planning, deploying, operating and maintaining ITS (external stakeholders only)
- Their future ITS needs
- Their future vision for ITS

There were seven (7) distinct categories of stakeholders interviewed as part of the Concept development process. The following is a summary of the interview results from each stakeholder category:

### GDOT Steering Committee

- GDOT should provide a statewide, integrated Transportation Management System which facilitates the collection, processing, sharing and dissemination of information to manage the roadway system throughout the State of Georgia.
- A key component of the Transportation Management System should be software packages and tools that can be provided at a low cost, with minimal infrastructure investment, and reach a broad range of users.
- GDOT should pursue new technologies that facilitate integration and interoperability of multiple standalone systems, even if they are outside the traditional NaviGator system.
- Future ITS field deployments need to be scalable, adaptive and cost-effective solutions to well defined problems.
- GDOT should better define their roles, responsibilities and interactions with local agencies and ITS stakeholders.

### GDOT District Offices

- The role of the District Offices in ITS will grow as the system is expanded statewide. This role should be better defined for the future.
- Currently the major ITS focus of the District Offices is operating and maintaining traffic signal systems. More technology should be implemented to interconnect all traffic signal systems to a central location for monitoring and control purposes.
- As ITS is further implemented outside the Metro Atlanta area, there will be a need for TMCs in the Districts. These TMCs could be staffed and operated jointly with local jurisdictions in some areas.
- The District offices should be more involved in working with local government agencies in planning and implementing ITS technologies.
- There needs to be increased awareness of potential ITS solutions and benefits at the District level.

### GDOT Management

- GDOT Management supports the use of ITS as a key solution to solving congestion problems throughout the State.
- Future implementations of ITS need to be scalable, more cost effective, and focused on needs.
- ITS needs to be better integrated into the project planning and programming process. ITS technologies need to be considered at the earliest parts of the project development stage.
- There needs to be a clear plan for operations and maintenance of existing ITS as well as for future implementations.

#### Local Transportation Agencies

- Local transportation agencies are focused on operating arterials, especially traffic signals.
- ITS is a tool that helps local agencies better operate signals. In many instances, the remote monitoring capabilities provided by ITS technologies result in improved traffic signal maintenance.
- Local agencies depend on GDOT to set the standards for ITS.
- Local agencies depend on GDOT to support them with technology evaluation and maintenance support.
- The NaviGator software does not always meet the needs of their TCCs.

#### Planning Agencies

- ITS is an important tool in fighting congestion. ITS should be considered in regional planning efforts as a supplement or alternative to capacity projects.
- Federal funds are available for the deployment, operations and maintenance of ITS.
- ITS needs to be better integrated into the planning process. Education is needed, particularly at the local agency level, as to how to program ITS projects into the regional transportation plans.

#### Public Safety

- More effort should be placed on coordination between transportation management and 911 centers.
- There is benefit to public safety agencies having access to video images. Video enables public safety agencies to easily confirm incidents and dispatch the appropriate resources.
- The lack of integrated radio/voice communication systems among incident responders is a major issue.
- The TIME task force has been beneficial in bringing together the public safety community.

#### Tennessee Department of Transportation (TDOT)

- There is interest by both Georgia and Tennessee in sharing data, video and other information.
- A Memorandum of Understanding (MOU) should be pursued to allow the agencies to cross borders for the purposes of incident management. For instance, there is a need for TDOT HELP vehicles to enter Georgia.

The results of the interviews were analyzed and synthesized into the development of the final Concept of Operations.

## **The Final Concept**

The following is the overall strategy that GDOT will utilize for the future implementation of ITS. The strategy discusses the operational environment in which ITS functions will be executed, the software and systems that support this environment, and the roles and responsibilities of GDOT in implementing ITS and supporting the partners in the NaviGATOR program.

### **Operational Environment**

Operations and management of ITS is a function distributed among GDOT and its many ITS partners. Each have their own unique roles and responsibilities that determine how they utilize ITS technology to meet their own organizational goals. Figure 3 (ITS Concept of Operations) identifies GDOT and its partners, the various services they provide, and a high level overview of the data flows between the partners. This figure is not intended to be all inclusive of the partners, services and data flows, but is provided as an illustration for reference in discussion of the operational Concept.

Most ITS operations managed by transportation agencies are executed in Transportation Management Centers (TMCs) and Transportation Control Centers (TCCs) which work together to provide ITS services over an integrated communications network. This communications network consists of physical facilities owned by GDOT and its partners (the NaviGATOR network) and the Internet. Via this communications network, the partners transmit and share traffic data, incident information and roadway conditions.

The TMCs and TCCs have various functions depending on the facility owner and the concept of operations for the particular facility. As depicted in Figure 3, there are three types of facilities deployed:

#### **Statewide TMC**

The GDOT Statewide TMC, located in Atlanta, is wholly owned and operated by GDOT. The Statewide TMC serves as the base for planning, management and operations of the NaviGATOR system. The Statewide TMC also houses the control center that serves as the hub of GDOT's statewide ITS operations and as the facility where freeways throughout Metro Atlanta are monitored and managed on a 24/7 basis.

#### **Regional TMCs**

Regional TMCs are facilities that serve as the base of operations for GDOT's transportation management functions outside the Metro Atlanta area. Regional TMCs, staffed by GDOT District personnel, monitor and manage freeways and arterials in their designated coverage areas (i.e., those that are not otherwise managed by a local agency). At the present time, only one Regional TMC has been implemented, a joint TMC/TCC in District 3 staffed by GDOT and Macon/Bibb County. As ITS is further implemented in more areas of the State, it is anticipated that additional Regional TMCs will be deployed. These Regional TMCs may be standalone facilities or co-located with local agency TCCs.

#### **Local Agency TCCs**

Local agency TCCs are owned and operated by local agencies. These TCCs serve as the base of operations for the local agencies for managing the arterial systems within the jurisdiction of the local agency.

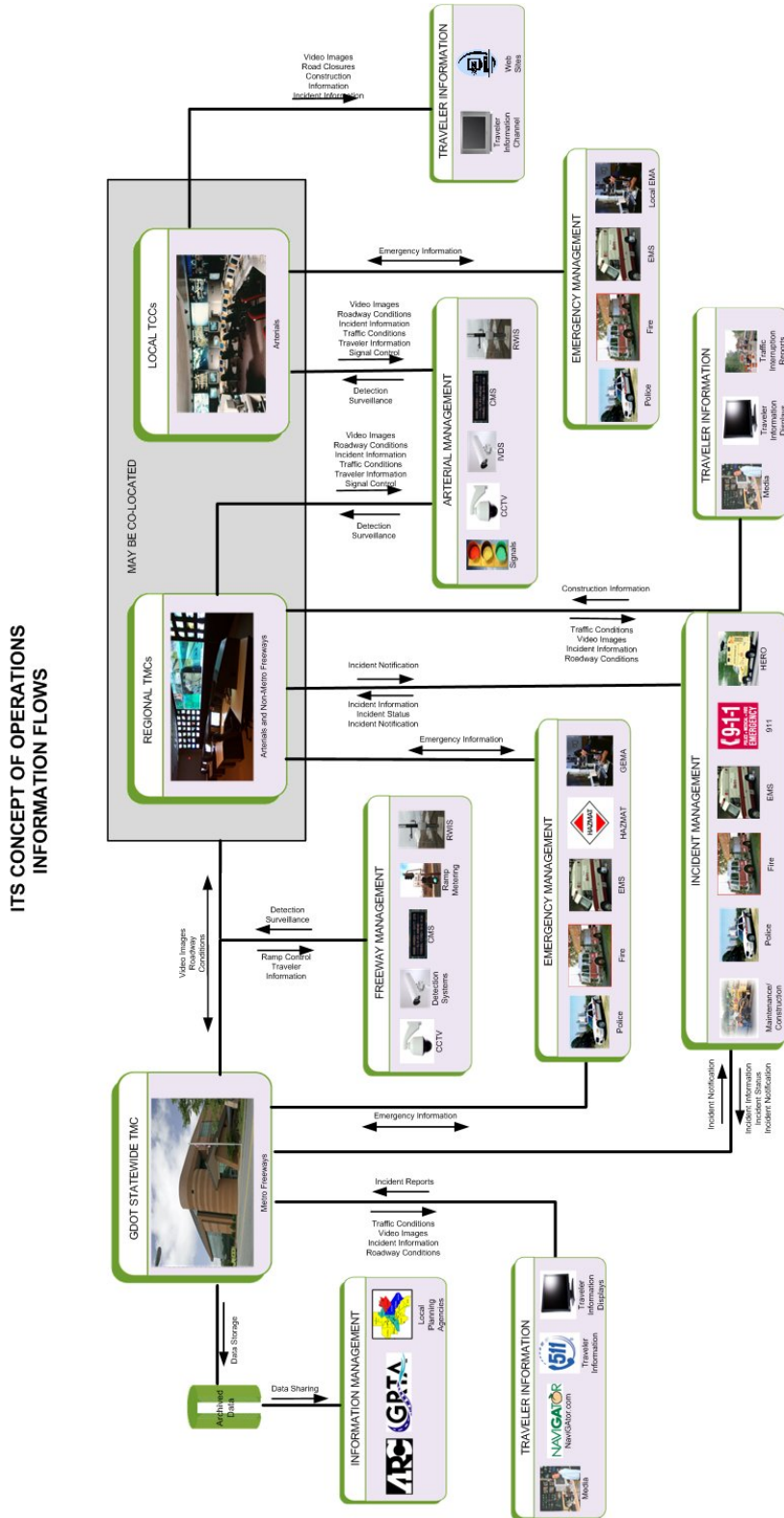


Figure 3 – ITS Concept of Operations

## Service Areas

Within the environment of the NaviGator system, the TMCs and TCCs work collectively to manage the freeway and arterial systems. These functions are executed in five primary ITS service areas: (GDOT's recommended Roles and Responsibilities within each service areas are summarized in the call-out boxes.)

### Freeway Management

***GDOT has the responsibility to manage traffic and coordinate incident management on the freeway system and state highways.***

Freeway management is primarily the responsibility of GDOT and is executed in its Statewide and Regional TMCs. Data is collected from ITS field devices on the freeways, transmitted across the NaviGator network and processed through the NaviGator software. The operators within the TMCs use this data to manage freeway operations with a focus on congestion mitigation and incident management.

### Arterial Management

***GDOT, working with local agencies, has the responsibility to plan, design, construct, operate and maintain traffic signals and any other ITS elements along state routes.***

GDOT typically delegates arterial management responsibilities to local government agencies in metropolitan areas. Local governments manage traffic signals in their jurisdictions from their TCCs and use NaviGator connected ITS tools such as CCTV to help them with this task. Where arterials are not managed by local agencies, GDOT's Regional TMCs assume this responsibility.

### Incident Management

***GDOT has the responsibility to minimize the impacts of incidents on the freeways.***

GDOT works with other state and local agencies to manage incidents from the Statewide and Regional TMCs. GDOT's primary role in incident management is to provide traffic control and clear the roadway of stranded vehicles, debris, etc. In metro Atlanta, these services are provided by GDOT HERO personnel dispatched from the Statewide TMC. As the HERO program is expanded outside the Metro Atlanta area, Regional TMCs will assume the HERO dispatch responsibility in their area of coverage.

### Traveler Information

***GDOT will serve as a clearinghouse for statewide traveler information and disseminate it using the NaviGator website, 511 and other ITS resources.***

GDOT collects traffic data and images, incident information and roadway conditions and distributes this information to the media, motorists and the general public. Operators in the TMCs are responsible for making sure the appropriate information is collected and disseminated. The 511 system is rolled out in August 2007, it is becoming the primary conduit for disseminating traveler information to the public. Other means of disseminating information such as the NaviGator website, the Media, private ISPs and CMS will also continue to be used. The majority of traveler information activities, such as hosting of the NaviGator website and the 511 system will be based out of the Statewide TMC, although the data collection functions will be shared with the Regional TMCs and TCCs.

Local agency TCCs also collect data and provide traveler information to their constituents. Local agencies use many of the same tools as GDOT for these functions, but also provide information specific to their jurisdictions via their own websites and local access television channels.

The 911 centers also play an import role in Incident Management. In many cases, the 911 centers are the first to receive notification of an incident. Presently, incident information is exchanged between GDOT, local agencies and the 911 centers through voice communications. The future concept is to exchange information automatically between TMCs, TCCs and 911 centers using open communication standards such as XML.

#### Emergency Management

***GDOT's primary responsibility is to serve in a support role to emergency management agencies, such as clearing the roadways after a major emergency to allow free flow of traffic.***

Large scale emergencies such as natural disasters, major infrastructure failures or other states of emergency require a cooperative effort between GDOT and the state and local agencies. Many of these emergencies involve some type of evacuation and/or re-routing of traffic. During emergencies, GDOT takes a lead role in managing traffic on the freeways and arterials, often with assistance from local government agencies. During major emergencies such as coastal evacuations, the TMC may dispatch HEROs to provide motorist assistance and traffic control support.

### CONCLUSION

#### Next Steps/Strategies

The following are six (6) strategies that were recommended at the time of the publishing of the Concept of Operations document in August 2007. Updates on the progress of these strategies are indicated in italics following each as applicable:

#### Strategy 1: Develop Strategic Deployment Plan (SDP)

The purpose of the Strategic Deployment Plan is to define the strategy for the expansion of the NaviGator system. The SDP should focus on physical deployment of the system within the existing service areas as well as the expansion of the system into new service areas. At a

minimum, the SDP should, establish guidelines for ITS geographic expansion, develop ITS capital projects and evaluate expansion of Regional TMCs.  
*As of spring 2008, the Strategic Deployment Plan has been completed. The document does establish the guidelines recommended in the Concept of Operations.*

#### Strategy 2: NaviGator Software Upgrades

GDOT is in the process of evaluating options for the upgrades to the NaviGator software. This Concept of Operations should be used as the basis for developing a project specific Concept of Operations, Architecture and Requirements for the next generation of NaviGator software.

*As of summer 2008, an upgrade to NaviGator has been developed and is being Beta tested.*

#### Strategy 3: Integrate District Offices into the NaviGator program

The District Offices should play an integral role in planning, deployment, operations and maintenance of ITS in GDOT. GDOT should formally establish an “ITS Liaison” at each District Office to serve as the ITS champion in the District and ensure that ITS is appropriately considered in District Office activities.

*Prior to the development of the Concept of Operations, one district had a staff member serving as the ‘de facto’ ITS liaison. This person was on the steering committee for the development of the Concept of Operations. No additional ITS Liaisons have been identified as of summer 2008.*

#### Strategy 4: Engage the Local Agencies

The local government agencies are important partners with GDOT in the implementation of ITS. These agencies will be users of ITS and play an integral role in its success. To maintain their support and participation in the NaviGator system, GDOT should initiate a focused effort on involving the local agencies in the future decisions regarding the NaviGator system. *GDOT has reinstated the holding of NaviGator user group meetings and has been providing this opportunity to engage local agencies. In addition, several local agencies in and around metro Atlanta have been making strides to plan and implement ITS solutions.*

#### Strategy 5: Focus on Collection of Data to Support Traveler Information Systems

For 511 to be successful in meeting customer expectations, GDOT must rapidly expand their data collection efforts to obtain timely and accurate information. This data will come from a multiple of sources including GDOT – from the TMC and the District Offices, local agencies and the private sector (cell phone probe data).

*GDOT has been working with various sources to improve and expand data sources for 511 traveler information.*

#### Strategy 6: Integrate ITS into Construction and Maintenance Projects and Activities

Construction and maintenance activities can have a significant effect on traffic flow. GDOT should take a proactive role in identifying potential problems associated with construction and maintenance activities by implementing ITS solutions to mitigate these problems.

*GDOT has begun to investigate ways to integrate ITS into construction and maintenance projects.*

## **Lessons Learned**

By definition, the Concept of Operations document was written at a high-level and was not intended to cover the specific details of the technologies that presently existed or were needed. Keeping the Concept development focused at a high level proved to be difficult at times. There was a tendency to want to discuss the concept in specific terms and suggest specific solutions. Specifics such as these are planned to be discussed in the subsequent Strategic Deployment Plan document, the fourth step in the systems engineering process.

Originally, the steering committee anticipated that there would be a new Concept developed as a result of the research that was to be accomplished. However, it was later realized that there was not much 'new' about the Concept moving forward. Instead, the research concluded that many work flows were good and only needed better definition and documentation.

The most significant new finding was that there needed to be a more concerted effort to involve the local transportation and public safety agencies across the state to provide relevant information on incidents and construction/maintenance activities.

## **ACKNOWLEDGEMENTS**

This research paper summarizes the work that was done for the Georgia Department of Transportation in order to develop a Concept of Operations for their Statewide ITS program, including the Georgia NaviGator system.

Instrumental in the successful completion of the Concept of Operations document were members of the Concept of operations Steering Committee which included staff members from the Georgia DOT, headed by Mr. Hugh Colton, GDOT Projects Manager, Mr. Marcus Wittich, Delcan consultant to GDOT and Mr. Bayne Smith. P.E., PTOE, Vice-President of the URS ITS Business Line.

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