DISTRICT DEPARTMENT OF TRANSPORTATION
2000 14th Street, NW
Washington, DC 20009

CAPITAL TRAFFIC OPERATION PLATFORM (CAPTOP)

PHASE 1: SOFTWARE FUNCTIONAL REQUIREMENTS DEVELOPMENT

(DC Contract # POKA-2006-T-0055-VH Task No. 7)

TASK 2: CONCEPT OF OPERATIONS

DISTRICT OF COLUMBIA
DISTRICT DEPARTMENT OF TRANSPORTATION

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10. Abstract

The objective of this report is to document the Concept of Operations for the CapTOP program. The Concept of Operations includes a Scope, Referenced Documents, User-Oriented Operational Description, System Overview, Operational and Support Environments, and Operational Scenarios.

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ACRONYMS

Abbreviation	Full Text
ANSI	American National Standards Institute
ATMIS	Advanced Traffic Management & Information System
ATMS	Advanced Traffic Management System
AVL	Automatic Vehicle Location
C2C	Center-to-Center
CAD	Computer Aided Dispatch
CapTOP	Capital Traffic Operation Platform
CATT	Center for Advanced Transportation Technology
CCTV	Closed-Circuit Television
CHART	Coordinated Highway Action Response Team
CIP	Critical Infrastructure Protection
CVISN	Commercial Vehicle Information Systems and Networks
ConOps	Concept of Operations
COTS	Commercial-Off-The-Shelf
DDOT	District Department of Transportation
DMS	Dynamic Message Sign
DOT	Department of Transportation

Abbreviation	Full Text
DVR	Digital Video Recorder
ESRI	Environmental Systems Research Institute
GIS	Geographic Information System
GUI	Graphical User Interface
HAR	Highway Advisory Radio
HSEMA	Security Emergency Management Agency
IPMA	Infrastructure Project Management Administration
ITS	Intelligent Transportation System
MPD	Metropolitan Police Department
NAWAS	National Warning System
NCR	National Capital Region
NOVA	Northern Virginia
NTCIP	National Transportation Communications for ITS Protocol
NVR	Network Video Recorder
PDMS	Portable Dynamic Message Sign
RICCS	Regional Incident Communications and Coordination System
RITIS	Regional Integrated Transportation Information System
ROP	Roadway Operations Patrol
RTMS	Road Traffic Monitoring System

Abbreviation	Full Text
RWIS	Road Weather Information System
SCADA	Supervised Control Data Acquisition
SDE	Spatial Database Engine
SHA	State Highway Administration
SQL	Structured Query Language
STC	Smart Traffic Center
TCP/IP	Transmission Control Protocol/Internet Protocol
TMC	Traffic Management Center
TSO	Transportation System Operator
UCC	Unified Communications Center
VCR	Video Cassette Recorder
VIPS	Video Interoperability for Public Safety
VDOT	Virginia Department of Transportation
WAN	Wide Area Network
WMATA	Washington Metropolitan Area Transit Authority

1. SCOPE

This chapter provides the system identification, purpose, and a CapTOP overview, which are based on information gathered from the reviews of technical documents and interviews with stakeholders. This chapter also provides a document organization for the remainder of this document.

1.1 System Identification

This document provides an operational concept for CapTOP, which is the District Department of Transportation's (DDOT's) Advanced Traffic Management System (ATMS). The content of this document was prepared in accordance with recommendations in the FHWA report, "Developing and Using a Concept of Operations in Transportation Management Systems" *(ref 1)*, which is based on industry standard IEEE 1362-1998 *Guide for Information Technology—System Definition—Concept of Operations (ConOps)* and the ANSI/AIAA G-043-1992 *Guide for the Preparation of Operational Concept Documents*. A complete list of documents consulted in the preparation of this document is provided in Chapter 2.

1.2 Purpose

The purpose of this Concept of Operations (ConOps) is to identify the key elements of CapTOP and to describe the business processes and functions that make up CapTOP operations. This ConOps document is a high-level overview of the functionality of CapTOP. It describes the interaction of various users and stakeholders with CapTOP and defines the capabilities needed by CapTOP to support the activities and needs of the Traffic Management Center (TMC) and other CapTOP users.

This ConOps is intended as a framework to guide DDOT efforts to enhance the existing CapTOP and to systematically develop it into a large-scale Advanced Traffic Management System (ATMS) that supports multiple users, stakeholders, and agencies, and integrates multiple Intelligent Transportation System (ITS) subsystems. This document provides a system-engineering approach to developing CapTOP which describes how CapTOP fits into the National ITS Architecture, and how it will interface with other transportation management systems in the D.C. region, including the Maryland State Highway Administration's (SHA's) Coordinated Highway Action Response Team (CHART) and the Virginia Department of Transportation's (VDOT's) Smart Traffic Center (STC) in the Northern Virginia (NOVA) region.

1.3 System Overview

The DDOT TMC plays a critical role in managing the traffic and mitigating the adverse impacts on the District's transportation system. The new CapTOP, as the core of the ATMS, will be the brain of the TMC. As envisioned by DDOT, CapTOP will evolve into a system to provide

centralized management of traffic management activities, including management and operation of ITS devices, and traffic management for planned and unplanned incidents and events that impact transportation in the District. CapTOP will facilitate the exchange of transportation-related information across a variety of agencies within the region, and provide an integrated interface to a variety of traffic-management related systems.

FIGURE 1, below, provides an illustration of the major functions envisioned to be performed by CapTOP. As shown, the system consists of an application server(s) that supports a suite of operational functions, a database server(s), and a web server(s).

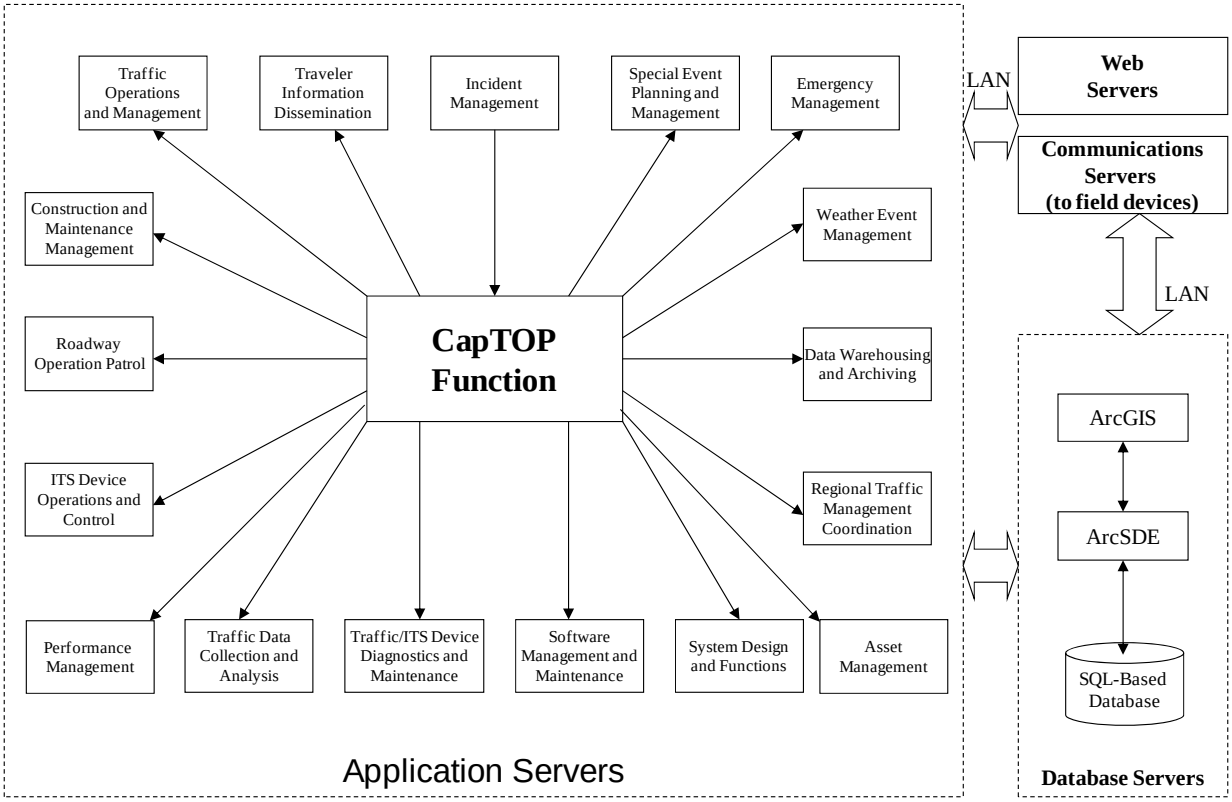

FIGURE 1 CapTOP Block Diagram Illustrating Major Functions and Servers

The application server provides a platform that can integrate the various functions of CapTOP ranging from ITS device control, incident management, and regional traffic management coordination, to traffic information dissemination. The database server is comprised of Microsoft SQL Server (or others such as Oracle, or DB2), ArcSDE (ArcInfo Spatial Database Engine), and ArcGIS (ArcInfo Geographical Information System), which are hosted on both servers and desktop machines. The CapTOP architecture, therefore, is based on a distributed client/server environment, with a central data repository supporting reporting, queries and analysis. In general, the CapTOP system will:

- Be integrated with all ITS components including Closed-Circuit Television (CCTV) cameras, Dynamic Message Sign (DMS) units, Road Weather Information System (RWIS) stations, and Highway Advisory Radio (HAR) stations;

- Interface with existing external systems such as QuicNet (i.e., for signals), CityWorks (i.e., for work orders), and others;
- Use standard interfaces fully compatible with National Transportation Communications for ITS Protocol (NTCIP) to integrate and communicate with ITS field devices;
- Monitor and control ITS devices under one common Graphical User Interface (GUI) using a standard set of control windows, pull-down menus, push-buttons, and mouse activated icons;
- Support an enterprise object-oriented spatial database that associates devices, device locations, device data, device control, roadways, roadway attributes, and analysis and response methodologies with observed events;
- Allow CapTOP users access to the subsystem or functions through a central application server;
- Support incident and special event management;
- Support asset management (including work order generation and tracking);
- Support information sharing with other centers.

Work on the CapTOP ConOps began by defining needs. These needs were expressed during stakeholder interviews and are specific to DDOT's traffic and incident management practices, and their ITS subsystems. As needs were identified, they were grouped into operational areas, with each need expressed as an operational function. The identified operational areas are consistent with the *user services* and *market packages* defined within the National ITS Architecture, and are also consistent with those used by other TMCs in this region and across the country. The market packages are used to provide a high level overview of the CapTOP system and its operational functions. These market packages reflect the desired operational functions which will be described in Chapter 5, and lay the foundation for defining the operational scenarios described in Chapter 7.

1.4 Document Organization

This ConOps document is organized around seven (7) chapters, as follows:

- **Chapter 1** describes the scope of this document.
- **Chapter 2** lists referenced documents related to this ConOps.
- **Chapter 3** provides a user-oriented operational description for CapTOP that identifies the users of the system, the operational functions they perform, the policies, procedures, constraints and organizational structure.

- **Chapter 4** identifies the DDOT operational needs, priorities, assumptions, and constraints that will drive the requirements for the CapTOP.

- **Chapter 5** presents a detailed operational concept for CapTOP that is based on the needs set out in Chapter 4 and describes system functions needed to meet user needs.

- **Chapter 6** describes CapTOP operational and support environments including hardware, software, and personnel needs.

- **Chapter 7** provides the operational scenarios, which are used to describe how the user interacts with the major functions of the system.

2. REFERENCED DOCUMENTS

The following documents were reviewed for preparation of this ConOps:

1. *Developing and Using a Concept of Operations in Transportation Management Systems*, Final Report (FHWA-HOP-07-001), Federal Highway Administration, August, 2005.

2. *CapTOP Phase 1: Software Functional Requirements Development Technical Memorandum 1: Document Review Findings (DDOT-TOA-CAPTOP-2008-002)*, August, 2008.

3. *CapTOP Phase 1: Software Functional Requirements Development Technical Memorandum 2: Interview Findings and Stakeholders' Needs (DDOT-TOA-CAPTOP-2008-003)*, August, 2008.

4. *National ITS Architecture, Version 6.0, U.S. Department of Transportation, April 23, 2007.*

5. *Capital Traffic Operation Platform-State of Work*, Transportation Operations Division, Traffic Services Administration, District Department of Transportation, August 21, 2006.

6. *DDOT ITS Program* Review (PowerPoint Presentation), Transportation Operations Division, District Department of Transportation, October 27, 2007.

7. *Capital Traffic Operation Platform User Manual*, Transportation Operation Division of Traffic Services Administration, District Department of Transportation, November 2006.

8. *Initiative Plan: New Transportation Management Center at Anacostia Gateway*, District Department of Transportation, January 27, 2006.

9. *Standard Operating Procedures for Transportation Management Center (TMC)*, Operators Manual Version 4, District of Columbia Division of Transportation, February 6, 2004.

10. *District Response Plan Functional Annexes ESF #1*, April 4, 2002

11. *District of Columbia Amber Alert Plan America's Missing: Broadcast Emergency Response for the District of Columbia Broadcast Area*, District Department of Transportation in cooperation with the Metropolitan Police Department and District of Columbia Emergency Management Agency Broadcasters Association, May 2005.

12. Technical Memorandum (Draft) "*Operator Tasks and Workstation Requirements Concept of Operations*", District of Columbia Division of Transportation, Document No: 96028-660-1004, November 20, 2002.

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15. *ATMS Concept of Operations*, Version 0.7, Virginia Department of Transportation, Northern Operations Region ATMS, Attachment D of RFP #173-BLW, January 2007.

16. *ATMS Software Requirement Specifications* Version 0.4, Virginia Department of Transportation Northern Operations Region ATMS RFP # 173-BLW Attachment E, Trevilon Corporation, January 3, 2007.

17. *CHART II Business Area Architecture*, Maryland State Highway Administration, SHA-06-CHART, January 26, 2007.

18. *CHART II System Requirements*, M361-RS-002R2, May 2, 2000.

19. *CHART Lite 3.0 System Design Document*, Maryland State Highway Administration, September 2005.

20. *Regional Integration Transportation Information System (RITIS*), All Hazards Forum Center for Advanced Transportation Technology (CATT) Laboratory, October 2006.

21. *Metropolitan Washington Area ITS Architecture Interconnect Matrix*, July 17, 2007.

3. USER-ORIENTED OPERATIONAL DESCRIPTION

The goals of CapTOP are to assist in the timely response to incidents, special events, weather events, and emergencies, and to disseminate traffic information to the roadway users in real time so that they can make informed decisions. This chapter identifies how the CapTOP goals and objectives are accomplished, including strategies, tactics, policies, and constraints from a user point of view.

3.1 Description of Current System

The existing DDOT TMC system is documented in *CapTOP Phase 1: Software Functional Requirements Development Technical Memorandum 1: Document Review Findings* (ref 2). This section will provide a brief summary of the current system.

The TMC is a 24/7/365 traffic management facility located on the 2nd floor of the D.C. Unified Communications Center (UCC). The TMC serves as the management and control center in the District, and provides monitoring and control over all DDOT's ITS assets. The Transportation System Operators (TSOs), whom operate the system, are located in the UCC, while the maintenance, Roadway Operations Patrols (ROPs), and support personnel are located at the backup TMC on the 2nd floor of the Reeves Building. The Reeves location also houses the spare ITS field devices.

Note: At the Mayor's and City Administrator's request, the TMC was relocated from the Reeves Building to the D.C. Unified Communications Center (UCC) in May 2008. The system resides in the Video Interoperability for Public Safety (VIPS) room of the UCC, which is managed by the Homeland Security Emergency Management Agency (HSEMA). The TMC functions the same as it did before the move, but is co-located with the control rooms for D.C. Protective Services and D.C. Schools. The UCC is also staffed by Fire and Rescue and Homeland Security personnel. The UCC facility, located on the East Campus of the St. Elizabeth's Hospital site, consolidates the "command and control" functions of the Office of Unified Communications (OUC). The center, which opened September 26, 2006, receives and processes calls to 911 and the District's customer service line, 311 (also known as the Mayor's hotline). During major emergencies, the center becomes the District's Emergency Operations Center (also known as the Mayor's Command Center) and provides a central location for multiple agencies to address any variety of situations. The former TMC location in the Reeves building will function as the backup TMC and will house spare equipment and support personnel. FIGURE 2 below provides a picture of the UCC.

The DDOT TMC is responsible for two major tasks:

- Monitoring and control of traffic flows on D.C.'s surface street network and a small portion of interstate highway. The TMC focus its efforts on detection, verification, and incident management, including the planning and management of special events. This also includes the dissemination of traffic/incident information to the public.

- Monitoring and control of traffic signal networks and ITS devices on surface street networks. The functions performed include the monitoring of field equipment and devices, and the dispatch of resources to return malfunctioning equipment to operational status.

FIGURE 2 Picture of the UCC Facility

The primary functions performed at the TMC include incident management, traffic monitoring via CCTV, signal and ITS device control and monitoring, problem reporting, dispatching and coordinating activities of the Roadway Operations Patrols (ROPs), coordination with external agencies, roadway weather condition monitoring, regional emergency information sharing, identification and requests for repairs of ITS device failures, answering DDOT Customer Service Center (61-DDOT) calls, and traffic information dissemination using HAR, telephone, the Internet, and DMS. The diagram in **FIGURE 3** depicts the external entities that interface to the current TMC. These include:

- **Closed-Circuit Television (CCTV)** provides real-time video of the transportation network from more than one hundred thirty-five (135) cameras. Transportation System Operators (TSO) can pan, tilt, and zoom cameras. Video feeds are accessible at the TMC and can be shared with other DDOT facilities.

- **Vehicle Detection Stations** consists of 116 vehicle detector stations, and 30 count stations. In addition, there also some 3rd party devices. There are 50 speed detector stations deployed by SpeedInfo Inc. The TMC receives the real-time traffic speed data through a private-public partnership with SpeedInfo, Inc. In addition, there are 15 Road Traffic Monitoring System (RTMS) detectors owned by Traffic.Com on I-295 and I-395. However, the data from RTMS has not been integrated into the TMC.

- **Roadway Weather Information System (RWIS)** consists of six (6) RWIS stations that provide comprehensive real-time data about weather conditions on the roadway surface and the surrounding atmosphere.

- **Highways Advisory Radio (HAR)** uses AM 1650 radio broadcasts to provide motorists with timely information through their AM radios. Six (6) HAR stations are currently operated by the TMC.

- **Dynamic Message Signs (DMS)** provide travelers with real-time information about roadway conditions, event information, and incidents. DDOT has sixty-three (63) portable dynamic message signs (PDMS) and 13 fixed dynamic message signs deployed.

- **Roadway Operation Patrols (ROPs)** consists of twelve (12) specially equipped and marked vehicles. ROPs are dispatched by the TSOs to assist motorists, determine and implement temporary traffic control techniques at incidents, and mitigate traffic congestion and delays. ROP drivers offer motorist assistance and communicate traffic and roadway problems and observations to the TMC. Drivers have laptop computers in their vehicles with wireless communications.

- **Traffic Signal System** includes more than sixteen hundred (1600) traffic signals. These signals are monitored and controlled using a commercial-off-the-shelf (COTS) package called QuicNet™ developed by McCain, Inc.

- **Asset Management** includes a system to enter and track customer complaints for things such as signal outages and traffic problems. The system is developed by Hansen Information Technologies.

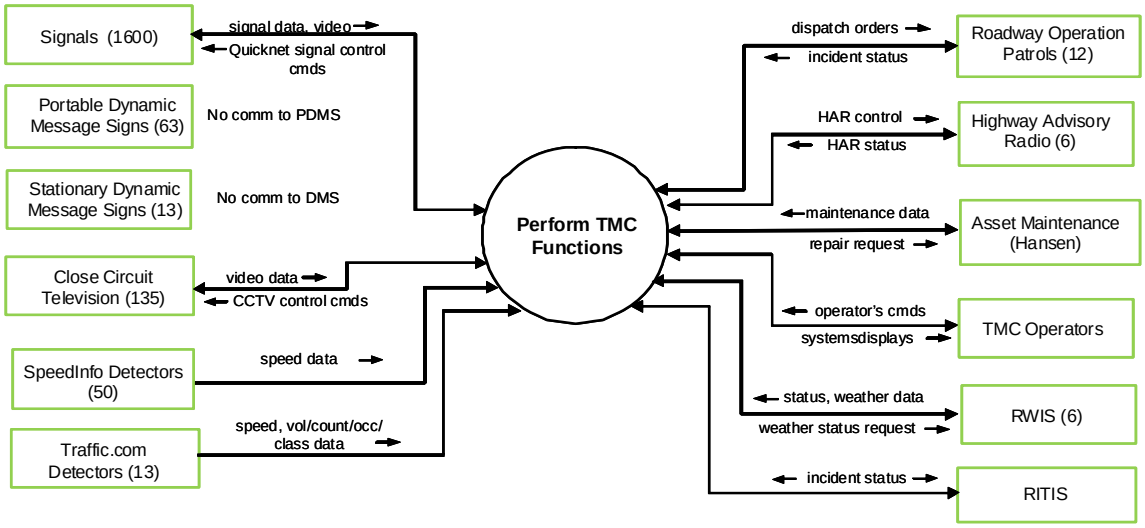


FIGURE 3 Context Diagram for Existing DDOT TMC

Existing TMC software is a collection of non-integrated systems purchased or developed over the course of the TMC system build out. The primary systems include CapTOP, QuicNet, Cityworks, and DR2000.

- ***CapTOP*** is a pilot version of ATMS initiated by DDOT for traffic operations and management. In its current version, the software consists of a traffic incident management subsystem and a roadway traffic information subsystem. The traffic incident management subsystem can record traffic incident/event information, monitor incident status, facilitate incident management and generate incident reports. CapTOP was developed using Microsoft .net technologies, ArcObjects, and an SQL-based database management system. It is a client-server system that allows multiple users to simultaneously perform system functions and access data stored in a centralized database. An Environmental Systems Research Institute (ESRI) Geographic Information System (GIS)-based user interface built using ArcObjects provides map-based displays used to locate initial events, display the location and status of open (ongoing) incidents, and display traffic speed and volume data on a color-coded map layer. Traffic/incident management capabilities of the existing pilot version of CapTOP are somewhat limited. However, the experience developing this system has provided valuable insight with regard to the functions and features that should be considered for incorporation into the fully-developed CapTOP. The DDOT experience developing the pilot version of CapTOP has demonstrated that a GIS-based ATMS platform is a good solution.

- ***QuicNet*** is a Windows-based ATMS, which operates in a multi-tasking, distributed network environment. QuicNet collects and disseminates real time traffic signal information. It includes a database management system and provides system surveillance capabilities for over 1600 signals in the District. QuicNet supports operation of the traffic signal system and CCTV. Traffic signal functions supported by QuicNet are monitoring traffic signal timing and signal status, and detection of signal malfunctions. CCTV functions supported by QuicNet are monitoring CCTV camera status, detecting camera malfunctions, and controlling cameras.

- ***DR2000*** supports control of HAR devices by providing remote data management, communication and viewing of transportation communication equipment. It is used for monitoring, creating, and changing broadcast messages of each HAR connected to the system. Messages can be recorded, edited, reviewed, scheduled and synchronized through the Graphical User Interface (GUI) that features map displays for each HAR system in the network.

- ***Cityworks*** is the GIS-based Asset Management System, which provides a complete solution for managing assets, maintenance, and property. Coupled with ESRI's ArcGIS software, the tiered asset management system includes both desktop and web-based application functionality to handle work requests, work order life-cycle management, and inspections for all of the assets under DDOT's responsibility. The implementation will fully integrate with the District's enterprise GIS and improving

the daily work management workflows of each of the user administrations. CityWorks is installed on TMC client workstations.

- ***RWIS*** consists of six (6) RWIS stations that provide comprehensive real-time data about weather conditions on the roadway surface and the surrounding atmosphere.

The TMC also provides coordination with external agencies. The following external interfaces to the existing TMC have been implemented:

- Washington DC 911 (Incident Notifications);
- CHART (Work Station);
- RITIS (Center-to-Center);
- Traffic.com (Web) which is accessible from http://www.traffic.com.

3.2 User Activities and Operations

The operational functions presented in TABLE 1 were developed through stakeholder interviews and identify the major types of activities undertaken by the DDOT TMC. These operational functions form the basis for deriving operational scenarios described in Chapter 7, as well as the CapTOP functional requirements which will be published in a future document.

TABLE 1 Operational Areas

Operational Functions	Description and Activities
Traffic Operations and Management	Provides management of the roadway network and supports traffic surveillance monitoring, traffic control, and arterial traffic management. This includes traffic signal control strategies, lane control, and management of reversible lane facilities, road closures, and barrier/safeguard systems. The activities include monitoring traffic through CCTV cameras and control of fixed DMS, Variable Speed Limit signs and portable DMS, as well as HAR messages to alert the public to potential problems or congestion.
Traffic Information Dissemination	Timely dissemination of traffic flow conditions, road restrictions, traffic incidents, and roadway weather condition information to the road users through ITS devices such as DMS and HAR, and also provides the interfaces that distribute traffic information from a traffic management center to the public and other agencies or private sector companies. The activities include travel time displays on DMS signs, and placing incident alerts and road restriction messages on DMS and HAR.
Incident Management	Detects and responds to any traffic incident that occurs on the road network that has an adverse impact on public safety and traffic flow. The activities include incident detection, response, resource tracking and coordination, as well as the dissemination of incident information to public. Also provides coordination between multiple transportation and safety agencies to clear roadway incidents quickly and minimize congestion.

Operational Functions	**Description and Activities**
Special Event Planning and Management	Provides planning and management of traffic in support of planned special events of all types, except construction/maintenance activities on the roadway.
Emergency Management	Provides support for incident management, emergency response, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications.
Weather Event Management	Provides current road weather conditions using data collected from environmental sensors deployed on, or near, the roadway. Includes weather monitoring of the roadway in support of snow center operations. Also provides coordination with Snow Center staff to monitor road-weather conditions, track available resources (e.g., people and equipment), and coordinate the notification of assigned resources when a weather related incident or condition occurs. The activities include monitoring the roadway conditions with CCTV and RWIS to monitor bridges and critical road sections.
Construction and Maintenance Management	Provides support for scheduled and unscheduled maintenance and construction on roadways. Monitors and manages roadway construction and maintenance activities. Remotely monitors and manages activity in work zones that is being performed by DDOT or their Contractors. Gathers, stores, and disseminates work zone information to other systems, as required.
Roadway Operations Patrol	Provides coordination and management support of Roadway Operations Patrol activities.
ITS Device Operation and Control	Provides monitoring and control of various ITS devices used to manage traffic and provide traveler information.
Traffic Signal Monitoring	Provides support to monitor the operational status of traffic signals.
Traffic Data Collection and Analysis	Provides support to collect traffic data and perform analysis that will be used to implement new traffic control strategies.
Multi-modal/Multi-Agency Coordination and Communication	Provides support for collecting and disseminating information from the TMC to agencies within the District that are involved in various modes of transportation, and managing incidents and special events.
Regional Traffic Management Coordination	Provides support for sharing traffic and incident information among traffic management centers to support regional traffic management strategies.
Amber Alert	Provides an interface to receive and (if required) take action in response to Amber Alerts.
Traffic/ITS Device Diagnostics and Maintenance	Provides an interface to install, configure, maintain, and monitor the status of ITS devices and traffic signals. The activities include asset tracking, failure detection with notification, and maintenance of ITS field devices. Provides interfaces with ITS devices to execute diagnostics, identify device malfunctions, gather and display information on device status, track maintenance needs/status, and provide inputs used in performance measures.

Operational Functions	**Description and Activities**
Performance Measurement	Addresses unique performance measurement needs specific to each operational area (as appropriate). This is cited as a separate operational area to emphasize the importance of measuring performance. Measures in this area may span, and be applicable, to multiple operational areas.
Data Warehousing and Archiving	Provide support to collect, archive, manage, and distribute data generated from various ITS sources or applications. Provides data warehouse functions to manage data collected from various sources (e.g., ITS devices, other agencies, etc.). The archived data is used in transportation administration, policy evaluation, safety, planning, performance monitoring, program assessment, operations, research applications, and inputs into Federal, State, and local data reporting systems. The major functions include collection, storage, archival, retrieval, backup, reporting, and data distribution.
Critical Infrastructure Protection	Provides support to manage and monitor those transportation facilities such as bridges and tunnels whose removal from service would significantly affect public safety, national security, economic activity or environmental quality.
Tunnel Operations and Control	Provides interfaces to support backup control and sharing of traffic/incident/video information with agencies responsible for monitoring and controlling tunnel operations.
Software Management and Maintenance	Provides support to manage, operate, and maintain CapTOP software and hardware to minimize failures, downtime, and to mitigate impacts when failures do occur.
CVISN Support	Provides support to enhance Commercial Vehicle Information Systems and Networks through the sharing of traffic/incident/video information

3.3 Operational Policies, Procedures, and Constraints

DDOT is the primary agency responsible for operating the TMC facility and for procuring, operating, and maintaining ITS devices within the District. DDOT uses Standard Operating Procedures to guide TMC personnel on how to properly manage different types of incidents and events under a range of conditions.

The TMC provides appropriate equipment & personnel required to perform continuous 24x7x365 management of the transportation system within the District. The operation is broken down into three (3) shifts as discussed in Section 6.4. Each shift typically has at least two or three operators. One of the operators is designated as a shift supervisor (or TMC Manager) who typically responds to traffic incidents and dispatches ROP drivers.

Interviews with stakeholders identified the following issues and challenges to improve traffic management and incident response:

- TMC functions are currently accomplished through the use of a variety of stand-alone software applications with no common, integrated interface. There is a strong desire for a common integrated interface to all ITS subsystems;

- Lack of remote communication with portable and fixed DMS for the purposes of monitoring and controlling the signs; Remote communications is also desirable for locating portable DMS;

- Inadequate staffing levels, particularly for the ROPs;

- Limited access to the training needed to develop and maintain staff skills and to train/prepare for response to specific kinds of events and incidents;

- Difficulty collecting and compiling data to document reported incidents and events, including the actions taken during incidents, the human and equipment resources needed to support response to incidents and events. This information is needed for process improvement and performance measurement;

- Poor logging and tracking systems, particularly for equipment inventories that maintain information such as model numbers and serial numbers of parts;

- TMC Operators need on-line information resources and decision-making support to increase efficiency and accuracy of actions;

- Lack of a reliable high-speed communications network with adequate bandwidth for voice, data, and video communications. This is necessary to support center-to-center and center-to-field communications;

- The existing TMC has been limited in space and functionality. There is the need for an expanded operation rooms or even a new TMC. *(Note: this need was expressed prior to the TMC move to the UCC).*

4. OPERATIONAL NEEDS

The ultimate goal for CapTOP is to support the DDOT mission of providing safe and efficient movement of people and goods in and around the District, providing a safe seamless transportation system, and enhancing the mobility of people and goods. Specific goals based on the mission are as follows:

- Reducing recurrent traffic congestion, resultant delay, emissions, and fuel consumption;
- Reducing traffic congestion caused by incidents.

Meeting these goals in the face of increasing congestion and limited roadway capacity has led to a need of an integrated CapTOP. This chapter describes the operational needs to satisfy the DDOT mission.

4.1 Stakeholder Operational Needs

Stakeholder operational needs were identified, organized and documented in *CapTOP Phase 1: Software Functional Requirements Development Technical Memorandum 2: Interview Findings and Stakeholders' Needs* (ref 3). Each need is associated with one or more of the operational areas identified in Chapter 3. The paragraphs below summarize the operational needs with regard to the CapTOP system and functions.

CapTOP System

- Create an open architecture with a modular design that supports integration of legacy systems. The system will be able to accommodate new hardware and software as it becomes available;
- Provide a client-server based architecture with unified graphical user interfaces, and database and application servers that allow the system to expand;
- Provide a single, integrated interface for a variety of systems/applications that support traffic management and track and manage assets of all types, including, but not limited to, Hansen, QuicNet, and CityWorks;
- Provide map-based interfaces and icons as layers to spatially present information to users, while allowing users to turn on/off layers as desired;
    - Provide capabilities for displaying different types of information appropriate for various types of stakeholders for different types of activities. Examples include traffic condition/congestion maps (for operators), maps showing the operational status of field devices (for maintenance technicians), maps showing the communication status of field devices (for maintenance

technicians), and maps that identify the types and locations of incidents/events (for operators);

  - Provide the capability to graphically display roadway conditions and ITS device status graphically on the map.

- Provide an integrated interface to support communication, coordination, and information sharing among DDOT personnel, as well as external organizations.

CapTOP Functions

- Provide functions to support the management of: daily traffic, traffic incidents, special events, weather related events, work zone, and other emergencies;

- Provide on-line, interactive decision support tools and resources tailored to the needs of different users and circumstances;

- Perform incident management, which includes automatic incident response plans;

- Support the development of activity reports and performance measures in all operational areas;

- Provide functions to monitor the condition and status of the transportation system;

- Provide functions to operate and monitor the status of field devices, including traffic signals, CCTV cameras, DMS, HAR, RWIS, detectors/sensors, communication, and other equipment;

- Facilitate the dissemination of timely, accurate information through a variety of devices, including HAR, DMS, the Internet, traveler information kiosks, automated telephone based information systems, text messaging, and e-mail;

- Provide functions for the collection, integration, analysis, and summation of traffic/incident data gathered by various surveillance technologies;

- Interface with other ATMS such as CHART to support effective regional transportation system management;

- Support communication and sharing information with outside agencies such as VDOT and MDOT, MWCOG, and WAMAT using standards-based center-to-center protocols;

- Provide consistent and timely road information including weather-related road conditions, warnings, closures, work zones, restrictions, incidents ;

- Support performance monitoring that uses common performance measures to evaluate the performance of the overall system, including support personnel;

- Provide comprehensive reporting tools for system performance evaluation and operations performance evaluation;
- Monitor and document the status of activities and resources required in response to incidents and special events;

4.2 Priorities among the Needs

CapTOP is expected to be developed in stages, over time. This section describes the prioritization among all functions that will be integrated into the CapTOP. First, all functionality that exists in the current CapTOP is the highest priority for integration into the new CapTOP. New functions will be integrated in the following order:

- Incident Management
- Special Event Planning and Management
- Traffic Information Dissemination
- Weather Event Management
- Data Warehousing and Archiving
- Traffic Operation and Management
- ITS Device Operation and Control
- Traffic Data Collection and Analysis
- Center-to-Center Communication
- User Interfaces
- Regional Traffic Management
- Maintenance and Construction Management

Further prioritization for operational functions of the CapTOP will be documented in the CapTOP Functional Requirements Document.

4.3 Assumptions and Constraints

CapTOP will be installed in the new TMC at the UCC facility. This facility will serve as the primary ATMS. CapTOP will also be installed at the existing TMC to serve as the backup system. CapTOP will replace the current pilot CapTOP and interface with existing management systems such as QuicNet, CityWorks and others, such as configuration management systems. This must be achieved without any degradation of performance in the current TMC.

The CapTOP system will monitor and control all field devices, but only a portion of them will be done directly. For example, traffic signals will continue to be controlled through

QuicNet. Therefore, the CapTOP system needs to provide an interface with QuicNet for the purposes of signal monitoring and control. It is not envisioned, at this time, that CapTOP will communicate directly with signals, but rather it will integrate with a traffic signal system like QuicNet, or equivalent.

5. CONCEPT OF CAPTOP SYSTEM

5.1 CapTOP System Architecture

FIGURE 1 in Chapter 1 presents a concept diagram of the CapTOP system architecture. This CapTOP system consists of client-server architecture with five (5) major components: Client Workstations, Web servers, Communication Servers, Application Servers, and Database Servers with GIS capabilities.

5.1.1 Database Servers with GIS

The database server of CapTOP is an enterprise solution for data integration, and will be comprised of a central data repository supporting reports, queries and analysis. A database will be utilized that contains various real time/historical data, archived TMC data, and system configuration information. The data stored will include traffic conditions data (volume, speed occupancy), ITS device settings (e.g., current message displayed), incident information, etc. All TMC activities will be logged and archived into an activity database. The database server also uses a configuration database to store configuration information for the software functions, traffic signals/ITS devices, and user account information.

CapTOP subsystems will have access to a common geospatial database. This database will use an enterprise database, such as SQL Server, Oracle or DB2. The database server will serve as a data hub for collecting, storing, processing, analyzing, reporting, distributing, and disseminating real-time data that supports effective traffic and incident management. The database server of CapTOP provides a warehouse capability and supports the generation of standard and predefined daily, weekly, monthly, and yearly reports with regard to various activities of the TMC. These reports will include incidents, special event, TMC operation activities, traffic information, system performance evaluation, and ITS device maintenance and management reports. Data maintained in the database will be easily accessed and formatted to produce reports for the TMC and the DDOT staff. The database server allows map-based and web-based interfaces to access data.

It is efficient and cost-effective to manage spatially-related data within a GIS environment. An ArcGIS map server integrated with the database server through ArcSDE will address spatial data demand and map the spatial data. A geodatabase data model will be used to tie various spatial data and manage these data as an integrated system. The conceptual geodatabase data model will have three (3) key features:

- **A Base Reference Network** based on the actual road geometry, which includes all major roads such as freeways, arterials, residential streets, intersections, and other features such as metro stations, park-and-ride lots, etc.;

- **A Location Reference Capability** to provide the capability to locate features based on measures (e.g., SIS distance from intersection) or other location methods (e.g., street address, latitude/ longitude, cross streets); and

- **A Layering Capability** to map data events like accidents, ITS field devices, traffic signals, traffic counts and lane closure segments, which may treated as point or as linear features.

5.1.2 Web Server

This server will provide data from the CapTOP database server to be displayed on a web server. The web server will provide traffic condition maps (showing traffic speeds, incidents, and lane closures) that will allow the public to access the data from the Internet. Internet connectivity will be provided through the D.C. Wide Area Network (WAN) infrastructure, via fractional T3 and redundant T1 circuits.

5.1.3 Communication Server

The communication server manages all communications to field devices (e.g., DMS, HAR, CCTV, etc.) and other systems (e.g., RWIS servers, etc.). The communication interfaces can be serial, modem, fiber, T-1, CAT5E, or wireless.

5.1.4 Application Server

The application server provides an object-oriented architecture that integrates CapTOP subsystems. This architecture is a collection of distributed object models or 3rd party applications. Use of a standard object-oriented GUI for all of the functions provides the ability to share a common architecture through the application server and provides users with direct access to CapTOP functions either locally or from remote locations.

The TMC functions are divided into two groups: operations and maintenance support. Operations functions include traffic management, incident management, special event management, weather event management, ITS device operations and control, emergency management, and information dissemination. Several CapTOP functions are used to support maintenance activities. These functions include traffic signal/ITS device diagnostics, TMC hardware/software management, system design, and software management and maintenance. They are essential to keeping ITS hardware/software systems running in the manner in which they were designed.

A set of market packages defined in National ITS Architecture have been selected and customized to describe the operational functions that CapTOP needs to perform to satisfy the stakeholder needs. According to the National ITS Architecture *(ref 4)*, market packages represent slices of the Physical Architecture that address specific services like surface street control. A market package collects together several different subsystems, equipment packages, terminators, and architecture flows that provide the desired service.

TABLE 2 below provides a mapping between the CapTOP functions and the National ITS Architecture market packages.

TABLE 2 ITS National Architecture Market Package Mapping

Area	Market Package	Market Package Name	CapTOP Function
Archived Data Management			
	AD1	ITS Data Mart	Data Warehousing and Archiving
	AD2	ITS Data Warehouse	Data Warehousing and Archiving
	AD3	ITS Virtual Data Warehouse	N/A
Public Transportation			
	APTS01	Transit Vehicle Tracking	N/A
	APTS02	Transit Fixed-Route Operations	N/A
	APTS03	Demand Response Transit Operations	N/A
	APTS04	Transit Fare Collection Management	N/A
	APTS05	Transit Security	N/A
	APTS06	Transit Fleet Management	N/A
	APTS07	Multi-modal Coordination	N/A
	APTS08	Transit Traveler Information	N/A
	APTS09	Transit Signal Priority	N/A
	APTS10	Transit Passenger Counting	N/A
Traveler Information			
	ATIS01	Broadcast Traveler Information	Traffic Information Dissemination
	ATIS02	Interactive Traveler Information	N/A
	ATIS03	Autonomous Route Guidance	N/A
	ATIS04	Dynamic Route Guidance	N/A
	ATIS05	ISP Based Trip Planning and Route Guidance	N/A
	ATIS06	Transportation Operations Data Sharing	Regional Traffic Management
	ATIS07	Yellow Pages and Reservation	N/A
	ATIS08	Dynamic Ridesharing	N/A
	ATIS09	In Vehicle Signing	N/A
	ATIS10	VII Traveler Information	N/A
Traffic Management			
	ATMS01	Network Surveillance	Traffic Operation and Management
	ATMS02	Traffic Probe Surveillance	Traffic Operation and Management
	ATMS03	Surface Street Control	Traffic Operation and Management
	ATMS04	Freeway Control	Traffic Operation and Management
	ATMS05	HOV Lane Management	N/A
	ATMS06	Traffic Information Dissemination	Traffic Information Dissemination

Area	Market Package	Market Package Name	CapTOP Function
	ATMS07	Regional Traffic Management	Regional Traffic Management
	ATMS08	Traffic Incident Management System	Incident Management Special Event Management
	ATMS09	Traffic Forecast and Demand Management	N/A
	ATMS10	Electronic Toll Collection	N/A
	ATMS11	Emissions Monitoring and Management	N/A
	ATMS12	Roadside Lighting System Control	N/A
	ATMS13	Standard Railroad Grade Crossing	N/A
	ATMS14	Advanced Railroad Grade Crossing	N/A
	ATMS15	Railroad Operations Coordination	N/A
	ATMS16	Parking Facility Management	N/A
	ATMS17	Regional Parking Management	N/A
	ATMS18	Reversible Lane Management	Traffic Operation and Management
	ATMS19	Speed Monitoring	N/A
	ATMS20	Drawbridge Management	N/A
	ATMS21	Roadway Closure Management	N/A
Vehicle Safety			
	AVSS01	Vehicle Safety Monitoring	N/A
	AVSS02	Driver Safety Monitoring	N/A
	AVSS03	Longitudinal Safety Warning	N/A
	AVSS04	Lateral Safety Warning	N/A
	AVSS05	Intersection Safety Warning	N/A
	AVSS06	Pre-Crash Restraint Deployment	N/A
	AVSS07	Driver Visibility Improvement	N/A
	AVSS08	Advanced Vehicle Longitudinal Control	N/A
	AVSS09	Advanced Vehicle Lateral Control	N/A
	AVSS10	Intersection Collision Avoidance	N/A
	AVSS11	Automated Highway System	N/A
	AVSS12	Cooperative Vehicle Safety Systems	N/A
Commercial Vehicle Operations			
	CVO01	Fleet Administration	N/A
	CVO02	Freight Administration	N/A
	CVO03	Electronic Clearance	N/A
	CVO04	CV Administrative Processes	N/A
	CVO05	International Border Electronic Clearance	N/A
	CVO06	Weigh-In-Motion	N/A
	CVO07	Roadside CVO Safety	N/A
	CVO08	On-board CVO and Freight Safety and Security	N/A

Area	Market Package	Market Package Name	CapTOP Function
	CVO09	CVO Fleet Maintenance	N/A
	CVO10	HAZMAT Management	N/A
	CVO11	Roadside HAZMAT Security Detection and Mitigation	N/A
	CVO12	CV Driver Security Authentication	N/A
	CVO13	Freight Assignment Tracking	N/A
Emergency Management			
	EM01	Emergency Call-Taking and Dispatch	N/A
	EM02	Emergency Routing	Traffic Operation and Management
	EM03	Mayday and Alarms Support	N/A
	EM04	Roadway Service Patrols	Incident Management
	EM05	Transportation Infrastructure Protection	Incident Management
	EM06	Wide-Area Alert	N/A
	EM07	Early Warning System	N/A
	EM08	Disaster Response and Recovery	N/A
	EM09	Evacuation and Reentry Management	Incident Management
	EM10	Disaster Traveler Information	N/A
Maintenance and Construction Management			
	MC01	Maintenance and Construction Vehicle and Equipment Tracking	N/A
	MC02	Maintenance and Construction Vehicle Maintenance	N/A
	MC03	Road Weather Data Collection	Weather Event Management
	MC04	Weather Information Processing and Distribution	Weather Event Management
	MC05	Roadway Automated Treatment	N/A
	MC06	Winter Maintenance	N/A
	MC07	Roadway Maintenance and Construction	Maintenance and Construction Management
	MC08	Work Zone Management	Maintenance and Construction Management
	MC09	Work Zone Safety Monitoring	N/A
	MC10	Maintenance and Construction Activity Coordination	Maintenance and Construction Management
	MC11	Environmental Probe Surveillance	N/A
	MC12	Infrastructure Monitoring	N/A

The customized market packages are used to define the major system functions, interconnection between these components, and interfaces to external systems. FIGURE 4 provides a legend to assist in interpretation of the Market Package diagrams.

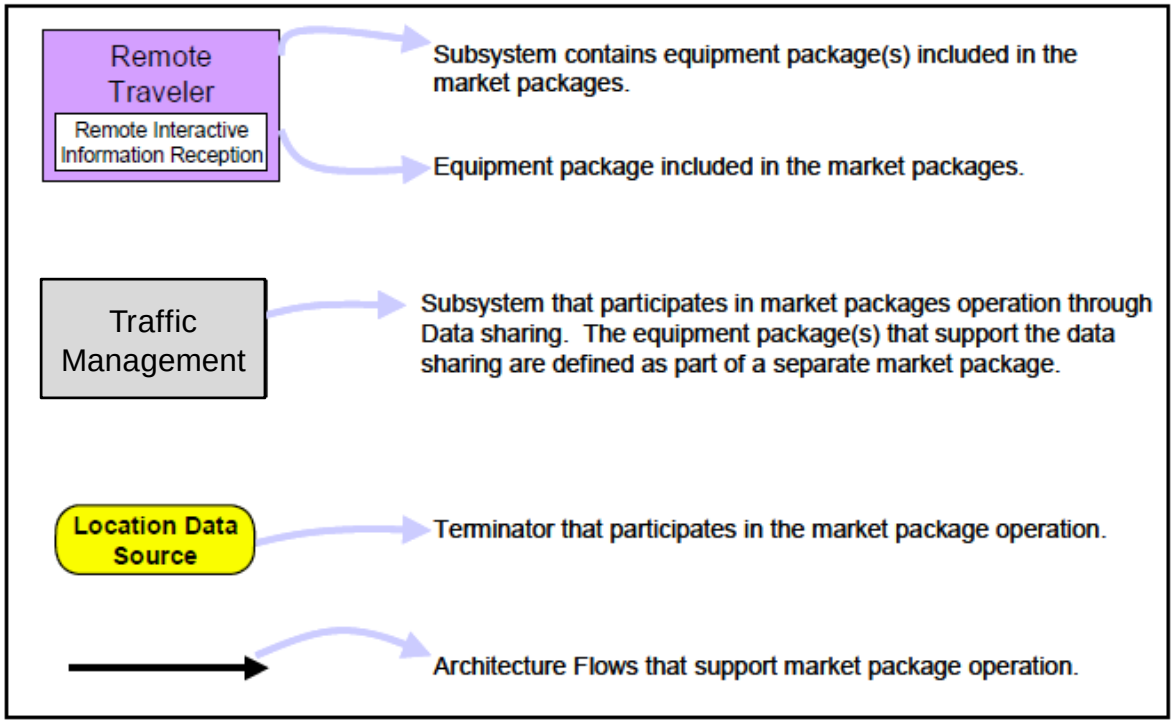


FIGURE 4 Market Package Diagram Elements

The market packages are defined in greater detail at this location:

http://www.odetics-its.com/itsarch/html/mp/mpindex.htm

The architecture flows used in these diagrams are defined in greater detail at this location:

http://www.odetics-its.com/itsarch/html/af/padde.htm

The section below provides a high-level description of key CapTOP functions.

5.2 CapTOP Functions

5.2.1 Incident Management

This customized market package describes the activities for managing unexpected incidents to minimize the impact to the transportation network and traveler safety. The market package includes incident detection capabilities through roadside surveillance devices (e.g., CCTV) and through ROP drivers or other road users as well as through regional coordination with other

traffic management, maintenance and construction management and emergency management centers. Information from these sources is collected and correlated to verify incidents and to implement an appropriate response.

This function supports TMC operators in developing an appropriate response in coordination with DC regional agencies using an event driven incident response engine. Incident response may include traffic control strategy modifications and dissemination of incident information to users (refer to the Traffic Information Dissemination market package in Section 5.2.3). Coordination can also extend to tow trucks and other allied response agencies and field service personnel. This function also supports incident tracking and documentation.

This function provides an event driven incident response engine that supports the ability to implement event-driven automatic incident response plans. This capability selects a pre-configured incident response plan, based on incident location, incident type/severity, and time of the day. The pre-determined response plan can be retrieved when an incident occurs in the location at or near the pre-determined area. The canned response plans can be reviewed and modified to manage incidents. The incident response plans shall be displayed on the GIS map, where applicable, and tabulated format to facilitate review and modification. The CapTOP tailored incident management market package is shown in FIGURE 5.

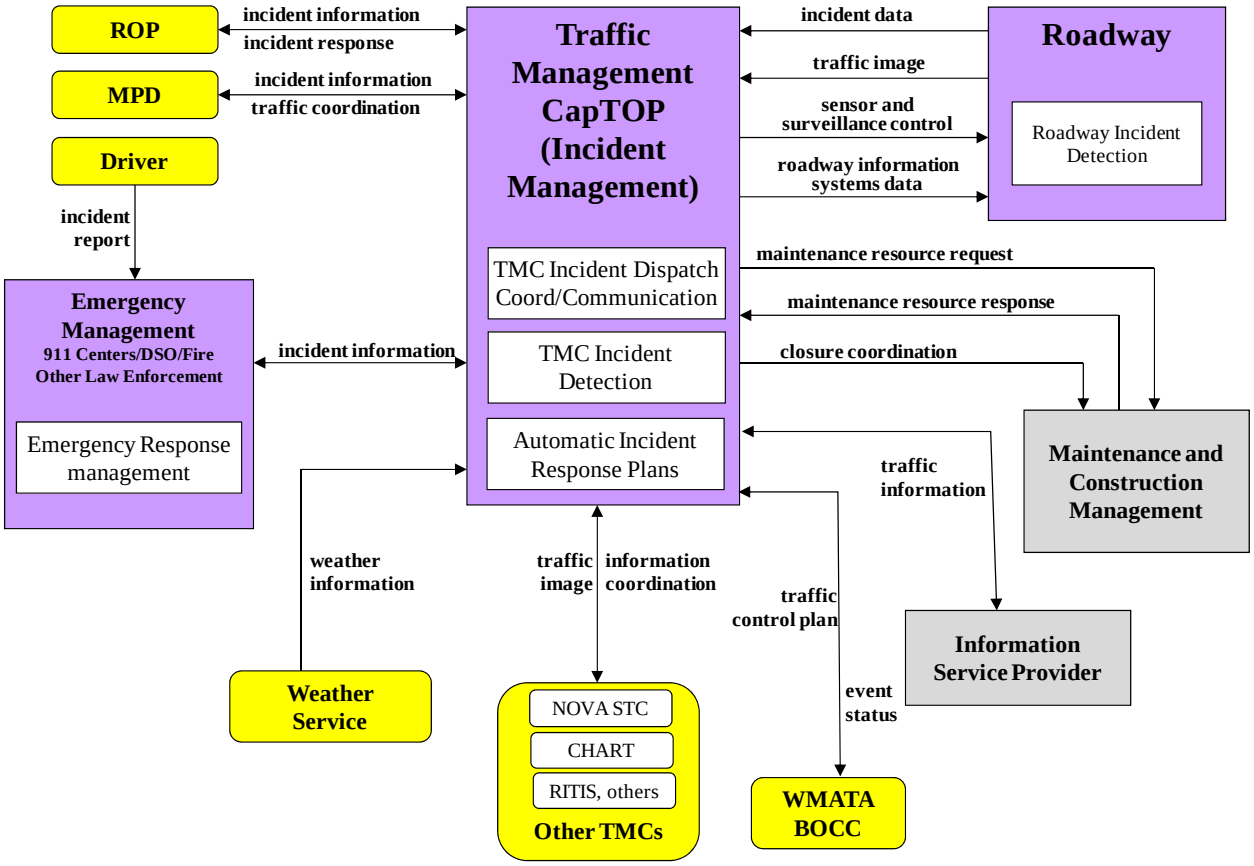


FIGURE 5 Incident Management

5.2.2 Special Event Planning and Management

Special Event Management addresses planned events, such as baseball games, parades, police motorcades, political events, festivals, etc. Like incident management, special event management incorporates automated incident response plans to guide the operator in managing the incident with proper response (e.g., DMS for traffic diversion, HAR messages, etc.). This customized market package describes the functions necessary for managing planned events or special events with the goal being to minimize the impact to the transportation network and traveler safety. Special event management involves information sharing and coordination with other transportation and safety agencies to manage the sudden increased traffic demand on the roadway to resulting minimize congestion. All activities before the event, during the event, or following the event are logged for after-the-fact analysis and evaluation. Special event management can also include implementing traffic management strategies on alternate routes to minimize delays for vehicles on diversion routes attempting to bypass the special event. The response may include traffic control strategy modifications and dissemination of information to affected travelers (refer to the Traffic Information Dissemination market package in Section 5.2.3). The CapTOP tailored Special Event Management market package is shown in FIGURE 6.

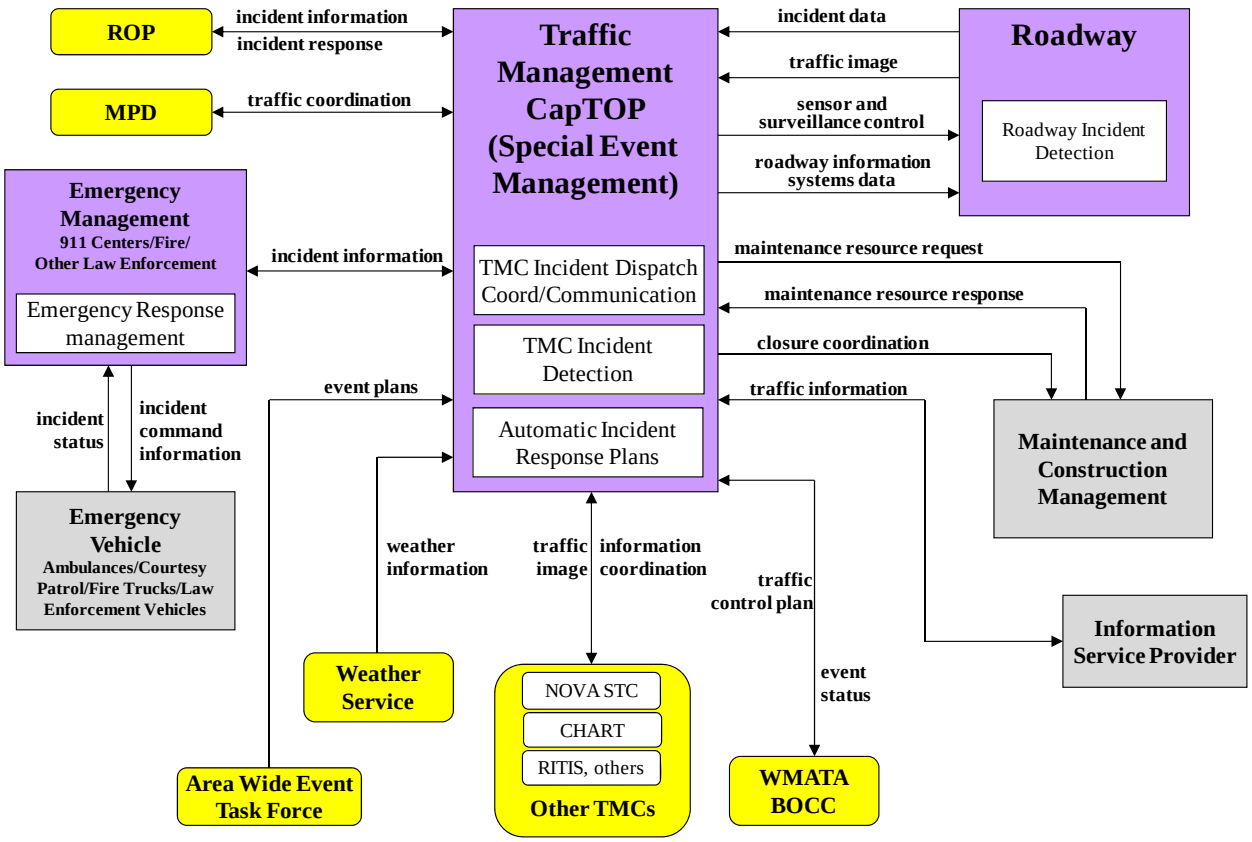


FIGURE 6 Special Event Management

5.2.3 Traffic Information Dissemination

This market package allows traffic information to be disseminated to roadway users using ITS devices such as DMS (or portable DMS), HAR, and the Internet. The TMC will serve as the dissemination source point for traffic/incident information to the public. This package provides a tool that can be used to monitor and control the ITS devices used to notify roadway users of information regarding incidents, congestion, travel times, air quality alerts, traffic safety messages, and lane closures. This package also covers the interfaces that provide traffic information from the TMC to the media (e.g., WTOP radio, TrafficLand.com, Fox 5, Channel 7, TRANSCOM), and other agencies. Information dissemination to other TMCs will be accomplished through the center-to-center communications link. The CapTOP tailored Traffic Information Dissemination market package is shown in FIGURE 7.

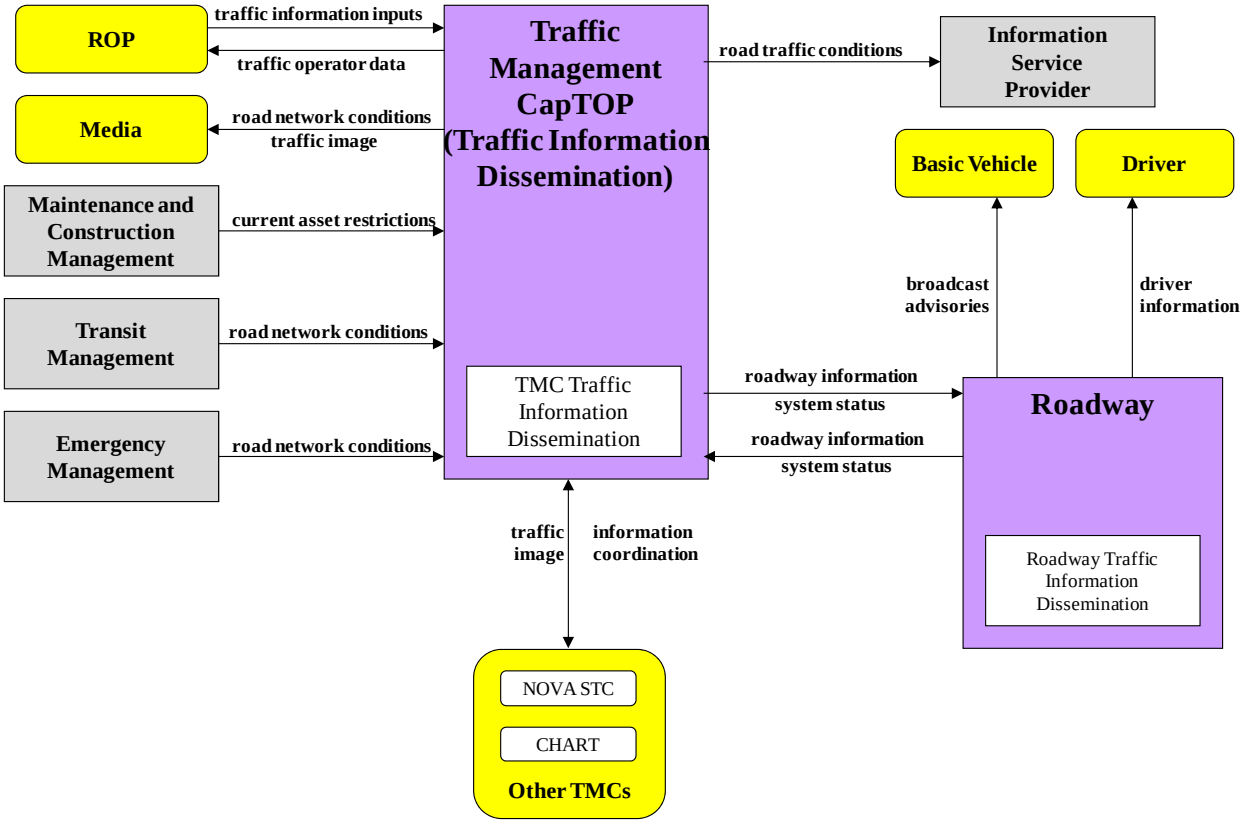


FIGURE 7 Traffic Information Dissemination

5.2.4 Weather Event Management

This market package monitors current and forecasted road and weather conditions using a combination of regional weather service information and data collected from environmental sensors deployed on or near the roadway. The collected road weather information is monitored and analyzed to detect and forecast environmental hazards such as icy road conditions, dense fog, and approaching severe weather fronts. This information can be used to more effectively deploy road maintenance resources, issue general traveler advisories, and support location specific warnings to drivers using the Traffic Information Dissemination market package (refer to Section 5.2.3). The weather function will provide interface to RWIS stations to get weather conditions information. The data from the RWIS will be published through TMC.

The system uses the following sources of environmental condition data to disseminate weather information to the traveling public:

- RWIS along the roadway;
- Environmental condition data from weather agencies;
- Satellite and Doppler radar images from the National Weather Service.

This information is also used to coordinate maintenance activities (e.g., snow plows) necessary to respond to the weather conditions. Construction and Maintenance personnel will coordinate directly with the TMC personnel if an emergency lane closure is required due to inclement weather conditions, or if a crew will need to alter the construction schedule due to weather conditions. The CapTOP tailored Road Weather Information market package is shown in FIGURE 8.

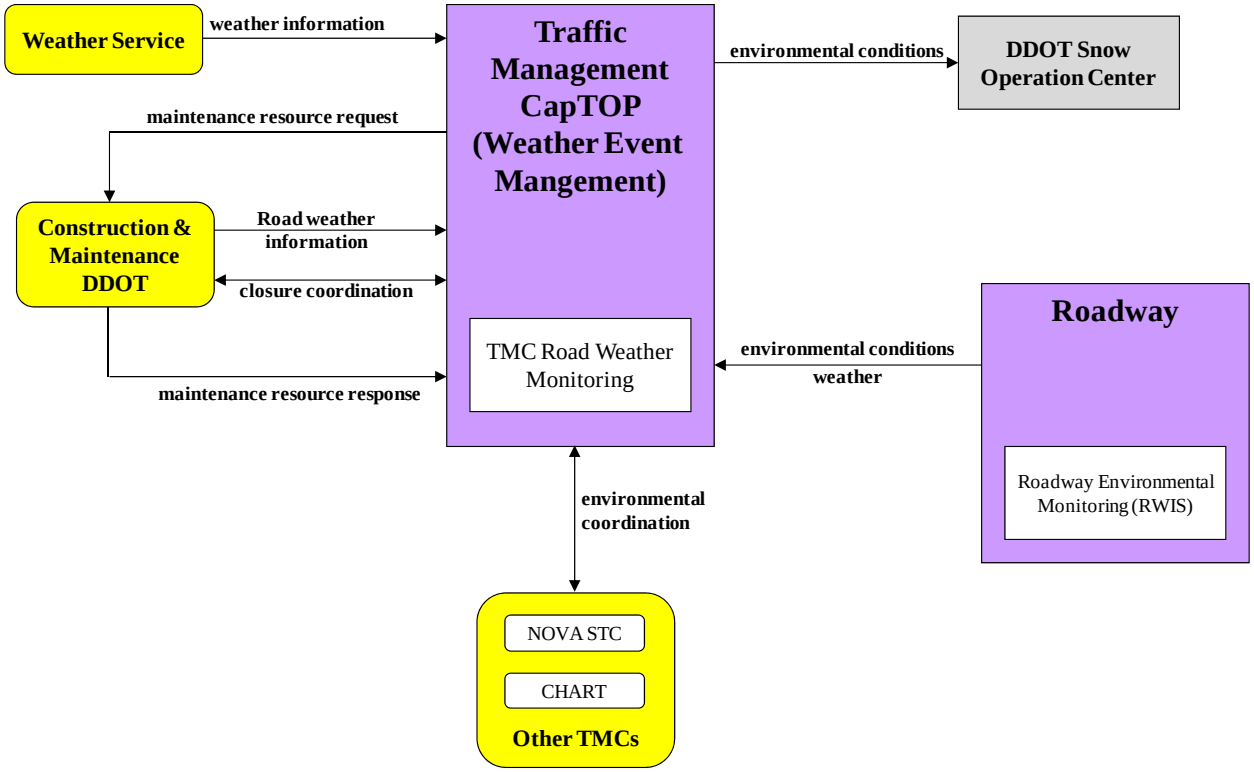


FIGURE 8 Weather Event Management

5.2.5 Data Warehousing and Archiving

This function is the integration of two basic market packages, ITS Data Mart and ITS Data Warehouse. This customized market package supports the capability to perform data archiving at different levels. This archive typically includes data for traffic/incident status and conditions, major special events, weather condition, and TMC activities. It also supports generation of standard, predefined daily, weekly, monthly, and yearly reports for incidents, special events, and for other TMC activities. These reports include statistics and summary information for incidents, traffic volumes, system evaluation, maintenance activities and operations activities. Data maintained in the database will be easily accessed to produce these reports. Generation of *ad hoc* reports will also be supported such that the data can be formatted to meet the needs of DDOT administrators and other agencies. The data archive will be flexible enough to allow different data formats and will be dynamically configurable by a system administrator. This function will

allow the retrieval and sharing of data to be used for planning, designing, and generating performance measures.

In addition to the archiving capabilities, the warehousing functionality allows for the collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs data management in a single repository with consistent formats. The data analysis and data mining features will be included in this market package in addition to the basic query and reporting features offered by the ITS Data Mart. The CapTOP tailored Data Warehousing and Archiving market package is shown in FIGURE 9.

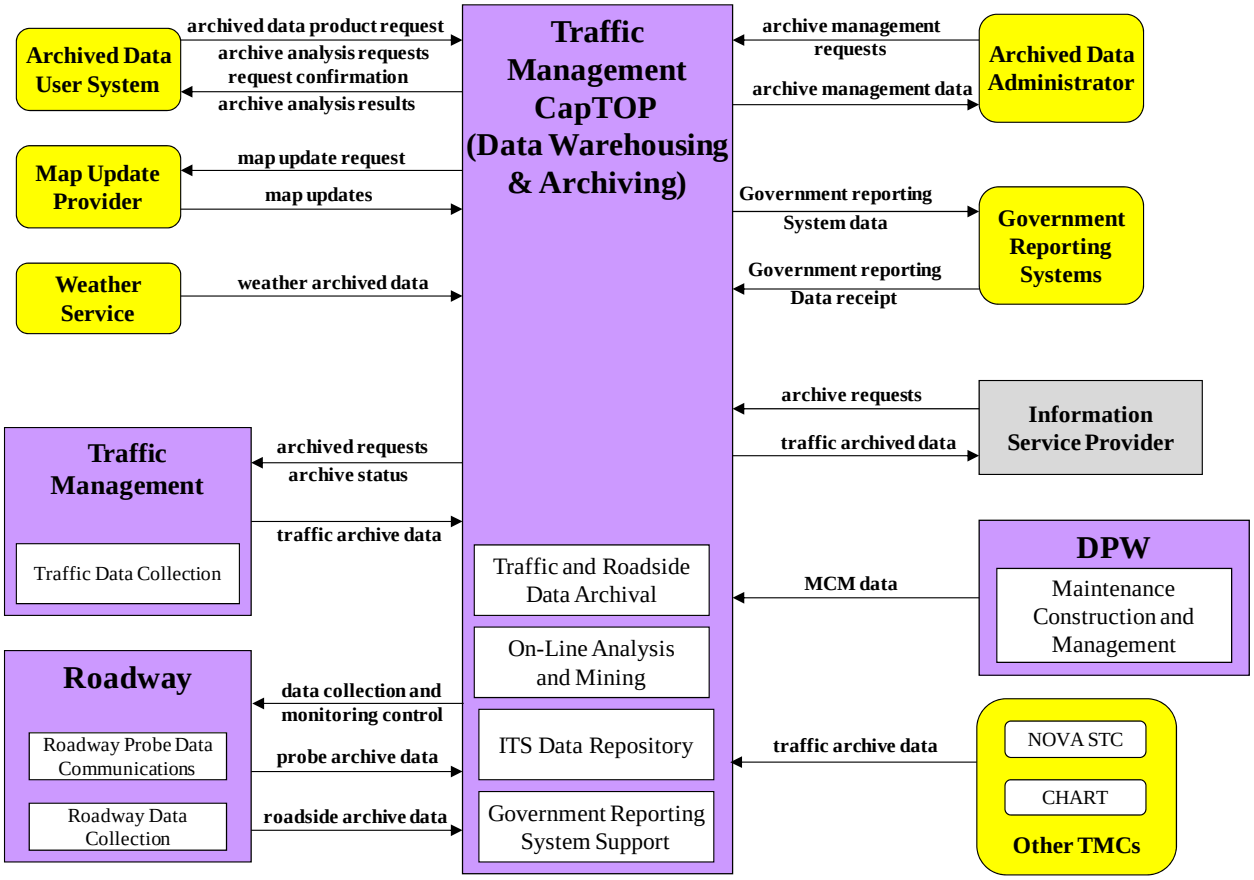


FIGURE 9 Data Warehousing and Archiving

5.2.6 Regional Traffic Management

This market package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. CapTOP will allow sharing of field device data and video as part of the information coordination with other agencies. This information coordination will allow the external agencies to better manage incidents and coordinate response plans.

RITIS provides the service of exchanging traffic/incident information among the transportation agencies within the Washington region. The CapTOP interfaces with RITIS to provide the exchange of traffic/incident data. Due to the diverse forms of information within RITIS, the NTCIP protocol for center-to-center (C2C) is used to exchange information among the agencies on an as needed basis and per a memorandum of agreement. CapTOP will integrate this interface into its overall communications network to provide DDOT's information to others, while receiving similar information from RITIS and other agencies in the region.

Communication between the DDOT TMC and other TMCs in the region is extremely important. To enhance system reliability and avoid total dependency on RITIS, direct communications will be established between the DDOT TMC and other TMCs within the regions. These communications links can be used to exchange information for traffic incidents, including the exchange of video. Direct communications with emergency and maintenance facilities is also planned. These links facilitate the response of support crews to clear incidents quickly, to make necessary repairs, and to clear snow and ice from the roadways in a timely manner. The CapTOP tailored Regional Traffic Control market package is shown in FIGURE 10.

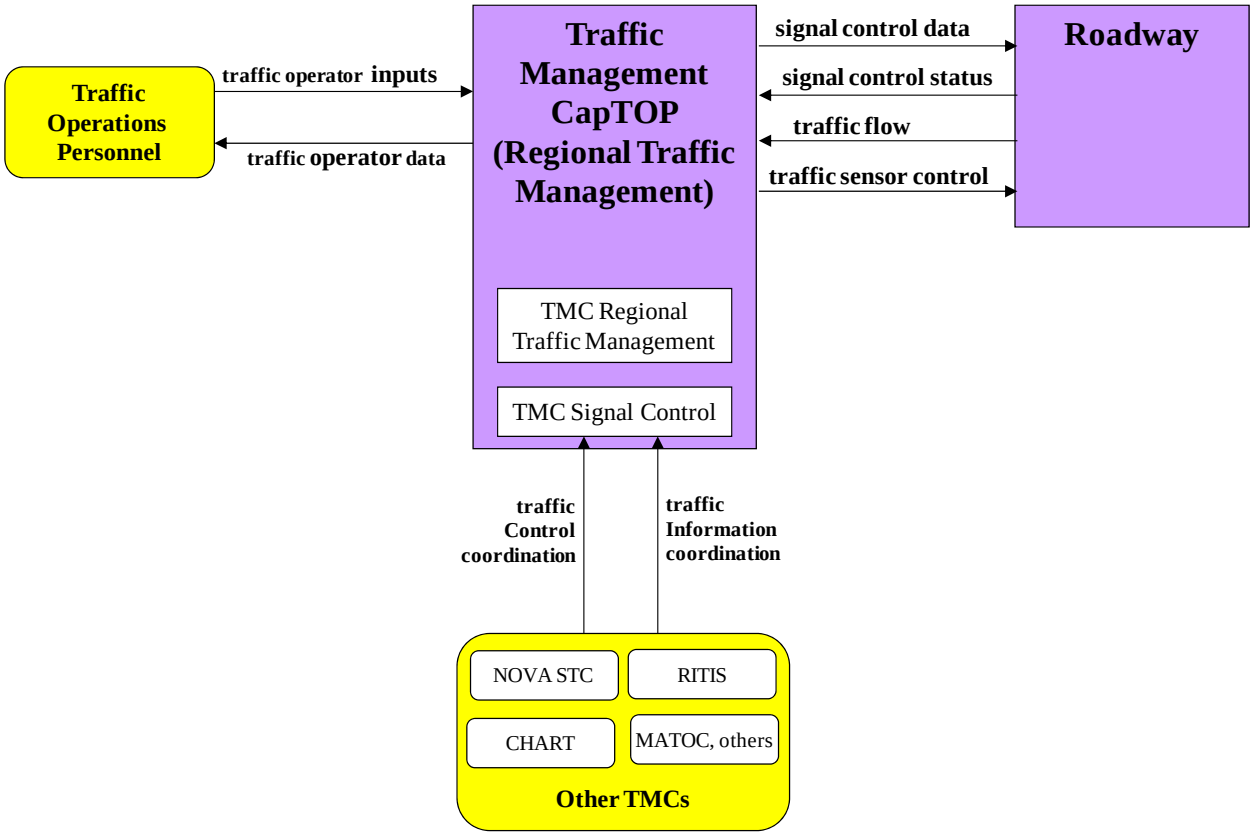


FIGURE 10 Regional Traffic Management

5.2.7 Maintenance and Construction Management

The Maintenance and Construction Management market package focuses on the exchange of roadway maintenance and construction schedules between agencies, and provides information to the media. These information exchanges help to ensure that other agencies can plan for impacts to their road networks as a result of road or lane closures in another jurisdiction. Maintenance includes routine maintenance of roadways, traffic signal equipment, and ITS devices, as well as activities specifically related to inclement weather such as snowplowing and ice removal.

As part of Maintenance and Construction Management, a connection between the DDOT TMC and DDOT Snow Operation Center is established to track maintenance vehicles and location. DDOT Snow Operation Center is also a primary source of weather and road conditions information. The CapTOP tailored Maintenance and Construction Management market package is shown in FIGURE 11.

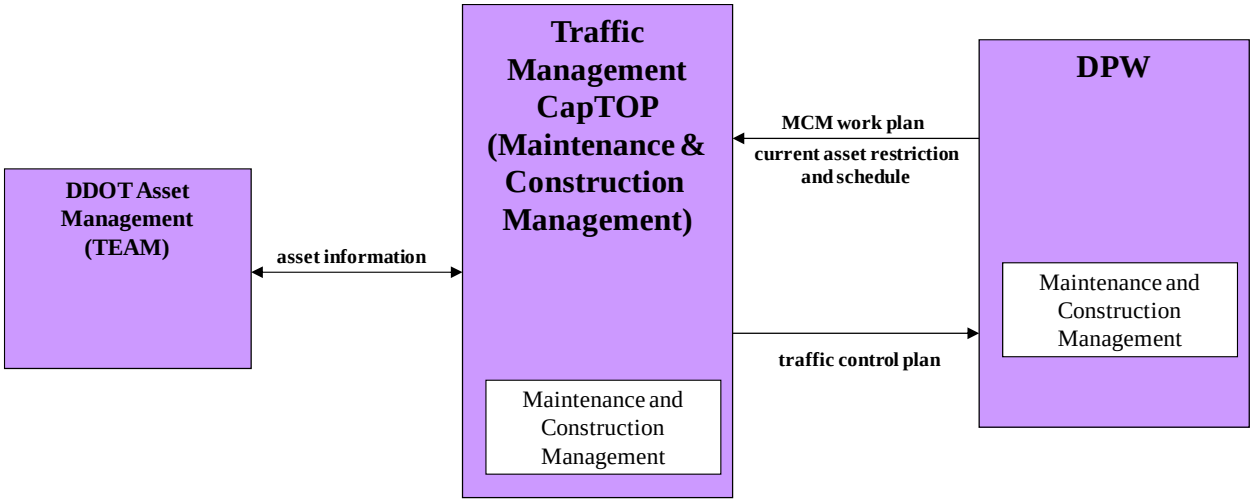


FIGURE 11 Maintenance and Construction Management

5.2.8 Traffic Operation and Management

This market package enables traffic managers to monitor traffic and road conditions (arterials, freeways, and the 3rd Street and 12th street tunnels), detect faults in operations, and collect traffic data. These functions support the monitoring of traffic and road conditions using CCTV and vehicle detectors, consisting of in pavement detectors and non-intrusive detectors. Speed is monitored where data is available (e.g., the speed detector in 16th Street). If the speed is determined to be excessive along monitored areas, roadside equipment (e.g., a portable DMS) can suggest a safe driving speed. Normal operations are achieved by ensuring the proper implementation of the daily traffic control schedule for a variety of traffic control devices. If any problems occur in this normal operation, personnel may be dispatched to the scene to immediately address the problem to ensure that public safety is maintained. All information collected by the system and user actions is logged. CapTOP provides an interface to all field equipment for the purposes of monitoring equipment status, collecting data, and performing

control. Advanced algorithms, data processing, and mass storage capabilities that support real-time assessment, historical data analysis, and the forecast of roadway network performance are provided. The CapTOP tailored Traffic Operations and Management is shown in FIGURE 12. Note: traffic signal control is managed outside of CapTOP through DDOT's Traffic Signal System.

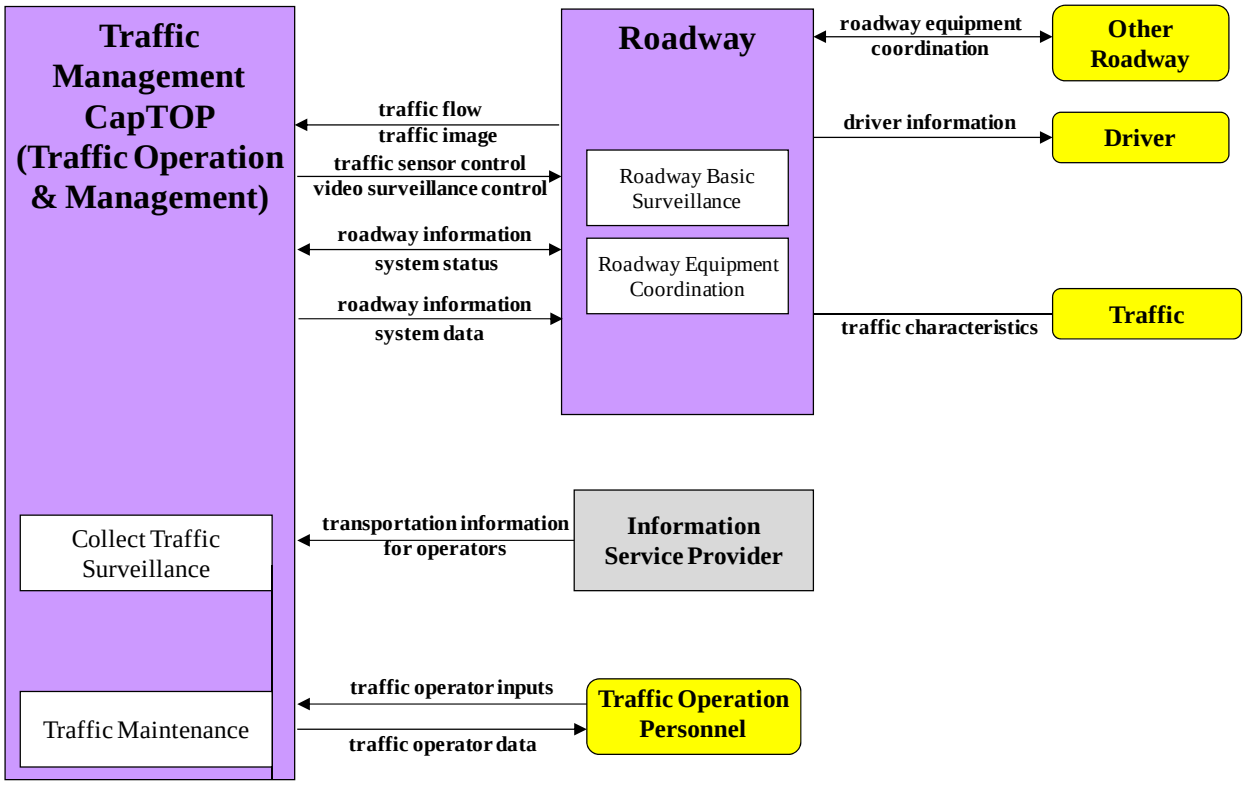


FIGURE 12 Traffic Operation and Management

5.2.9 ITS Device Operation and Control

This CapTOP function provides monitoring and control of all ITS field devices, including CCTV cameras, portable and fixed DMS units, RWIS units, vehicle detectors, HAR stations, and traffic signals. The National Transportation Communications for ITS Protocol (NTCIP) for specific ITS devices will be used for communication between the TMC and the ITS devices, where available and mature. This market package provides central control and monitoring equipment, communication links, and the signal control equipment that supports 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. Coordination across jurisdictions is accomplished by using a common time base or other strategies that do not require real time coordination. This market package is consistent with typical urban traffic signal control systems.

5.2.10 Traffic Data Collection and Analysis

This CapTOP function provides the ability to collect raw traffic data, including real-time and historical data from a variety of sources, and perform analysis that will be used to implement new traffic control strategies and to derive measures of effectiveness. Data collection and dissemination of control signals will be accomplished over a communication network. The system should not be limited to the type of detectors used to gather traffic data; however, it may be necessary to develop new software modules to interface to the detectors if the communication protocols are based on proprietary specifications.

This CapTOP function provides the following:

1. A network to support communication with all DDOT traffic sensors and signals (via the Traffic Signal System);
2. Data collection from a variety of field sensors and data storage at the TMC for future processing and analysis;
3. The capability to accept real time or historical data from other TMCs, such as CHART, NOVA STC, etc.;
4. Data storage of processed, aggregated or synthesized data from multiple sources, including raw traffic data, historical data, system status data, system configuration data, and signal timing plan data.

5.2.11 Center-to-Center Communications

CapTOP will support a standard center-to-center (C2C) interface and support NTCIP C2C communications to exchange traffic information between TMCs. Through the C2C interface, users at remote centers can obtain system status and ITS device information using the NTCIP standard protocol. If other systems implement the NTCIP C2C protocol, CapTOP users will be able to monitor and control those systems through the CapTOP GUI and benefit from two-way traffic information exchange.

5.2.12 User Interfaces

The user system interfaces consist of two types of interfaces: a Graphical User Interface (GUI) and a GIS-based map interface.

5.2.12.1 Graphical User Interface (GUI)

The GUI will provide access to all functions and subsystems (e.g., DMS, CCTV, incident management, etc.) using industry standard web-based browser technologies. The benefit of a browser implementation is the ability to inexpensively develop the user interface (i.e., there is a plethora of reusable mainstream software) and to be able to run the interface from any location without the need for client software. The GUI provides a robust and intuitive interface between ITS devices/subsystems and the user, which enables users to work with a single “common-look-and-feel” interface.

5.2.12.2 GIS-Based Map Interface

The GIS-based map display provides support in displaying freeway, arterial, surface, and residential streets along with various attributes. This capability is compatible with the ArcGIS application that is capable of displaying traffic conditions, incidents, lane closures, and device (e.g., DMS, CCTV) status in a real-time fashion. The GIS-based map supports the display of various attributes using layers. Layers can be turned on or off at user request. Support is also provided to import and export data (e.g., shape files, layers, etc.).

The displayed layers will be color coded so that trouble spots can be easily identified by observing a graphical view. The operator will be able to pan and zoom the map so that regions of interest can be expanded or contracted depending on the operator's needs. Icons will be displayed for field equipment locations, incidents, and lane closures. The operator can access the field equipment monitor and control functions by selecting the icon for the device of interest. The map display provides an accurate depiction in regard to the actual physical location of each device or incident. The GIS-based map display provides the user an environment to interactively add ITS devices or incidents to the CapTOP system by placing an icon representing the new device directly on the map display. Then, the user defines the new device with its various attributes in the database. Alternatively, the user may use the GIS-based geocoding functions to locate the device or incidents by specifying the x/y coordinates, street address, or cross streets on the map display.

5.3 Organization and User Classes

The organizational structure to support CapTOP is presented in FIGURE 13. There are a minimum of eight (8) CapTOP user groups who have different access privileges. Each of the user groups will be assigned data access and specific privileges by the CapTOP account management features. A brief description of the roles and responsibilities of the key personnel to support the organizational concept is described below.

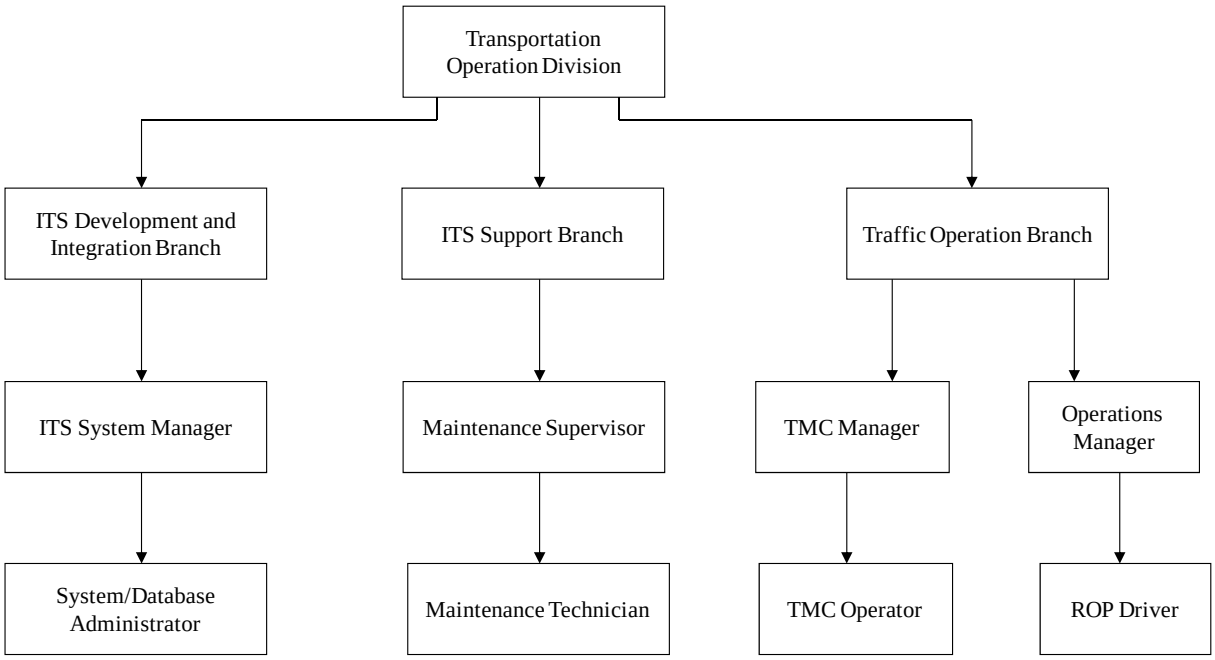


FIGURE 13 CapTOP Organization Chart

TMC Manager – the TMC Manager is responsible for the following:

- Scheduling operator assignments for the TMC;
- Monitoring and maintaining the quality of work of the TMC operators;
- Supervising day-to-day administrative functions and logging all operator activities;
- Documenting the outputs and outcomes of traffic management and incident response efforts;
- Creating and updating incident response plans;
- Implementing and/or approving control commands ITS devices (e.g., DMS and HAR);
- Reviewing and analyzing TMC response to incidents using the incident report and status logs;
- Defining or limiting the range of operator monitoring and control in regard to TMC field resources, and also resolving any conflicts in the use of TMC workstations and CCTV wall monitors;
- Ensuring that all current incidents are being worked and regularly checked for status via the traffic/incident condition display, or status logs and incident reports;
- Coordinating training and approving certifications of new TMC operators;

- Coordinating with maintenance personnel and system administrators for any outages, testing, repairs, software updates, etc. to minimize impact on operations.

The TMC Manager uses CapTOP to coordinate, track, and document activities of TMC operators. They also use the system to identity, track, and deploy staff and equipment needed to support traffic management during incidents and events. In addition, they use the system to communicate and coordinate with other agencies and jurisdictions during special events, regional weather events, major incidents, or other unusual conditions. Finally, the TMC Manager uses the system in the same way a normal operator does in situations where there is an abundance of incidents, or, where there are shortages in staff.

TMC Operators – TMC Operators are responsible for the following:

- Carrying out daily operations;
- Coordinating transportation activities for day-to-day traffic management;
- Managing all types of incidents and events that affect the road transportation network;
- Monitoring of daily traffic flow on the surface street network via the CCTV cameras;
- Verifying incidents through the CCTV cameras, two-radio and telephone communications;
- Pinpointing incident location, incident type, and severity;
- Assessing incident impact on traffic flow and implementing response plans to clear incidents;
- Tracking and documenting incident status from detection through recovery;
- Notifying external agencies with the incident notifications that provide the incident location, type and severity;
- Answering phone requests for assistance from citizens and ROP drivers;
- Monitoring and controlling ITS devices (e.g., CCTV, vehicle detectors, DMS/PDMS, HAR, and RWIS);
- Monitoring Metropolitan Police Department (MPD) 911 dispatch data for traffic incidents;
- Monitoring communications and advisories (e.g., amber alerts) from other agencies, including Homeland Security and EMA, and from neighboring jurisdictions (Maryland and Virginia);

- Providing alerts to government officials through the National Warning Systems (NAWAS) about major roadway traffic incidents;
- Contacting VDOT and SHA to coordinate activities for incidents or events at or near jurisdictional boundaries, or that may impact traffic across jurisdictional boundaries;
- Coordinating information sharing with other agencies and the private sector in regard to planned events and emergency repairs;
- Posting and updating information on traffic websites;
- Answering and routing telephone calls, entering complaints from the public and others regarding problems and malfunctions of traffic equipment, the infrastructure, or other conditions affecting traffic;
- Entering work order/repair requests into the asset management system, and initiating/coordinating communication with utility companies or others involved in repairs affecting the roadway (e.g., the McDean database).

Note: from time to time a special kind of operator can be a guest. The system shall be able to restrict quests to read-only capability.

Maintenance Supervisor – Maintenance Supervisors are responsible for the following:

- Supervising DDOT maintenance technician activities and maintenance services provided by Contractors;
- Developing and implementing traffic signal and response plans for daily operations and in support of incidents, including special events.
- Coordinating the maintenance of field equipment;
- Managing inventories of spare equipment and supplies for maintenance-related items, and ordering replacements as required;
- Tracking the status of repair activities, and communicating with other agencies or Contractors to advise them about the status of devices, or to coordinate and share resources;
- Supervising maintenance personnel;
- Maintaining computer systems and communication networks;
- Coordinating repairs of and improvements to field equipment and computer systems with vendors;
- Coordinating installation and testing for ITS devices and signals;

- Arranging for the repair of equipment under warranty, or in cases where there is a lack of in-house expertise;
- Assigning problem resolution tasks to maintenance technicians.

Maintenance Technicians – include various specialists with expertise in computer hardware and software, electronics, communication systems, traffic signals, and ITS devices. Maintenance Technicians occupy the TMC and have remote access to the same traffic information as the traffic operators through their own workstations. Maintenance technicians are responsible for the following:

- Maintaining all traffic signals and ITS-related devices, including CCTV cameras, portable and fixed DMS, RWIS, and HAR;
- Maintaining and monitoring the performance of all TMC workstations, servers, networks, and communications;
- Maintaining the TMC computer systems performance and performing the necessary troubleshooting for problems or "bugs";
- Providing performance monitoring and troubleshooting of the communications and ITS devices;
- Maintaining inventories of field equipment and spare parts;
- Setting and updating traffic signal parameters
- Note: traffic signal engineers are granted the same privileges as a maintenance technician.

Operations Manager – the Operations Manager is responsible for the following:

- Supervising ROP activities;
- Dispatching ROPs to motorists in need, and to potential incident locations;
- Dispatching ROPs as requested by the TMC Operator;
- Providing support at the scene of incidents;
- Notifying TMC Operators of incident status, and needs;
- Providing access to mobile video from inside the ROP vehicle;
- Logging all ROP activities;

- Coordinating incident responses with TMC Operators and other agencies via radio and/or telephone;
- Providing limited TMC Operator functions outside normal working hours.

ROP Drivers – the ROP Drivers are responsible for the following:

- Supporting TMC personnel in managing traffic flow and incidents;
- Patrolling the DDOT traffic network and reporting any incidents;
- Managing minor incidents at the scene, as requested;
- Supporting traffic control during incidents;
- Notifying TMC Operators and the Operations Manager of status changes with regard to active incidents;

System Administrator – the System Administrator is responsible for the following:

- Maintaining all user group definitions and security privileges;
- Altering system configuration such as adding users, deleting users, adding devices, deleting devices, or altering system configuration parameters (e.g., content and frequency of data sent/received from other centers);
- Managing and maintaining the CapTOP database;
- Performing database backups, as required;
- Coordinating software installation and testing on TMC computer system;
- Monitoring the performance of all TMC computers and system networks;
- Monitoring CapTOP system event logs and user logs for technical or operational issues.

Remote Guest – remote guests are responsible for the following:

- Viewing the status of traffic signals and ITS devices via the Center-to-Center interface;
- Exchanging traffic/incident information via Center-to-Center interfaces.

5.4 Account Management and System Security

During the course of TMC operations, user accounts will need to be added, deleted and changed. This capability requires TMC Manager or System Administrator privileges. A multi-level user security system will be implemented within the CapTOP. The levels to be defined include: TMC Operator, TMC Manager, Maintenance Supervisor, Maintenance Technician, Operations Manager, ROP, Traffic Engineer, and System Administrator. The TMC Manager or System Administrators specifies the restricted functions for each user group.

6. OPERATIONAL AND SUPPORT ENVIRONMENT

This section describes the operational and support environment, or "world", in which CapTOP operates. This includes all environments of the system that play a supporting role in enabling the system to operate effectively.

This section includes information about the system's environment in terms of the following categories:

- Facilities
- Equipment
- Hardware
- Software
- Personnel
- Operational Procedures
- Support Necessary to Operate the Deployed System

FIGURE 14 illustrates the CapTOP system context diagram. This diagram identifies the interfaces between CapTOP and various systems, centers, and devices.

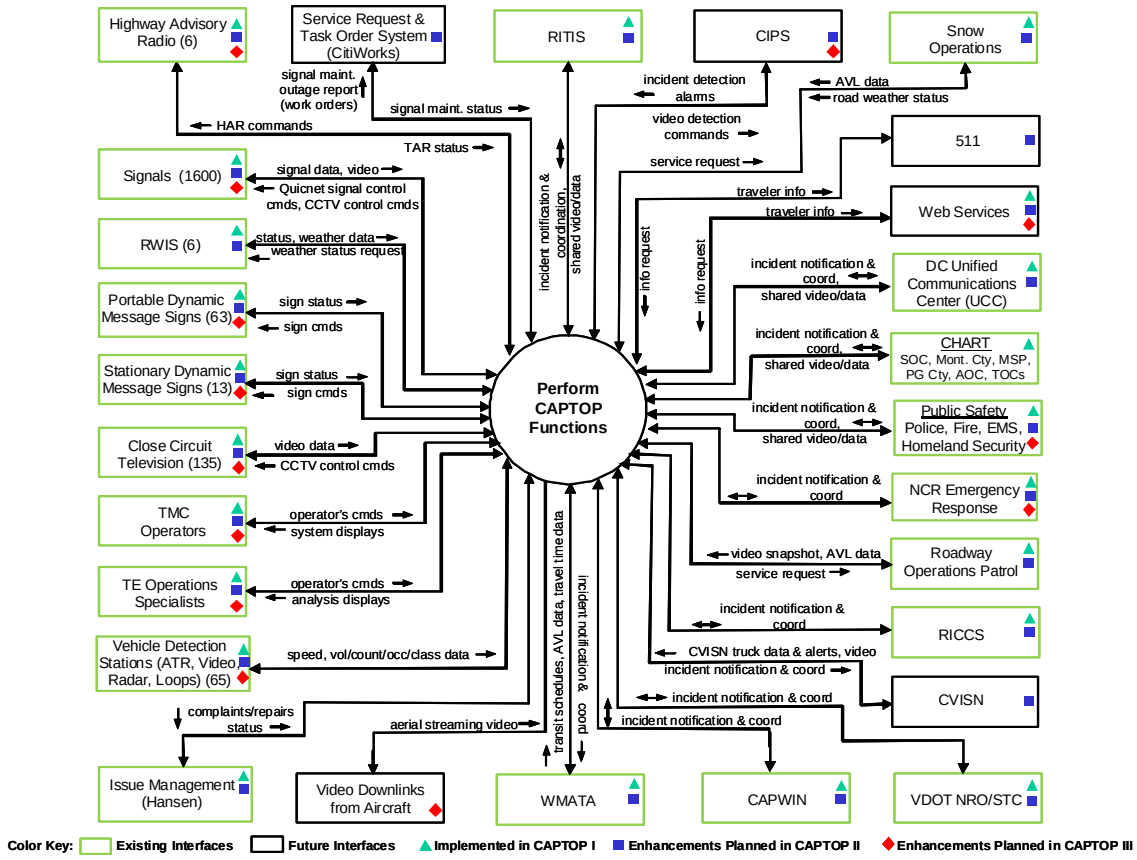


FIGURE 14 Context Diagram for CapTOP System

6.1 Facility

The DDOT Traffic Management Center (TMC) is a 24x7x365 traffic management facility. The TMC is located on the 2nd floor of the UCC. Refer to Section 3.1, Description of Current System, for additional information. The backup TMC is located on the 2nd floor of the Reeves Building. The TMC supports regional emergency management functions and information sharing and integration with MDOT, VDOT and Washington Metropolitan Area Transit Authority (WMATA). The TMC serves as a command and control center to integrate new functions identified in the area of homeland security, including Critical Infrastructure Protection (CIP), interoperable communications, intelligence/information sharing, information gathering, and information dissemination.

CapTOP is supported by an operations and development environment as follows:

1. Operations Environment – this environment houses the production system, which is the "live" system to manage day-to-day traffic operations.

2. Development Environment – this environment is used for software development, testing, simulation and training where items such as patched software, new releases, and new control strategies are tested in an offline configuration.

6.2 Hardware and Equipment

This section is subdivided into field hardware and center hardware. The CapTOP program interfaces with a variety of ITS field devices including CCTV, vehicle detectors, RWIS, DMS, HAR, and a traffic signal system. A description of each of these devices is provided in Section 3.1, Description of Current System.

With regard to the central hardware, refer to FIGURE 15 for a diagram illustrating the CapTOP central hardware configuration. For the CapTOP implementation, the following hardware is anticipated:

- **Client Workstations** – one for each operator in each shift. The CapTOP user interface is graphical and GIS-based; therefore, 4-headed monitors are envisioned with leading edge dual Intel-based processors.

- **Network Switch** – a 10/100/1000 Base T Ethernet switch is required for network connectivity and the display of live IP video. The CapTOP software executes in a distributed computing environment utilizing the Transmission Control Protocol/Internet Protocol (TCP/IP) to communicate between software applications.

- **Video Switch** – a 512 input x 256 output analog NTSC video switch is required for legacy video.

- **Application Servers** – the number of these servers varies based on the number of subsystems deployed, the processing power of the server, and how many ITS devices each of those subsystems is required to support.

- **Database Servers** – these servers host relational database management software with built-in redundancy for high availability.

- **Communication Servers** – these servers are used to provide center-to-center and center-to-field communications using T-1 connections, dialup modems, firewalls, terminal servers, and wireless modems. TCPIP and serial protocols are used to communicate with all devices. Where available, standard protocols, such as NTCIP, will be utilized.

As previously discussed, the hardware and software discussed in this section is available in the operational environment, and a replica copy (though on a smaller scale) in the development (or support) environment.

In addition to the field and center hardware identified above, the CapTOP architecture supports the addition of future ITS field devices and center hardware.

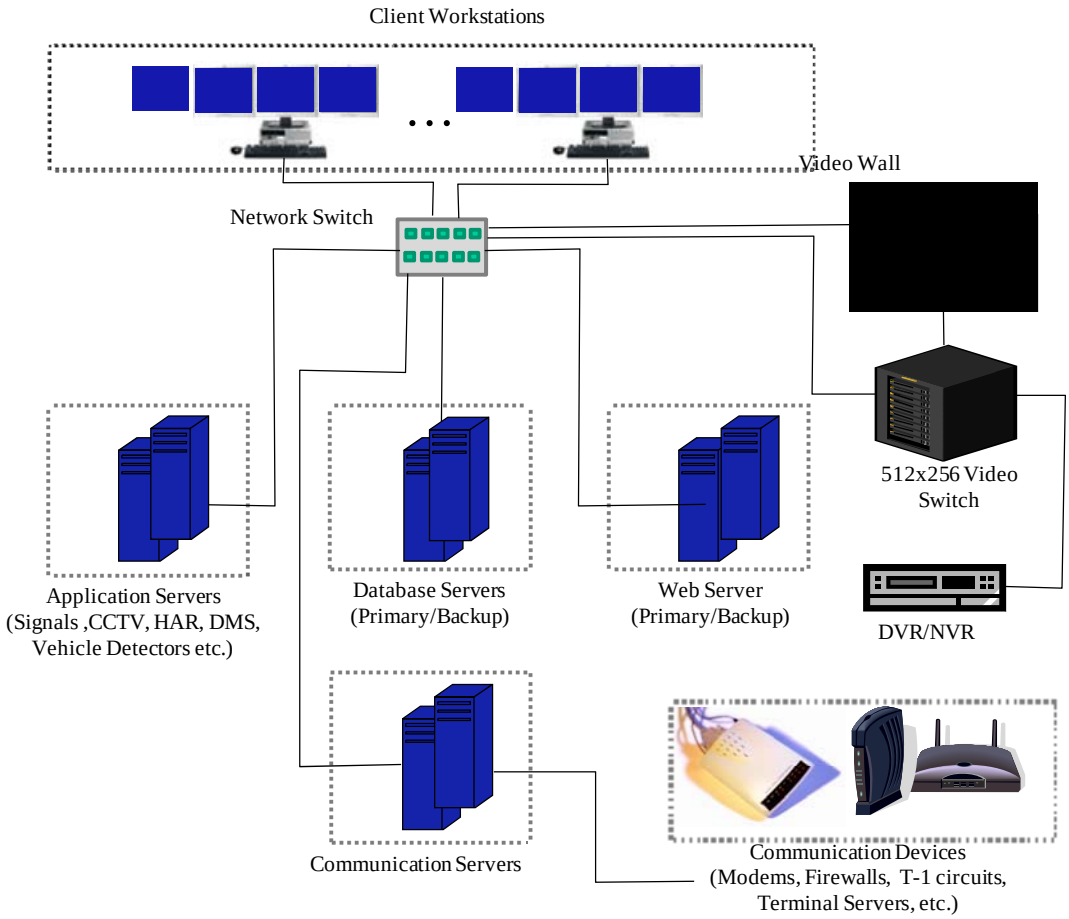


FIGURE 15 CapTOP Hardware Architecture

6.3 Software

The CapTOP software consists of a large number of processes (software applications) that interact in a cooperative environment, as subsystems, to provide CapTOP functionality. FIGURE 16 provides an illustration of the CapTOP software architecture.

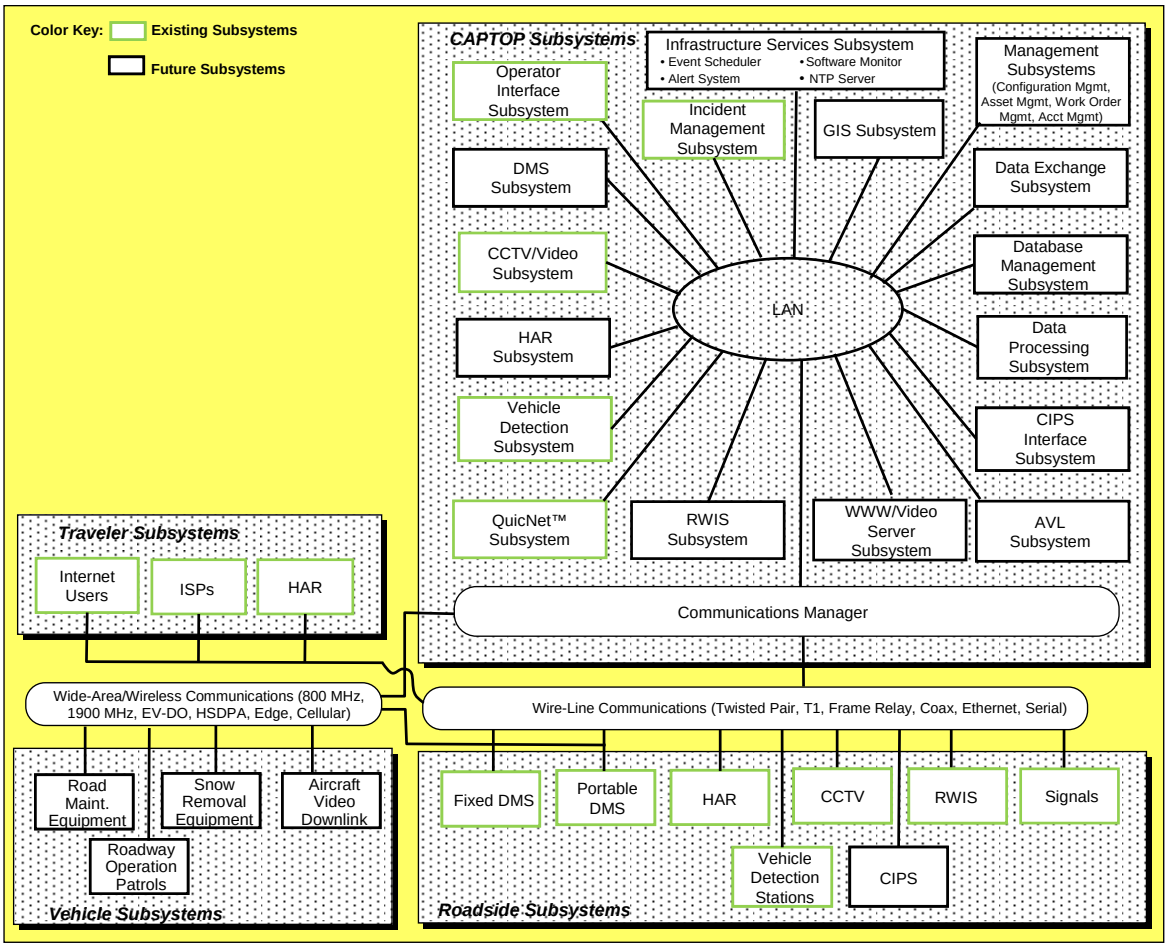


FIGURE 16 CapTOP Software Architecture

Each CapTOP subsystem is described below:

- **Operator Interface Subsystem** – this subsystem provides an intuitive graphical user interface (GUI). An integral part of the GUI is the Geographical Information System (GIS) – based map display, which provides spatial and temporal functions linking traffic management activities to real-world maps.

- **DMS Subsystem** – this subsystem provides monitor and control functions for the DMS/PDMS devices.

- **CCTV/Video Subsystem** – this subsystem provides monitor and control functions for the CCTV cameras, as well the video switch and video wall.

- **HAR Subsystem** – this subsystem provides monitor and control functions for the HAR devices.

- **Vehicle Detection Subsystem** – this subsystem provides monitor and control functions for the various types of vehicle detectors, including loops, peizos, radar-

based devices, etc. Some detectors are sponsored by 3rd parties and are read-only (i.e., no control). This subsystem is based off 3rd party COTS products.

- **QuicNet™ Subsystem** – this subsystem provides monitor and control functions for the 170E traffic control signals. In the future, the 170E controllers will be upgraded to 2070 controllers. This subsystem is based off 3rd party COTS products.

- **RWIS Subsystem** – this subsystem provides monitor-only functions for the RWIS devices, which are managed by a 3rd party.

- **Incident Management Subsystem** – this subsystem provides robust incident management functions, including special event management. Support is provided for automated response plans, as well as on-line procedures.

- **GIS Subsystem** – this subsystem provides the map based capability that works in conjunction with the GUI. This subsystem is based off 3rd party COTS products.

- **Infrastructure Services Subsystem** – this subsystem provides services that are available to the operator and multiple subsystems, including the following:

    - **Event Scheduler** – this service schedules recurring and non-recurring events to remind the operator to take action. This can include scheduled DMS/PDMS messages (e.g., display a new message, or blank sign), HAR messages, alerts, or CCTV tours to be run.

    - **Alert System** – this service provides alerts in the form of emails, text messages or paging messages to individual subscribers or distribution lists.

    - **Software Monitor** – this service provides the ability to monitor, stop, and restart critical software processes.

    - **NTP Server** – this service provides Network Time Protocol (NTP) time synchronization data to all workstations, servers, and controllers.

- **Management Subsystems** – this subsystem supports three separate applications:

    - **Asset Management** – this application provides the ability to control and mange mobile and fixed assets. The software centrally manages the inventory of assets, their location, the users of them, configuration and warranty information, and all costs associated with the various assets. This subsystem is based off 3rd party COTS products.

    - **Work Order Management** – this application provides the ability to enter, schedule, and track work orders. This subsystem also provides the ability to enter and track customer complaints, such as signal outages. This subsystem is based off 3rd party COTS products.

- **Configuration Management** – this application provides an integrated source code baseline for all aspects of the project. This subsystem provides version control, with version numbers, and descriptions to identify what is changed for each release.

- **Account Management** – this application allows the user to add, delete, and change CapTOP user accounts.

- **WWW/Video Server Subsystem** – this subsystem provides data that will be disseminated on the Internet, including live traffic video (or snapshots), congestion, incident, special event, and construction information. This subsystem also facilitates video sharing between other agencies and centers.

- **Automatic Vehicle Location (AVL) Subsystem** – this subsystem provides automated tracking of AVL-equipped vehicles, such as ROPS and maintenance vehicles. This subsystem is based off 3rd party COTS products.

- **CIPS Interface Subsystem** – this subsystem provides an interface to the CIPS, for the purpose of receiving incident notifications.

- **Data Processing Subsystem** – this subsystem is responsible for providing the following services:

  - **Data Collection and Analysis** – a collection of applications that provide access to historical traffic, incident, and performance data. Also provides tools that support graphical displays, statistical analysis, and data mining.

  - **Data Warehousing and Archiving** – provides a repository for electronically stored data. Includes software and hardware that support electronic storage and retrieval of traffic data, response plans, timing plans, ITS device status, system event log, measures of effectiveness and other data. A collection of applications to support various reporting and analysis functions, and to provide a means to retrieve and analyze data, to extract, transform, load, and display data.

- **Database Management Subsystem** – this subsystem provides relational database management functions, including redundancy and mechanisms to provide high availability. This subsystem is based off 3rd party COTS products.

- **Data Exchange Subsystem** – this subsystem provides a standard interface for the purpose of exchanging two-way incident and video information with other centers (i.e., center-to-center), agencies, or private sector companies. CapTOP will provide a mechanism for exchanging two (2) types of data:

  - Traffic data – this type of data is pushed to other centers and includes traffic condition data (e.g., speed, volume, and occupancy), incident information (e.g., accidents, construction, and lane closure), special event information,

video, and current device status (e.g., DMS/PDMS messages, HAR messages, etc.);

- Command/Control data – this type of data is when an operator in one center issues a command to another center to change the current state of an ITS device (e.g., an operator can send a request to change a DMS/PDMS that another center operates).

6.4 Personnel

This section describes the different types of personnel necessary to operate the CapTOP system. The following personnel are necessary to staff CapTOP:

- **Operations Personnel** – are responsible for traffic management functions and are knowledgeable and experienced in the various aspects of ITS including, monitoring, incident management, traffic control, dispatch, and traffic information dissemination. The staff consists of a TMC Manager and TMC operators. Staffing requirements are based on the size of the system, the number of ITS devices, the average daily number of incidents, and the need to conduct 24x7x365 operations. Refer to TABLE 3 for the hours of operation and staffing levels.

TABLE 3 Operations Personnel Staffing

Day of Week	Shift	Hours	# Supervisors (Leads)	# Operators
Weekdays	Morning	5:30 AM – 3:30 PM	1	4
	Mid	2:30 PM – Midnight	1	3
	Night	10:30 PM – 8:00 AM	1	4
Weekends	Morning	5:30 AM – 3:30 PM	1	1
	Mid	2:30 PM – Midnight	1	1
	Night	10:30 PM – 8:00 AM	1	1

- **Maintenance Personnel** – are responsible for corrective and preventive maintenance of all ITS assets. The maintenance staff consists of one (1) supervisory engineering technician (supervisor), seven (7) engineering technicians, one (1) IT technician, one (1) electrical engineering technician, and two (2) electronics mechanics. Staffing requirements are based on the size of the system, the number of ITS devices, and the average daily number of devices to service. Refer to TABLE 4 for the hours of operation and staffing levels.

TABLE 4 Maintenance Personnel Staffing

Day of Week	Shift	Hours	# Supervisors (Leads)	# Personnel
Weekdays	Morning	7:00 AM – 3:30 PM	1	11
	Mid	2:30 PM – Midnight	N/A	N/A
	Night	10:30 PM – 7:00 AM	N/A	N/A
Weekends	Morning	5:30 AM – 2:30 PM	N/A	N/A
	Mid	2:30 PM – Midnight	N/A	N/A
	Night	10:30 PM – 7:00 AM	N/A	N/A

Notes:

1. Maintenance personnel work Mon – Fri only and work special events, as required. All technicians have cell phones and are on-call 24x7x365.
2. Actual start time varies between 6AM and 10:30 AM. End time varies between 2:30 PM and 7:30 PM.
3. In the future, the department may expand to cover other shifts.

- **Roadway Operations Patrols** – provide courtesy roadway patrol assistance to police and emergency personnel in responding to roadway incidents, preventing illegal stops and deliveries, and providing assistance with traffic control for special events in the Central Business District (CBD). ROPs serve as the in the field "eyes and ears" of TMC operators, and keep abreast of conditions and traffic incident management activities. These efforts are aimed at improving traffic flow, decreasing congestion, and improving air quality. The staff consists of an Operations Manager and patrols. These personnel operate 24x7x365. Refer to TABLE 5 for the hours of operation and staffing levels.

TABLE 5 Roadway Operations Patrol Personnel Staffing

Day of Week	Shift	Hours	# Supervisors (Leads)	# of Patrols
Weekdays	Morning	6:00 AM – 2:30 PM	1	3
	Mid	2:00PM – 10:30 PM	N/A	2
	Night	10:30 PM – 6AM	N/A	2
Weekends	Morning	6:00 AM – 2:30 PM	N/A	3
	Mid	2:00PM – 10:30 PM	N/A	2
	Night	10:30 PM – 6AM	N/A	2

6.5 Modes of Operation

The CapTOP system will operate in the following modes:

- **Startup Mode** – This mode starts all systems orderly and renders the TMC operable.

- **Normal Mode** – This is the normal operational mode of the system in which all services are available. The TMC is staffed with a TMC Manager and operators 24x7x365 in accordance with the staffing plan. From this mode, the system can transition to any of the other modes below.

- **Emergency Mode** – This operational mode will involve the coordination of the DDOT ITS Operations, Maintenance, ROPS, and Management personnel with external emergency management agencies and the media (e.g., WTOP radio, TrafficLand.com, Fox 5, Channel 7, TRANSCOM). Other users (some external to DDOT) may log in and use the CapTOP system for emergency management information and control coordination. DDOT will staff the TMC appropriately until the emergency situation has subsided. This mode is determined by the TMC Manager, not the system. All functions are available in this mode.

- **Abnormal Mode** – In this mode, the system has suffered a hardware, software, or communication failure or degradation and must go to maintenance mode.

- **Maintenance Mode** – This operational mode will be used when system upgrades or repairs are taking place. The system will be capable of running from a single workstation/server in this mode.

- **Development/Simulation/Training Mode** – This mode will be used periodically for activities, such as testing a new software release, simulating a new control strategy/tactic, or the training of a new operator. This mode typically executes on a non-operational set of hardware.

- **Backup Mode** – This operational mode will be used in the event of a catastrophic failure at the Primary TMC. In this scenario, backup operations will occur at the backup TMC.

- **Shutdown Mode** – This mode shuts down all systems orderly and renders the TMC inoperable.

6.6 Operational Procedures

This section describes the operational and support procedures used to manage CapTOP. The CapTOP software is being designed and implemented with the following policies and limitations in place:

- The software is designed to support operations on a 24x7x365 basis;

- The software is designed to have at least one operator “in the loop” to implement response plans to incidents;

- All operations activities will be guided by the use of written standard operating procedures for all traffic management activities. This material will be available on-line within CapTOP;

- The software is designed to operate on commercially available operating systems and hardware platforms.

6.7 Asset Management, Work Order Management and Configuration Management

This section describes the configuration, work order, and asset management functions used to manage CapTOP.

- **Asset Management** – CapTOP will use Asset Management software to provide the ability to control and mange mobile and fixed assets. The software will centrally manage the inventory of assets, their location, their users, configuration and warranty information, and will track all costs associated with the various assets. This subsystem is expected to be based on 3rd party COTS products.

- **Work Order Management** – This subsystem provides the ability to enter, schedule, and track work orders. This subsystem also provides the ability to enter and track customer complaints, such as signal outages. This subsystem is also expected to be based on 3rd party COTS products and to replace Contractor-specific databases (such as the McDean database).

- **Configuration Management** – It will be a requirement for the CapTOP software development to have a single integrated source code baseline for all aspects of the project. Robust and disciplined configuration management is mandatory to assure that the software baseline is properly maintained. The design of the CapTOP software will be highly modular and well documented. Each file in the CM system will be version controlled, with version numbers, and descriptions to identify what is changed for each release. There will be a rollback capability in the event a new release breaks functionality. A configuration management board should be established and meet regularly to discuss enhancements and issues. This board approves all changes to the software baseline. This subsystem is also expected to be based on 3rd party COTS products.

6.8 Security

The CapTOP software assumes a network environment that will support the exchange of TCP/IP packets between CapTOP applications. No specific security, other than the encryption of passwords and user privilege control, is performed by the CapTOP software. Other security requirements must be adhered to as published by DDOT's Office of Information Technology Innovation (OITI).

6.9 Additional Support Necessary to Operate the Deployed System

This section includes all other supporting labor that is not specifically designated by the operations of the system. This support includes the following personnel:

- **ITS Management Staff** – Consists of four (4) individuals who are responsible for managing the current and future TMC operations, maintenance activities, and the ROPS.

- **ITS Integration and Development Staff** – Responsible for managing all integration and development activities for the TMC. This includes integrating and developing new software to address operations needs.

7. OPERATIONAL SCENARIOS

This section presents operational scenarios in the form of use cases. Use cases describe how the user interacts with the system in the course of conducting various activities. They detail how the new system would impact the user's activities under a range of conditions, from normal conditions to stress and failure conditions. The use cases tell stories from the perspective of different user classes over a variety of circumstances. As such, use cases are useful tools to convey how the system will be used by various stakeholders. They provide valuable information to the system developer about how to piece the system together, and help stakeholders and users relate to the system through the 'story-telling' method that use cases provide. The use cases in this section are divided into system-level use cases and subsystem-level use cases.

7.1 Use Case Introduction

This section describes the format for presenting the use cases. A description is provided of the use case specification, the use case actors, and the use case diagrams.

7.1.1 Use Case Specification

A use case specification contains a brief description of the use case, identifies the actors, defines the pre-conditions and post-conditions for the use case, and describes the main and alternate flow of events. Each use case will follow the outline below:

- **Use Case Title –** Clearly identifies the task addressed by the use case.
- **Description –** Provides a summary of the use case, including its purpose and goal.
- **Pre-Conditions –** Identifies any conditions that must be met before the use case is executed.
- **Actors –** Lists actors who participate in the use case.
- **Basic Course –** Provides a narrative description of the main sequence of activities.
- **Alternative Courses –** Identifies alternative execution paths within the use case. If a basic course step has more than one possible outcome, the outcome not described in the basic course is defined in the alternate course, along with subsequent steps, which may return to the basic course.
- **Post-Conditions –** Describes the state of the actors and/or system after the use case.
- **Related Use Cases –** Identifies use cases that are referenced by, or related to, the use case.

7.1.2 Use Case Actors

TABLE 6 provides a listing of the actors used in the various use cases.

TABLE 6 Summary of Use-Case Actors in the System

ACTORs (Users)	DESCRIPTION
TMC Operator	• Manage traffic • Manage incidents and special events
TMC Managers	• Supervises operators • Perform system administration and measures effectiveness • Manage over all TMC activities: operations, maintenance, ROPS • Evaluate effectiveness and define process improvement • Develop and maintain response plans
Maintenance Supervisor	• Supervises technicians • Perform system administration and measures effectiveness • Implement signal timing changes
Maintenance Technician	• Troubleshoot system problems • Perform preventive and corrective maintenance
Operations Manager	• Supervises patrols • Perform system administration and measures effectiveness
ROP	• Provide courtesy assistance to travelers in need • Aide police and emergency personnel in incident management • Report the incident status and other information to TMC
Traffic Engineer	• Analyze historical and simulated traffic data • Devise new control strategies and tactics
System Administrator	• Maintains and configures system • Implements operating system and software patches • Maintains and configures all databases • Implements database management software patches Note: database work may be performed by a Database Manager or Database Administrator. For the purposes of this document, those personnel fall into the category of System Administrator.

7.1.3 Use Case Diagrams

The use cases are described at the system-level (SL) and the subsystem (SS) level to help articulate the requirements of the CapTOP system. Six (6) system-level use cases that will be described in this section are as follows:

1. Normal Traffic Operations

2. Incident Management
3. Special Event Management
4. Weather Event Management
5. Center-to-Center Operations
6. Failover Operations

The system-level use cases are shown in FIGURE 17 below.

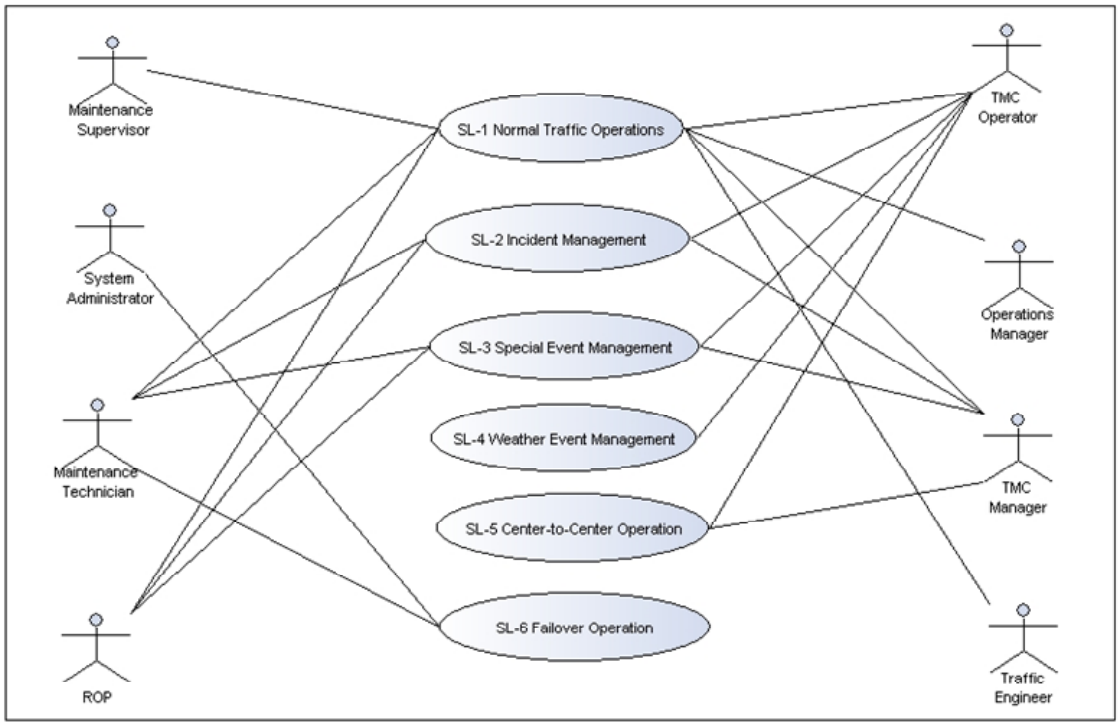


FIGURE 17 System Level Use-Case Diagram for the CapTOP System

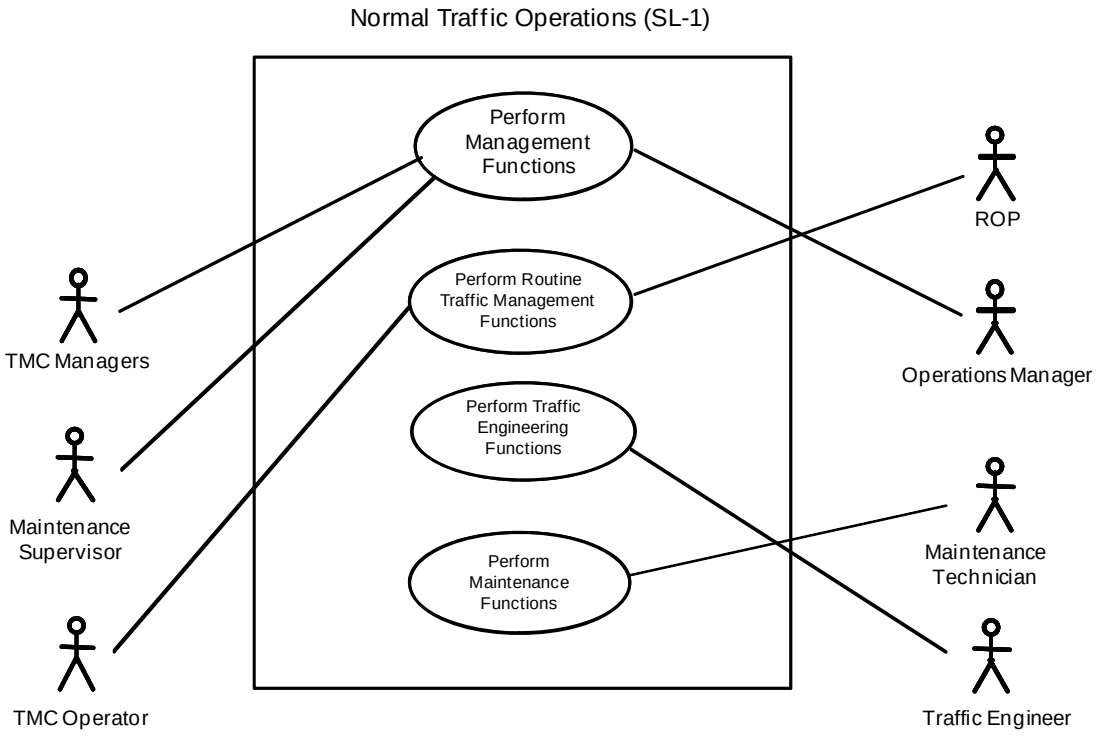
7.2 System-Level Use Cases

7.2.1 Use Case SL-1: Normal Traffic Operations

Description

This use case describes a course of actions to be performed by various actors as part of normal traffic operations. The actions include performing management functions, routine traffic

management functions, center-to-center coordination, traffic engineering functions, database backup, and maintenance/diagnostic functions. The goal of this use case is to describe the general behavior of the CapTOP system. FIGURE 18 below provides an illustration of SL-1.



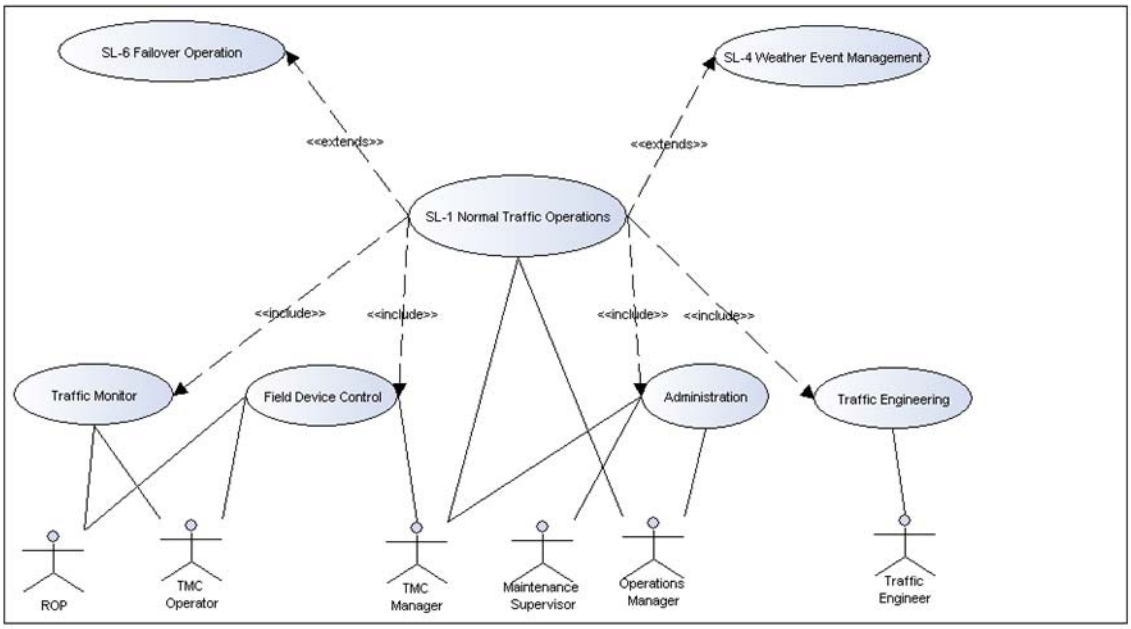


FIGURE 18 Normal Traffic Operations Use Case Diagram (SL-1)

<u>Pre-Conditions</u>

The user must have the appropriate access rights to access the needed functions.

Actors

1. TMC Managers.
2. Maintenance Supervisor.
3. TMC Operator.
4. ROP.
5. Operations Manager.
6. Maintenance Technician.
7. Traffic Engineer.

Basic Course

1. The user logs in using a valid username and password combination as illustrated in FIGURE 19 and FIGURE 20. If the user does not login successfully after three (3) attempts, a 30 second timeout will occur.

FIGURE 19 Sample Desktop Login Icon

FIGURE 20 Sample User Login

2. If the user is valid, he/she will have read access to the system and will be able to monitor system status, including the following:

    a. Subsystem device status – which includes the real-time status of signals, DMS/PDMS, CCTV, HAR, RWIS, and Detectors. The user will be able to obtain device status summary (e.g., online, offline, comm. failure, etc.) information for each device in the chosen subsystem. For each device, the user will also be able to see additional status including the following:

        i. Signals – timing plans currently implemented and the current signal phase;

        ii. DMS/PDMS – the current message displayed;

        iii. CCTV – the current video feed;

        iv. HAR – the message currently being broadcasted (e.g., an audio playback of the .wav file);

        v. RWIS - data from the weather sensor via the SCANweb application;

        vi. Detectors – the speed, volume, and occupancy data from intersection detectors (available through QuicNet), from RTMS detector, and from SpeedInfo, Inc. detectors.

    b. Map display data – The user uses the map display to pan and zoom to the area of interest. Refer to FIGURE 21 and FIGURE 22 below for a sample illustration of

the map display.The map display graphically presents the following to the operator:

i. map detail to include freeways, arterials, surface streets, residential streets, and other types, each as separate layer;

ii. geocoding on operator request, where the location can be specified as either a latitude/longitude pair, an address, or cross streets;

iii. system status using color coded icons for each device (signals, DMS/PDMS, CCTV, HAR, RWIS, Detectors) with color coding to signify different states (e.g., online, offline, comm. failure, etc.); Each icon shall be a separate layer that can be displayed independently or with other layers; Note: despite the fact that the PDMSs are mobile, the system is able to accurately track and display the location of PDMS that are equipped with GPS units.

iv. the congestion level for the arterial and freeway segments;

v. the location of ROPS roving on the map display;

vi. control icons for DMS/PDMS should indicate if there is a message being displayed (e.g., a green icon); Similarly, control icons for HAR should indicate if a message is being broadcast;

vii. the location of incidents, including accidents, construction events, or special events and a color coded status for each;

viii. the system event log that displays all recent events executed by the system or operators in a scrollable and filterable form.

c. Alarms – The user peruses the event log and is notified of alarms. Alarms are categorized and color-coded as critical, warning, and informational.

3. If the user has TMC Manager, Maintenance Supervisor, or Operations Manager privileges, additional capabilities are provided. Refer to Alternative Course 1.

4. If the user has TMC Operator privileges, refer to Alternative Course 2.

5. If the user has Traffic Engineer privileges, refer to Alternative Course 3.

6. If the user has Maintenance Technician privileges, refer to Alternative Course 4.

7. If the user has ROP privileges, refer to Alternative Course 5.

8. If during normal operations there is an incident identified or detected, the operator uses the incident management features. Refer to SL-2: Incident Management.

9. If during normal operations there is a critical failure, the system and operations will be failed over to the backup facility. Refer to SL-6: Failover Operations for more information.

10. As needed, the user has the ability to integrate or streamline data entry into QuicNet, CityWorks, Hansen, Snowtrak, and other 3rd party applications through a unified interface.

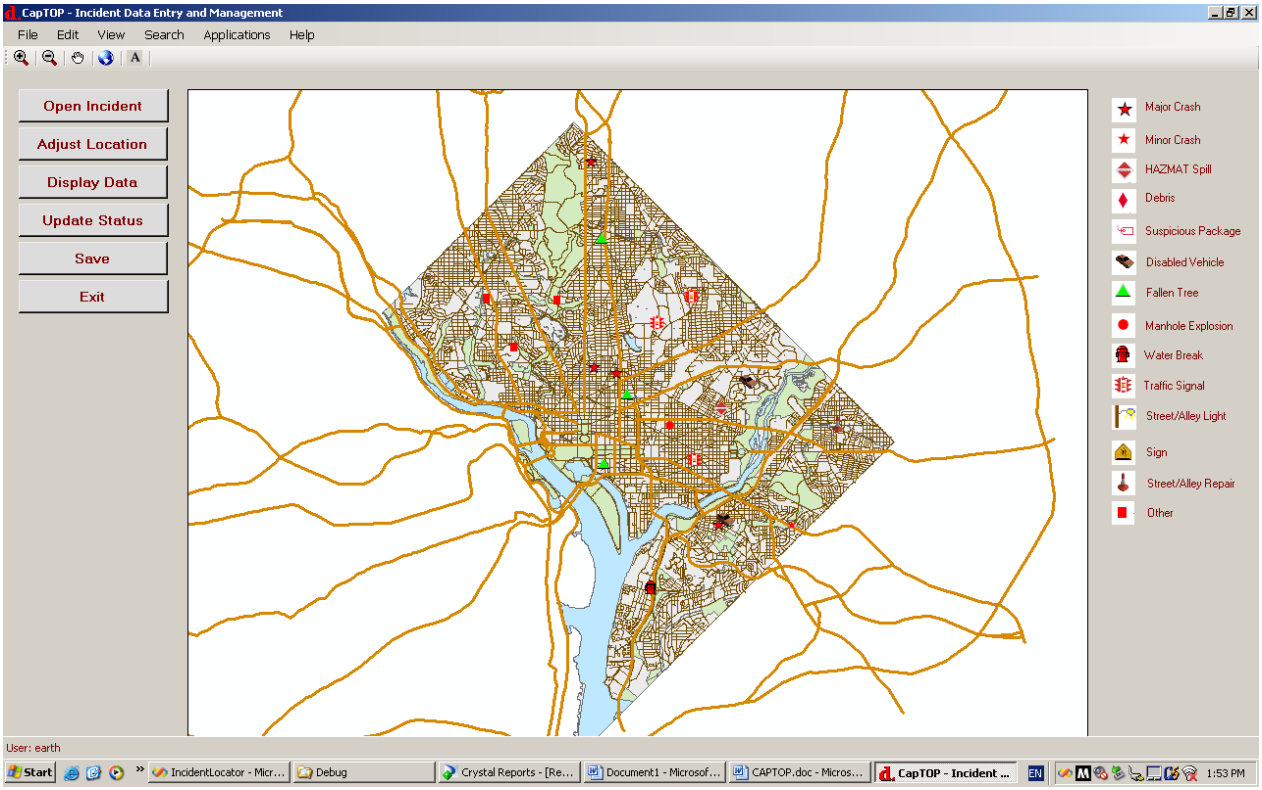


FIGURE 21 Sample Display Showing Default Map

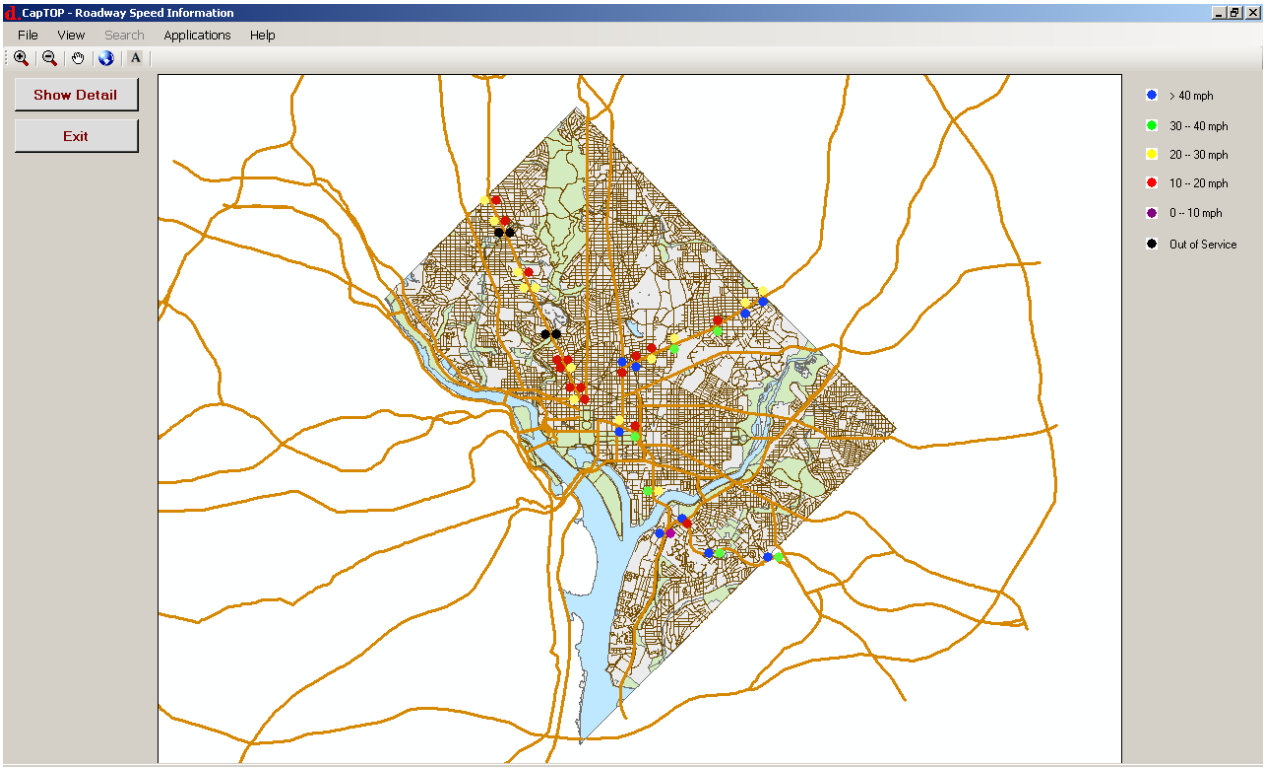


FIGURE 22 Sample Map Display Showing Traffic Speeds

Alternative Courses

Alternative Course 1 – Perform Management Functions

Note: all functions below require supervisory privilege.

1. The TMC Manager can create new user accounts or edit existing user accounts. Refer to MGR-1: Creating/Editing User Accounts.

2. The TMC Manager can generate reports useful for developing measures of effectiveness. Refer to MGR-2: Performance Measurement.

3. The TMC Manager can override any device that is locked by other users, such as cameras or DMS/PDMS.

4. The TMC Manager can start, stop, and restart system processes and receive visual indicators (e.g., red or green dots) to indicate process status.

5. The TMC Manager can purge system event log data.

6. The TMC Manager can access trouble shooting procedures and diagnostics.

7. The TMC Manager can perform asset management functions. Refer to MGR-3: Asset Management.

8. The TMC Manager can perform configuration management functions. Refer to MGR-4: Configuration Management.

9. The TMC Manager can perform work order management functions. Refer to MGR-5: Work Order Management.

10. The TMC Manager can decide to close a road, or display a DMS or HAR message. The Maintenance Supervisor can implement a signal control plan, if reqired.

11. The TMC Manager can stop, start, or restart software processes. Refer to MGR-6: Restarting Software for additional information.

12. The TMC Manager can add, change or delete devices in the system, including CCTV, DMS/PDMS, RWIS, vehicle detectors, HAR, and signals. Refer to MGR-7: Adding/Deleting Devices for additional information.

Alternative Course 2 – Perform Routine Traffic Management Functions

1. The user can monitor and control the following traffic monitoring devices:

    a. CCTV cameras. Refer to TMD-1: Monitoring/Controlling CCTV Cameras;

    b. Vehicle detectors. Refer toTMD-2: Monitoring Vehicle Detectors;

    c. Vehicles with AVI tracking devices. Refer to TMD-3: Monitoring AVI Vehicles Using AVL;

    d. Weather information. Refer to SL-4: Weather Event Management for monitoring road weather devices and regional weather reports.

2. Normal operations are achieved by ensuring the proper implementation of the daily traffic control schedule for a variety of traffic control devices. The user can monitor and control the following traffic control devices with final approval required to be made by a supervisor:

    a. Traffic Signals. Refer to TCD-1: Monitoring and Controlling Signals;

    b. DMS/PDMS. Refer to TCD-2: Monitoring and Controlling DMS/PDMS;

    c. HAR. Refer to TCD-3: Monitoring and Controller HAR;

    d. WWW. Refer to TCD-4: Posting Web Updates;

    e. Traffic Alerts. Refer to TCD-5: Sending Alerts;

    f. Tunnel Devices. Refer to TCD-6: Tunnel Operation and Control.

3. The user can display and print various types of reports. Each report can be sorted and filtered on any field. The types of reports include:

    a. List of incidents;

    b. List of system events;

    c. List of system errors;

    d. List of CCTV device configuration;

    e. List of CCTV device status;

    f. List of HAR device configuration;

    g. List of HAR device status;

    h. List of DMS/PDMS device configuration;

    i. List of DMS/PDMS device status;

    j. List of Signal device configuration;

    k. List of Signal device status;

    l. List of RWIS device configuration;

    m. List of RWIS device status;

    n. List of Vehicle Detector device configuration;

    o. List of Vehicle Detector device status;

    p. List of operator actions;

    q. Listing on preconfigured device schedules.

4. The user can configure the event scheduler to post messages on specific DMS/PDMS at specified times, download HAR messages, transmit alerts, and run CCTV tours.

Alternative Course 3 – Perform Traffic Engineering Functions

1. The user can display historical traffic data and perform analysis and mining functions. Refer to TEN-1: Data Collection and Analysis

2. The user can analyze statistics and perform traffic analyses and simulations to generate new traffic control strategies/tactics. Refer to TEN-2: Perform Traffic Simulations and Generate New Traffic Control Strategies, Tactics and Plans for additional information.

3. The user can generate historical reports that show the following:

    a. Average traffic speed, volume, and occupancy by road, lane number, direction, and time of day;

    b. Locations of where long traffic queues/delays occur;

    c. Areas of recurring congestion;

    d. "Hot spots" for incidents;

    e. Signal timing plans and changes to them over time;

    f. Measures of effectiveness for each signal timing plan.

Alternative Course 4 – Perform Maintenance Functions

1. The Maintenance Technician can connect to CapTOP through a computer in the TMC or via a laptop in the field equipped with a wireless connection.

2. The user can obtain a list of devices, by subsystem, and filter on operational status (e.g., failed, operational, etc.).

3. The user can access the Work Order Management subsystem to update open trouble tickets or create new trouble tickets.

4. The user can access the Work Order Management subsystem to view the repair history for particular devices.

Alternative Course 5 – Perform ROP Functions

1. The ROP can connect to CapTOP either by using a computer in the TMC or via a laptop in the field with a wireless connection.

2. The user can display a list of accident locations.

3. The user can display a list of locations where a motorist requires assistance.

4. The user can obtain incident status data.

5. The user can view the map display and get the location/coordinates of incident locations and DMS locations.

<u>Post-Conditions</u>

1. The user logs out if activities are complete.

2. The system log has a record of all significant user actions.

Related Use Cases

MGR-1: Creating/Editing User Accounts.

MGR-2: Performance Measurement

MGR-3: Asset Management

MGR-4: Configuration Management

MGR-5: Work Order Management

MGR-6: Restarting Software

MGR-7: Adding/Deleting Devices

TMD-1: Monitoring/Controller CCTV Cameras

TMD-2: Monitoring Vehicle Detectors

TMD-3: Monitoring AVI Vehicles Using AVL

SL-2: Incident Management

SL-4: Weather Event Management

SL-6: Failover Operations

TCD-1: Monitoring and Controlling Signals

TCD-2: Monitoring and Controlling DMS/PDMS

TCD-3: Monitoring and Controlling HAR

TCD-4: Posting Web Updates

TCD-5: Sending Alerts

TCD-6: Tunnel Operation and Control

TEN-1: Data Collection and Analysis

TEN-2: Perform Traffic Simulations and Generate New Traffic Control Strategies, Tactics and Plans

TEN-3: Data Warehousing and Archiving

7.2.2 Use Case SL-2: Incident Management

Description

This use case describes a course of actions to be performed by different actors as part of incident management. An incident can include any number of different events that impact traffic, including accidents, congestion, or construction/utility maintenance or repair. A Special Event is a special case of an incident which is discussed separately in SL-3. The major actions performed by the user are monitoring traffic, data entry, verifying incidents, classifying incidents, managing incident response, and building or updating response plans. The goal of this use case is to describe the user's interaction with the system during incident management. FIGURE 23 below provides an illustration of SL-2.

Pre-Conditions

The user must have the appropriate access rights to access the needed functions.

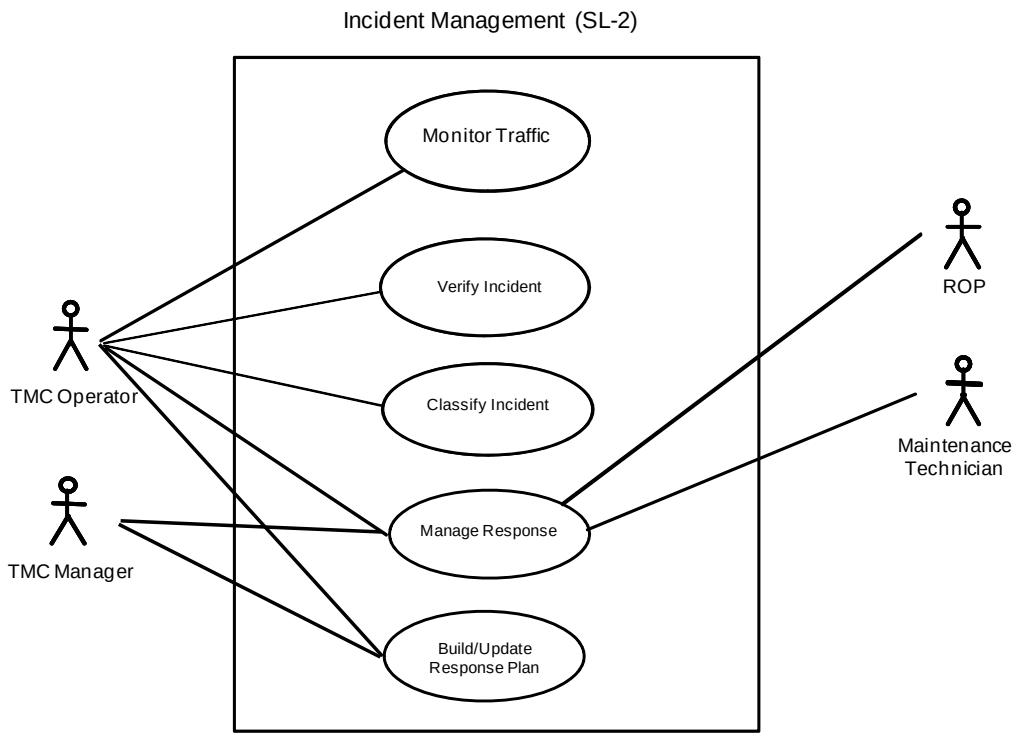
Actors

1. TMC Operator.
2. TMC Manager.
3. ROP.
4. Maintenance Technician.

Basic Course

1. The user logs in using a valid username/password combination. Refer to SL-1, basic course step 1.
2. If the user has TMC Operator, ROP, or Maintenance Technician privileges, the user invokes the CCTV subsystem and Vehicle Detection Subsystem to monitor for traffic incidents. The user also takes 311 calls, and listens to police scanners and two-way radio for reports of incidents, outages or complaints. Refer to TMD-1: Monitoring/Controlling CCTV Cameras, Use Case MGR-5: Work Order Management, and TMD-2: Monitoring Vehicle Detectors for additional information.

   Note: Incidents on urban streets are detected using information from a variety of other sources as well, including MPD, two-way radio, police scanners, traffic radio, TV news reports, phone calls, ROPS, DDOT or other DC government employees, external systems (e.g., CHART), and NetViewer (i.e., the web interface to UCC's/MPD's 911-CAD system).



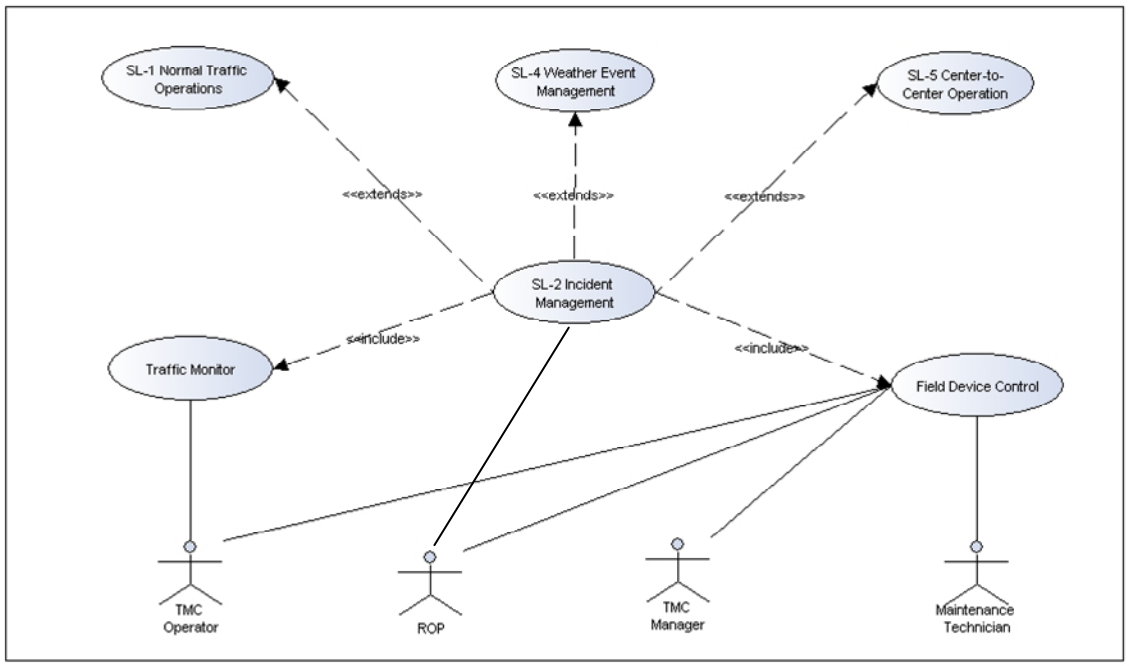


FIGURE 23 Incident Management Use Case Diagram (SL-2)

3. An incident may also be detected automatically by the following methods:

    a. an incident detection algorithm using vehicle detectors or video image processing;

    b. via notification of a detection event from the CIPS;

    c. via notification of a detection event from NetViewer Police/911-CAD system.

4. If the incident was not automatically detected, the user views the map display to locate the closest camera to the incident and routes the video from that camera to the video wall and/or a local desktop monitor. The user pans/tilts/zooms the camera, as required, to verify the incident.

5. If the incident was detected automatically, the system will prompt the user and automatically select and display the camera closest to the incident on default monitors (e.g., a specific dedicated section on the video wall and/or desktop). The system will also automatically move the camera to a camera preset in the direction of the incident. The user pans/tilts/zooms the camera, as required, to verify the incident.

6. If the incident involves fatalities or sensitive images, the TMC Manager can black-out the video using a push button on the GUI.

7. If there is a desire to have the video recorded, the operator can route the video to a recording device (e.g., VCR/DVR/NVR) while simultaneously viewing the video.

8. If the incident has been verified either through CCTV or Police communication, the user will use the map display to select the incident location. This can be done one (1) of three (3) ways: i) by entering the street address, block address (e.g., 3400 Block of Massachusetts Ave. NW.) or cross streets of the incident; ii) by entering the latitude/longitude coordinates of the incident, or iii) by clicking on the map at the incident location. Regardless of method, the system will instantly display the incident location on the map for operator confirmation. Refer to FIGURE 24 below for illustrations. Only a user with TMC Operator privileges can declare a new incident. The system will verify that duplicate incidents have not already been entered.

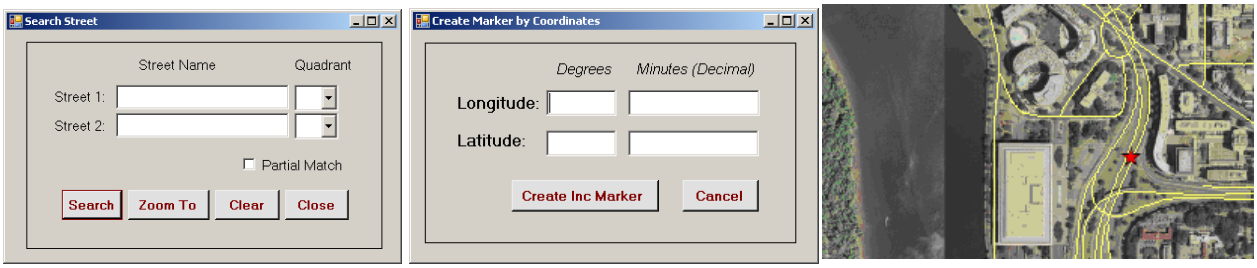


FIGURE 24 Examples of Declaring Incident Locations

9. Next, an incident entry window is displayed pre-populated with the incident location. The user classifies the incident and enters required information, including the incident type, start time, lanes blocked, and direction of travel. The record cannot be saved unless all

required data has been entered. Note: the system strictly enforces that all required information be entered before a response plan can be suggested. Refer to FIGURE 25 for an example of the Incident Entry window. Only a user with TMC Operator privileges can declare a new incident.

10. As part of the monitoring traffic function, the user can also monitor AVI vehicles, road weather devices, and regional weather. Refer to TMD-3: Monitoring AVI Vehicles Using AVL, and SL-4: Weather Event Management for additional information.

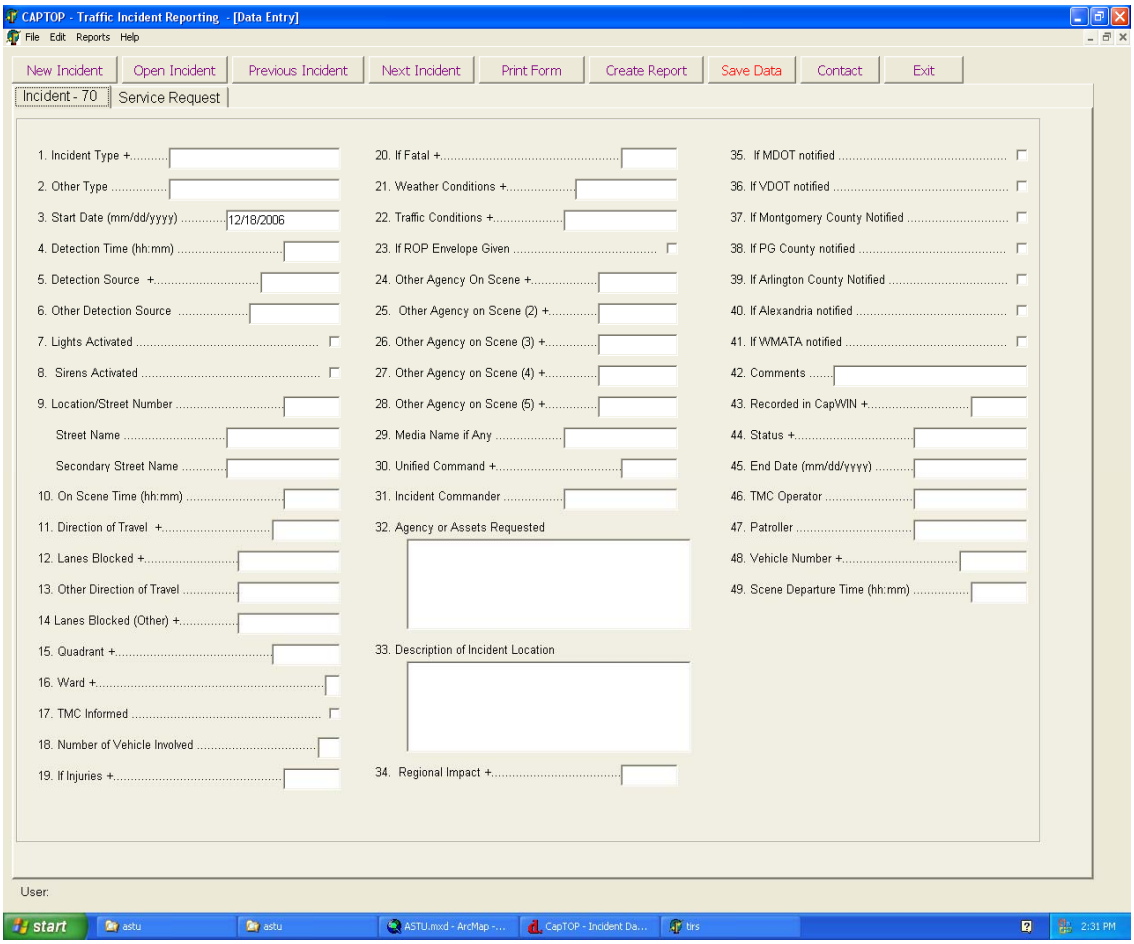


FIGURE 25 Incident Entry Window

11. The user is presented a list of valid incident types from a pull-down list. Refer to FIGURE 26 for a list of the various incident types. If the incident type is not one of the identified types, the user selects "other". Note: the illustration above is from the current system and does not (but should) include additional incident types, including construction/work zone, road damage, and special event.

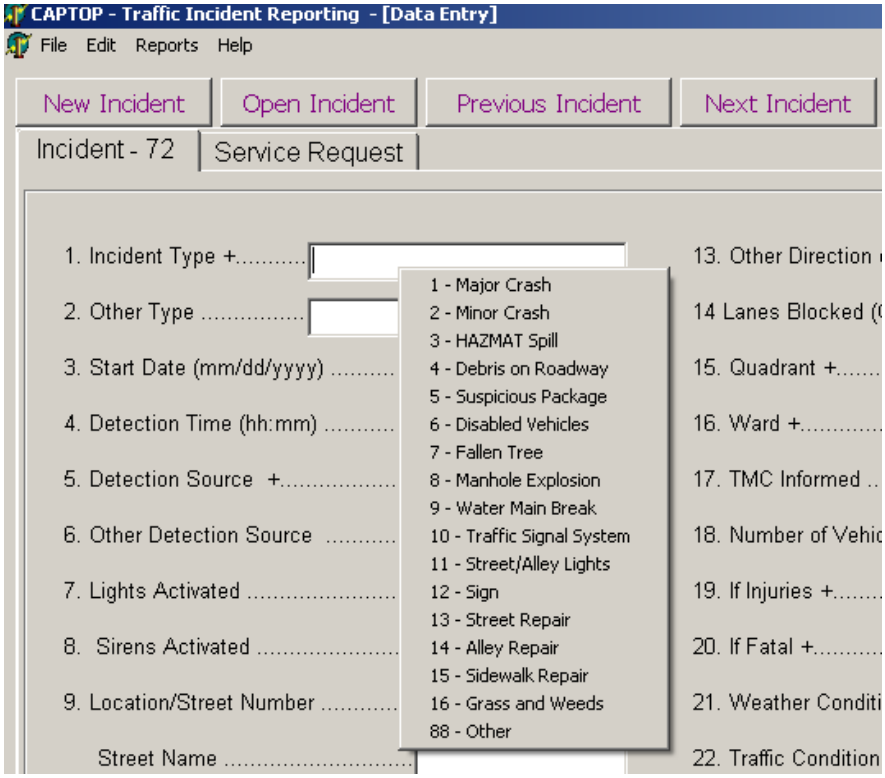


FIGURE 26 Valid Incident Types

12. Based on the type, location and severity of the incident, the user is prompted with an automated response plan. The plan consists of an online version of the standard operating procedure (SOP) for this type of incident and a pre-defined incident response plan, consisting of the following:

    a. Recommended messages for DMS/PDMS;

    b. Recommended messages for HAR;

    c. Recommended signal timing plan changes or other traffic control changes such as reversing lanes, or turning restrictions (must be implemented by the Maintenance Supervisor);

    d. Recommended messages to be sent out via text messages, e-mail messages, or paging messages to WMATA, DC UCC, 511, RITIS, RICCS, CHART, public safety agencies, National Capital Region (NCR) Emergency Response, Prince George's County, Commercial Vehicle Information Systems and Networks (CVISN), VDOT, and other agencies;

    e. The plan should also identify the following:

        i. the geographic location of the incident on a map;

ii. the location of the DMSs (portable or fixed) that will be used on a map with icons;

iii. the location of the cones, barriers, DMS, tow trucks, and SUVs with arrow boards;

iv. the location of traffic control officers on a map with icons, as required.

f. The systems will prompt the user for each recommendation. No actions will be taken automatically. Only users with TMC Manager rights can issue control directives to DMS, HAR, or other traffic control devices. Note: traffic signal timing plan changes can only be made by the Maintenance Supervisor using the Traffic Signal System (separate from CapTOP).

Note: As part of incident planning, the operator uses the response plan editor, within the Incident Management subsystem, to devise a response plan for various types of incidents. A new plan can be created from scratch, an existing plan can be modified, or an existing plan can be used as-is. The plan is then associated with a location and incident type. As part of incident management, the user is responsible for keeping the plans update to date and accurate for future use. Reference TCD-7: Building Response Plans for additional information.

13. The user will communicate with the ROP using two-way radio to dispatch and communicate with the ROPS, as required. The location of ROP can be tracked using the AVL subsystem. Refer to TMD-3: Monitoring AVI Vehicles Using AVL for additional information.

14. If the situation calls for inter-agency coordination (e.g., a major incident that has regional impact), the Operator may inform other centers of the incident. Refer to SL-5: Center-to-Center Operations.

15. When assistance, such as use of DMS control, is requested from other jurisdictions or agencies, the user enters details for this request in the incident log, including the time and date the request was received, the time, date, and content of the response, confirmation that the response was received, any notification that the response was not delivered (or was rejected), and any other actions taken in response to the request.

16. The user has the ability to access an on-line database of Points of Contact (POCs) for agencies and others involved in responding to, or, managing incidents in the region.

17. Alternatively, the user has the flexibility to initiate actions directly by controlling the devices outside of the response plan. Refer to TCD-1: Monitoring and Controlling Signals, TCD-2: Monitoring and Controlling DMS/PDMS, TCD-3: Monitoring and Controlling HAR, TCD-4: Posting Web Updates, and TCD-5: Sending Alerts for more information.

18. At any time, the user may engage in an online teleconference with video (e.g., virtual round-table discussions) to coordinate with offsite locations or other agencies.

19. The user continues to monitor the incident, and updates status as required. When the incident is cleared the user updates the status, and insures that all relevant information for the incident has been entered in the database. The user is prompted to change or remove unnecessary messages displayed on DMS/PDMS, HAR, and the web, or other control directives (e.g., signal timing plans). Only a user with TMC Operator privileges can close an incident. Note: traffic signal timing plan changes can only be made by the Maintenance Supervisor using the Traffic Signal System (separate from CapTOP). These steps are required in order to assess incident management effectiveness.

20. After the incident has been cleared (or closed) the user can perform after-the-fact analysis and produce reports that include data on:

    a. Location and type of incidents;

    b. Number of ROPS utilized;

    c. Equipment used, including # of DMS, cones, barriers and other equipment deployed;

    d. Incident duration (start date/time, end date/time);

    e. HARs used and messages broadcast;

    f. DMS used and messages displayed;

    g. Traffic signal timing changes made;

    h. Traffic alerts posted (including e-mails, text messages, paging messages transmitted);

    i. Website updates implemented;

    j. EMA, MPD and Fire Dept. involvement;

    k. Involvement of other agencies.

<u>Alternative Courses</u>

None.

<u>Post-Conditions</u>

1. The user logs out if activities are complete.

2. The system log has a record of all significant user actions.

Related Use Cases

SL-1: Normal Traffic Operations

TMD-1: Monitoring/Controller CCTV Cameras

TMD-2: Monitoring Vehicle Detectors

TMD-3: Monitoring AVI Vehicles Using AVL

SL-4: Weather Event Management

SL-5: Center-to-Center Operations

TCD-1: Monitoring and Controlling Signals

TCD-2: Monitoring and Controlling DMS/PDMS

TCD-3: Monitoring and Controlling HAR

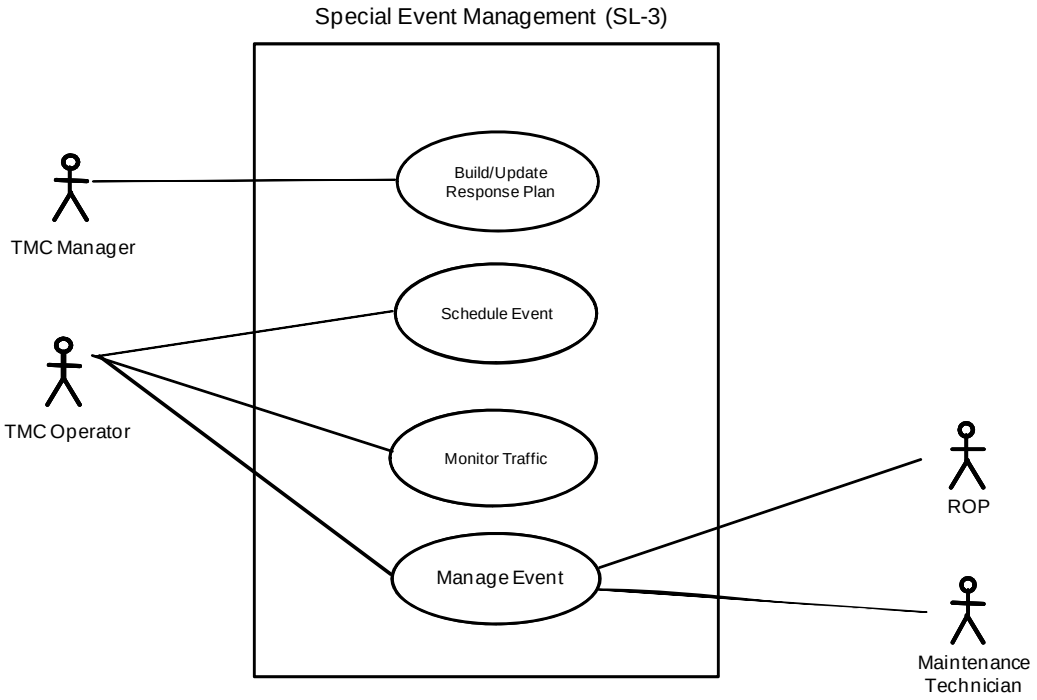
TCD-4: Posting Web Updates

TCD-5: Sending Alerts

7.2.3 Use Case SL-3: Special Event Management

Description

This use case describes a course of actions to be performed by different actors as part of Special Event Management. A special event can a range of events, including festivals, police motorcades, Amber Alerts, papal visits, parades, marathons, concerts, political events and demonstrations, sporting events, and cultural events. The major actions performed by the user are building and updating a response plan, scheduling the event, managing the event, and monitoring the event (mainly traffic and weather around the event). The scenario is akin to incident management, but has some unique characteristics, including a differing sequence of activities. The goal of this use case is to describe the user's interaction with the system during special management. FIGURE 27 below provides an illustration of SL-3.



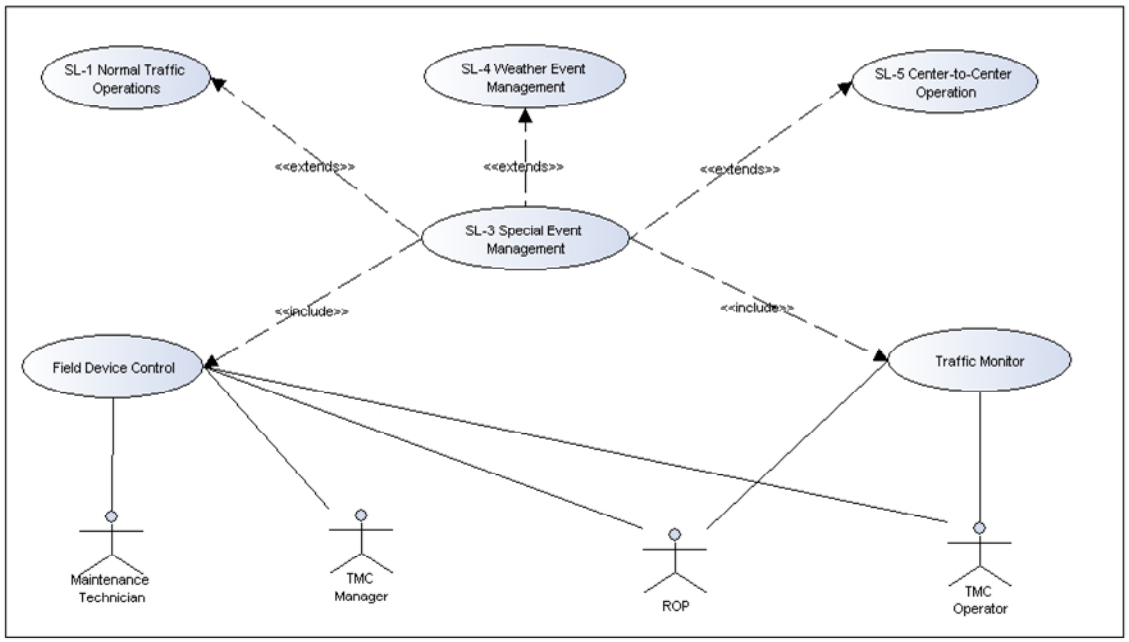


FIGURE 27 Special Event Management Use Case Diagram (SL-3)

<u>Pre-Conditions</u>

The user must have the appropriate access rights to access the needed functions.

Actors

1. TMC Operator.
2. ROP.
3. Maintenance Technician.

Basic Course

1. The user logs in using a valid username/password combination. Refer to SL-1, basic course step 1.

2. As part of pre-event planning, the operator uses the response plan editor, within the Incident Management subsystem, to devise a response plan tailored for this event.

   The plan for each special event includes a Traffic Control Plan (TCP) which identifies: a) any signal timing changes at affected intersections, b) officer deployment locations, c) no parking locations, and d) DMS locations and planned messages. Note: traffic signal timing plan changes can only be made by the Maintenance Supervisor using the Traffic Signal System (separate from CapTOP).

   A new response plan can be created from scratch, an existing plan can be modified, or an existing plan can be used as-is. The plan is then associated with a location and event type. Reference TCD-7: Building Response Plans for additional information.

   Note: special event management normally involves multiple agencies, as well as non-government groups (event organizers). Special Events are approved by the Mayor's Task Force. MPD is responsible for planning. In most cases, an initial overall event plan is provided by the organization that is planning the special event. DDOT reviews the traffic elements of the plan, and provides support for implementing plans.

3. Users with TMC Operator, ROP, or Maintenance Technician privileges can invoke the event scheduler and schedule the event using an offset from the established event date/time. The user also chooses an appropriate incident management response plan. The event should be scheduled at a time in advance of the actual event start time, allowing sufficient time to coordinate the various preparatory activities in the response plan.

4. When the date/time occurs the system prompts the operator with a reminder that it is time to manage the scheduled event. Typically, at a predetermined time before the event (e.g., 1 hour), the event schedule displays a flashing special event icon on the map display to indicate the pending event. The event scheduler also prompts the user with a reminder window. The user can click on the flashing icon or reminder window and begin managing the event.

5. Users with TMC Operator, ROP, or Maintenance Technician privileges can invoke the CCTV subsystem and Vehicle Detection Subsystem to monitor roadway and traffic conditions. Refer to TMD-1: Monitoring/Controlling CCTV Cameras and TMD-2: Monitoring Vehicle Detectors for additional information.

6. The user uses the map display to locate the closest camera to the incident and routes the video to the video wall and/or a local desktop monitor. The user pans/tilts/zooms the camera, as required, to monitor the event.

7. If there is a desire to have the video recorded, the operator can route the video to a recording device (e.g., VCR/DVR/NVR) while simultaneously viewing the video.

8. As part of the monitoring traffic function, the user can also monitor AVI vehicles, road weather devices, and regional weather. Refer to TMD-3: Monitoring AVI Vehicles Using AVL, and SL-4: Weather Event Management for additional information.

9. Next, the user is prompted with an automated response plan that is associated with this special event. The plan consists of an online version of the standard operating procedure for this type of event and a pre-built traffic control plan, consisting of the following:

    a. Recommended messages for DMS/PDMS;

    b. Recommended messages for HAR;

    c. Recommend signal timing plan changes or other changes such as reversing lanes; Note: traffic signal timing plan changes can only be made by the Maintenance Supervisor using the Traffic Signal System (separate from CapTOP).

    d. Recommended messages sent out via text messages, e-mail messages, or paging messages to WMATA, DC UCC, 511, RITIS, RICCS, CHART, Public Safety agencies, NCR Emergency Response, Prince George's County, WMATA, CVISN, VDOT, and other agencies.

    e. The plan should also identify the following:

        i. the geographic location of the special event on a map. The location may be shown as a point or as a route (e.g., in the case of a marathon);

        ii. the location of the DMSs (portable or fixed) that will be used are displayed on a map with icons;

        iii. the location of the no parking areas displayed on a map using icons;

        iv. the location of the traffic cones/barriers will be displayed on a map with icons. Information describing the number and type of devices needed and their placement will also be provided.

        v. the location of traffic control officers on a map with icons;

vi. the location of the command vehicles (e.g., MPD, Fire) and media vehicles displayed on a map with icons. This will be static information. Real-time tracking is not required.

The user will be prompted for each recommendation. The system will not take any action automatically. Only a user with TMC Manager can send the control directives to DMS, or HAR. Note: traffic signal timing plan changes can only be made by the Maintenance Supervisor using the Traffic Signal System (separate from CapTOP).

10. If the situation calls for inter-agency coordination (e.g., a major special that has regional impact), the Operator will inform other centers of the incident. Refer to SL-5: Center-to-Center Operations.

11. The user will use two-way radio to dispatch and communicate with the ROPS, as required. The ROPS' location can be tracked using the AVL subsystem. Refer to TMD-3: Monitoring AVI Vehicles Using AVL for additional information.

12. When other jurisdictions request assistance (e.g., use of DMS), the user documents in the incident log when the request was sent, confirmation when the message was received, and any accept/reject responses. The user can access on-line Points of Contact (POCs) for agencies and others involved in responding to, or, managing incidents in the region.

13. Alternatively, the user can initiate actions and control devices outside of the response plan. Refer to TCD-1: Monitoring and Controlling Signals, TCD-2: Monitoring and Controlling DMS/PDMS, TCD-3: Monitoring and Controlling HAR, TCD-4: Posting Web Updates, and TCD-5: Sending Alerts for more information.

14. At any time, the user may engage in an online teleconference with video (e.g., virtual round-table discussions) to coordinate with employees at offsite locations or other agencies.

15. The user continues to monitor the event, and updates status as required. When the event is cleared the user updates the status, and other information necessary for measures of effectiveness (e.g., event duration, # of resources used, etc.) in the database and is prompted to removes any unnecessary messages (e.g., messages on signs, HARS, the web, etc.) or other control directives (e.g., signal timing plans). Only a user with TMC Operator privileges can close out an incident. Note: traffic signal timing plan changes can only be made by the Maintenance Supervisor using the Traffic Signal System (separate from CapTOP).

16. The user can also utilize any of the following after-the-fact features for special event management:

    a. a report capability to determine the number of events over a specified time period, the number of events of a particular type, and other types of reports;

b. a report capability to provide information with regards to the number of resources (e.g., DDOT employees, equipment, etc.) for any special event;

c. The ability to track and present information related to DDOT personnel and other costs associated with supporting special events.

Alternative Courses

None.

Post-Conditions

1. The user logs out if activities are complete.
2. The system log has a record of all significant user actions.

Related Use Cases

SL-1: Normal Traffic Operations

TMD-1: Monitoring/Controller CCTV Cameras

TMD-2: Monitoring Vehicle Detectors

TMD-3: Monitoring AVI Vehicles Using AVL

SL-4: Weather Event Management

SL-5: Center-to-Center Operations

TCD-1: Monitoring and Controlling Signals

TCD-2: Monitoring and Controlling DMS/PDMS

TCD-3: Monitoring and Controlling HAR

TCD-4: Posting Web Updates

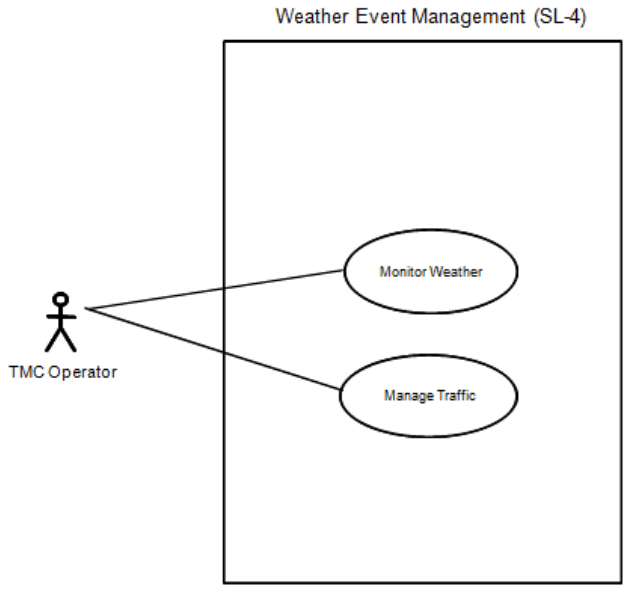
TCD-5: Sending Alerts

7.2.4 Use Case SL-4: Weather Event Management

Description

This use case describes a course of actions to be performed by the TMC Operator as part of Weather Event Management. The major actions performed by the user are monitoring weather conditions and managing traffic. The goal of this use case is to describe the user's interaction

with the system during Weather Event Management. FIGURE 28 below provides an illustration of SL-4.



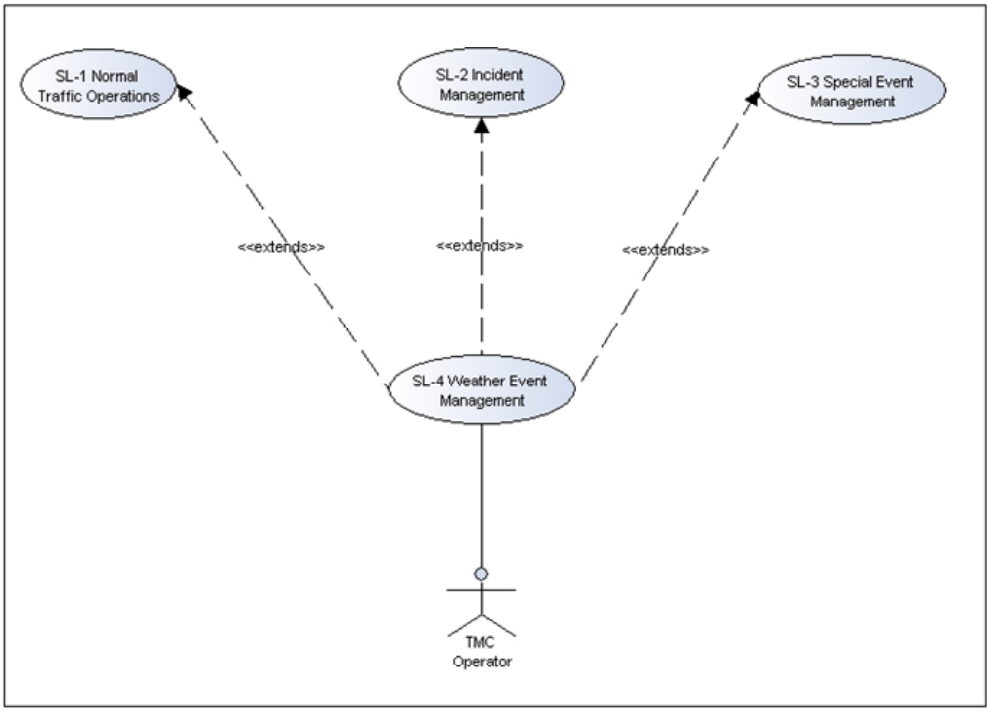


FIGURE 28 Weather Event Management Use Case Diagram (SL-4)

<u>Pre-Conditions</u>

The user must have the appropriate access rights to access the needed functions.

Actors

TMC Operator.

Basic Course

1. The user logs in using a valid username/password combination. Refer to SL-1, basic course step 1.

2. Using the map display, the user displays the road weather station device layer. The user clicks on sensor icons to obtain the following:

    a. air readings: temperature, relative humidity, dew point;

    b. wind readings: average wind speed, wind gusts, wind direction;

    c. visibility readings: visibility level;

    d. precipitation readings: precipitation (yes/no), precipitation type, precipitation intensity;

    e. surface: road surface temperature, subsurface temperature, surface condition (dry, wet, frozen), chemical composition;

    f. imagery: snapshot video on the area.

    The color of the icons indicates the presence of ice or snow on roadway surfaces.

3. Using the Internet Browser the user can view current and forecasted weather conditions, including air temperatures, wind, visibility, precipitation readings, and radar, Doppler, and satellite imagery.

FIGURE 29 provides an illustration of road weather information. FIGURE 30 provides an illustration of regional weather information.

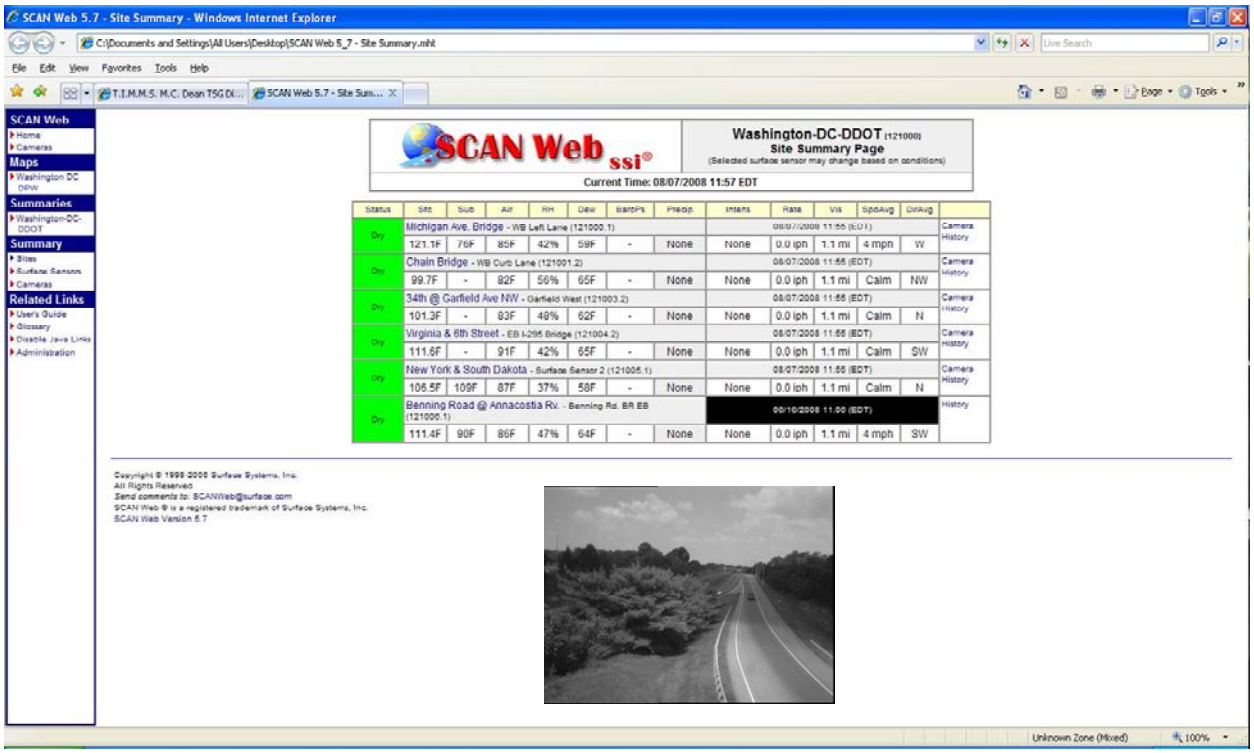


FIGURE 29 Sample Road Weather Data

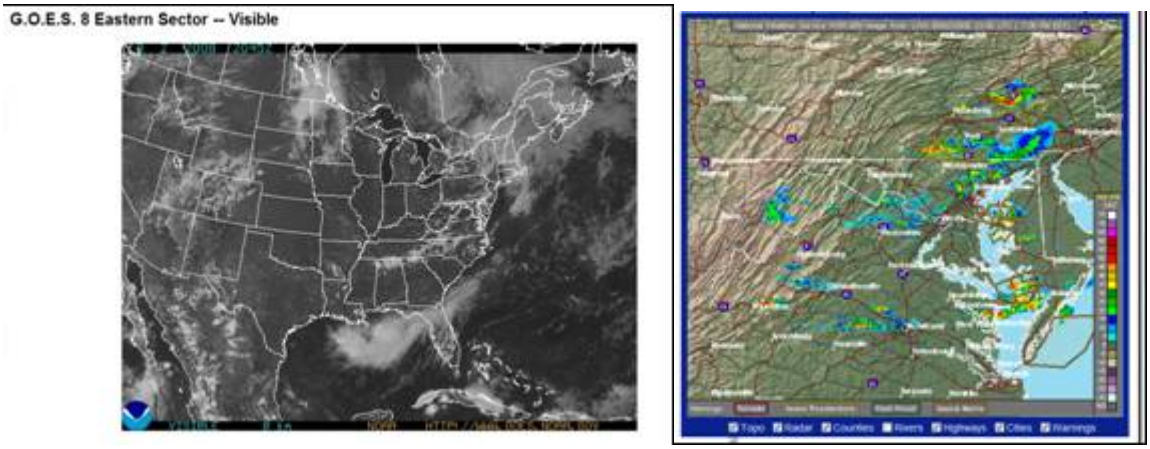


FIGURE 30 Sample Regional Weather Data

4. If the user determines the existence of a hazardous condition or an incident, the user will declare an incident and manage the response. Refer to SL-2 Incident Management for more information.

<u>Alternative Courses</u>

None.

Post-Conditions

1. The user logs out if activities are complete.
2. The system log has a record of all significant user actions.

Related Use Cases

SL-1: Normal Traffic Operations

SL-2: Incident Management

SL-3: Special Event Management

7.2.5 Use Case SL-5: Center-to-Center Operations

Description

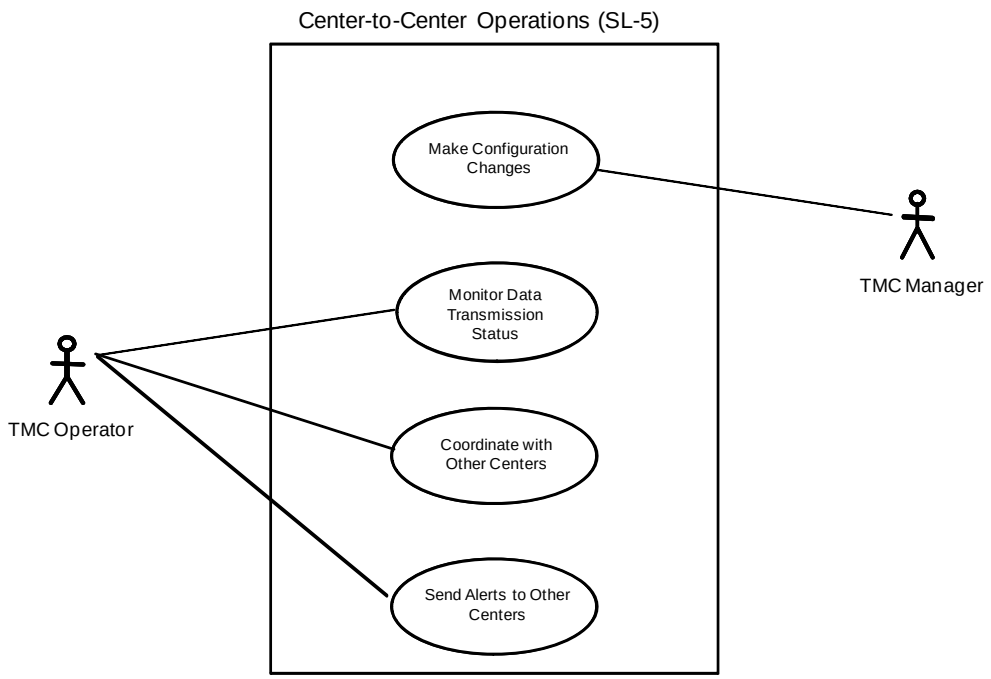
This use case describes a course of actions to be performed by the TMC Operator and TMC Manager as part of center-to-center operations. These center-to-center operations are aimed at enhancing regional traffic coordination when there is a major incident or a special event that has a regional impact, or in lesser situations, where the TMC needs to coordinate with other centers in the region. These centers may include VDOT, CHART, Prince George's County, DC UCC, RITIS, RICCS, and NCR Emergency Response. The major actions performed by the system are receiving information from other centers and transmitting information to other centers. FIGURE 31 below provides an illustration of SL-5.

Pre-Conditions

The user must have the appropriate access rights to access the needed functions.

Actors

1. TMC Operator.
2. TMC Manager.



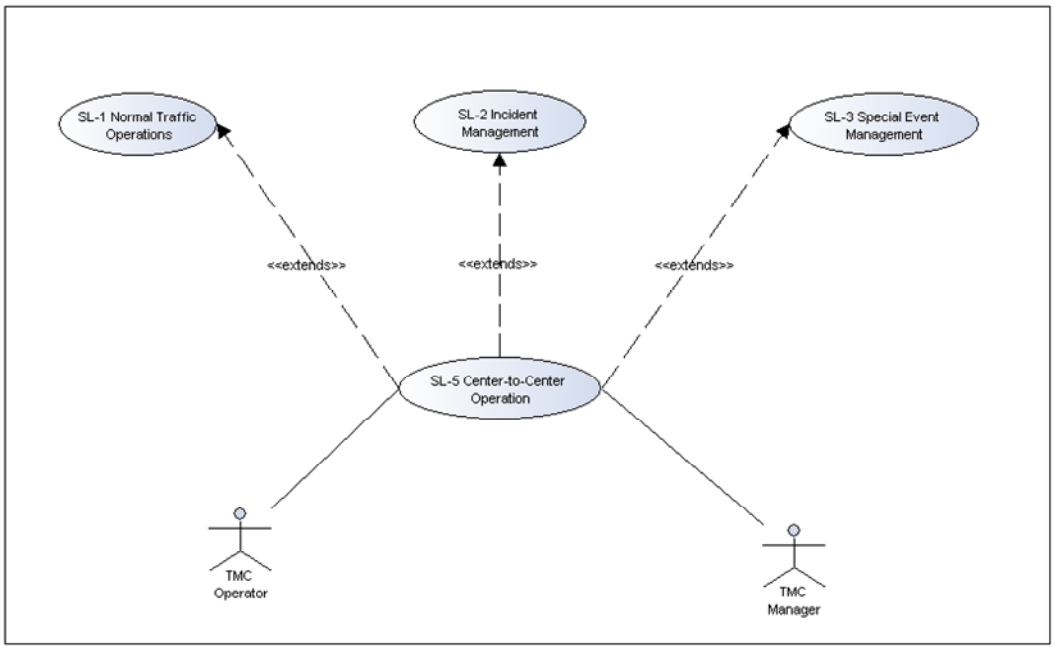


FIGURE 31 Center-to-Center Use Case Diagram (SL-5)

<u>Basic Course</u>

1. The user logs in using a valid username/password combination. Refer to SL-1, basic course step 1.

2. In the course of conducting normal traffic operations, incident management, or special event management the Operator may receive or transmit information to or from other centers. The CapTOP software provides a standard interface for the purpose of independently exchanging two-way incident and video information with other centers (i.e., center-to-center), agencies, or private sector companies. CapTOP provides a mechanism for exchanging two (2) types of data:

    a. Traffic data: this type of data is pushed to other centers and includes traffic condition data (e.g., speed, volume, and occupancy), incident information (e.g., accidents, construction, and lane closure), special event information, video, and current device status (e.g., DMS/PDMS messages, HAR messages, etc.);

    b. Command/Control data: this type of data is when an operator in one center issues a command to another center to change the current state of an ITS device (e.g., an operator can send a request to change a DMS/PDMS that another center operates).

    This software is an integrated part of the CapTOP software. The system will be designed to support various information sharing links to other centers. On an as-need basis, the TMC Manager can configure (i.e., enable/disable) the software offline to define what data can be received and what data can be transmitted to/from each center. The TMC Manager can enable/disable each interface through the GUI, without the involvement of the System Administrator.

3. In the course of monitoring traffic conditions, the operator will be able to display the data received from other centers. The information will be available both as a graphical map display and in tabular form. The operator will be able to easily discern the source of the information.

4. The system automatically transmits, without operator intervention, information to other centers at defined intervals or as events occur. The information transmitted is preconfigured into the system. The user may also manually push information to other centers using the features of the incident management subsystem.

<u>Alternative Courses</u>

None.

<u>Post-Conditions</u>

1. The user logs out if activities are complete.

2. The system log has a record of all significant user actions.

Related Use Cases

SL-1: Normal Traffic Operations

SL-2: Incident Management

SL-3: Special Event Management

7.2.6 Use Case SL-6: Failover Operations

Description

This use case describes scenarios involving failures in the system and the resulting required actions. FIGURE 32 below provides an illustration of SL-6.

Pre-Conditions

The user must have the appropriate access rights to access the needed functions.

Actors

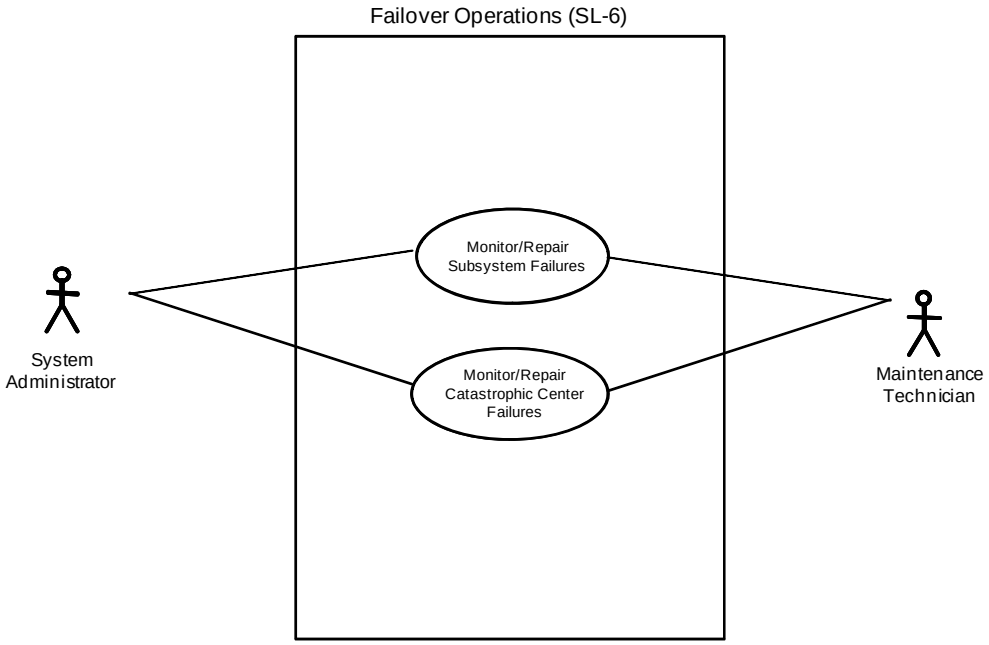
1. Maintenance Technician.
2. System Administrator.

Basic Course

1. The user logs in using a valid username/password combination. Refer to SL-1, basic course step 1.
2. In the case of a catastrophic failure (e.g., building power outage, multiple server failure, etc.), the Maintenance Technicians, Database Manger, and System Administrator will boot the backup TMC, move personnel, and resume operations.
3. In the case of a subsystem failure, the Maintenance Technicians and System Administrator will restore operations by troubleshooting, restarting, rebooting, or replacing the failed components (e.g., workstation, server, communication device) with spared components. Hot standby and automated failover may occur for some devices, such as the application or database servers, which use clustering technologies. Other devices, such as communication servers with serial connections use cold spares and may require some manual re-cabling. The system will provide software status and the ability to restart software using the Software Monitor application. The system will also provide on-line troubleshooting and maintenance procedures.

Alternative Courses

None.



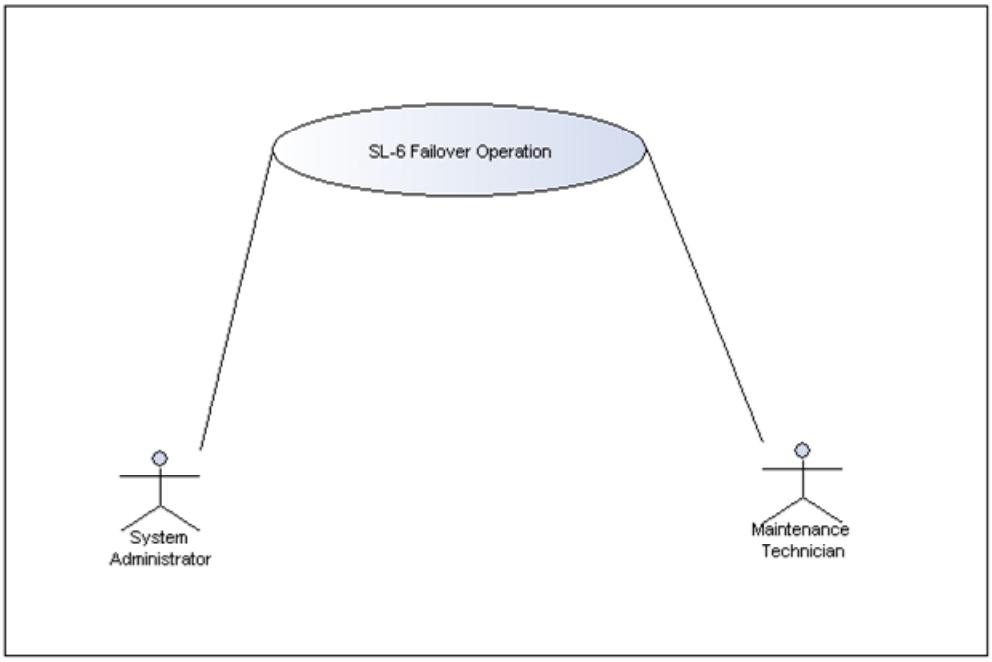


FIGURE 32 Failover Operations Use Case Diagram (SL-6)

<u>Post-Conditions</u>

1. The user logs out if activities are complete.

2. The system log has a record of all significant user actions.

Related Use Cases

None.

7.3 Subsystem-Level Use Cases

7.3.1 Traffic Monitoring

Traffic monitoring includes monitoring the following type of events using CCTV and other types of surveillance data:

1. Freeways/Arterials
2. Work zones/Detours
3. Incidents
4. Flood areas
5. Dark areas (e.g., power outages)
6. Blocked roadways
7. Bus routes
8. DMS message validation
9. Field monitoring using CCTV
10. ITS device status
11. Hot/congested areas based on traffic detector data collected during AM, PM and other times

The following administration functions shall also be supported:

1. Network security (e.g., web security, cross network installation, etc.)
2. System status and health monitoring, and alarm notification

7.3.1.1 Use Case TMD-1: Monitoring/Controlling CCTV Cameras

CapTOP provides the user the ability to intuitively monitor the status and control all cameras. The user can easily perform the following:

Camera Control

1. Select a camera from either a map display icon, or from a drop down list;

2. Use the graphical controls to pan left or right, tilt up or down, pan/tilt together diagonally (NE, SE, SW, NW), zoom in or out;

3. Use the graphical controls to set the iris to automatic mode or manual mode;
4. Use the graphical controls to set the focus to automatic mode or manual mode;
5. Use the graphic controls to control the pan/tilt/zoom speeds (hi, medium, low);
6. Power on/off the camera remotely;
7. Provide access to any ancillary camera controls;
8. Provide access to any camera diagnostics software (Maintenance Technician only).

Presets

1. Use the graphical controls to set a preset, name/rename a preset, move to a preset, or delete a preset.

Video Routing and Tours

1. Use a drag and drop capability to route any video input to any wall monitor, desktop monitor, or recording device;
2. Click a button to blackout the video in the event sensitive imagery is displayed;
3. Add, delete, modify a tour, consisting of a tour name, and series of cameras and presets that can be run once or endlessly, and that can be routed to any monitor;
4. Rewind, Pause, Fast forward tours;
5. Software decode and display MPEG-2/MPEG-4 video directly on the desktop without the need for a hardware decoder or an NTSC monitor.

Reports

1. Get a summary report of the cameras and their operational status (online, offline, failed).

FIGURE 33 provides an illustration of the existing CCTV capability that will be enhanced with the new system.

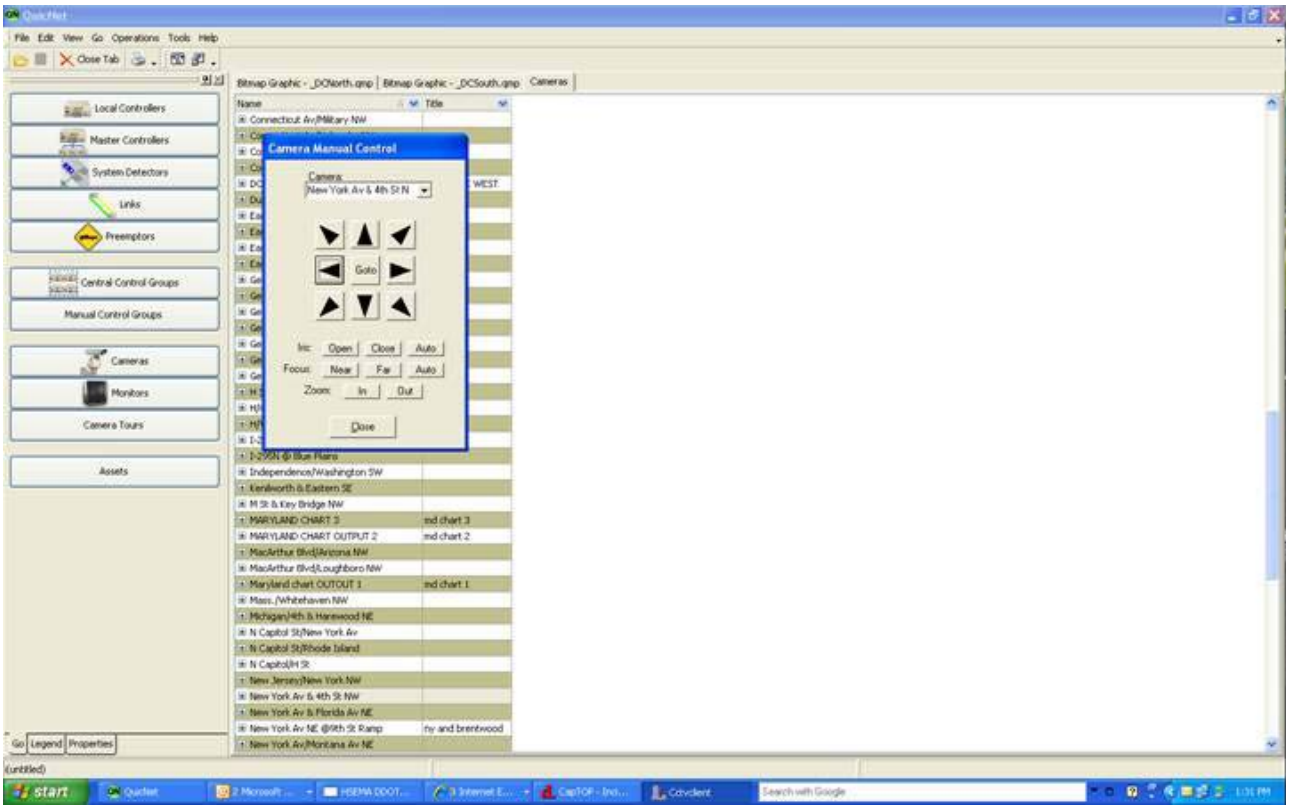


FIGURE 33 Illustration of Existing CCTV Control Capability

7.3.1.2 Use Case TMD-2: Monitoring Vehicle Detectors

CapTOP provides the user the ability to intuitively monitor the status of all traffic monitoring detectors. The user can easily perform the following:

1. Select a detector from either a map display icon, or from a drop down list. The detector can be solar-powered radar detectors (provided by SpeedInfo), DDOT detector stations, Traffic.com sensors, etc.;

2. Click a button to see instantaneous speed, volume, and occupancy from the detector;

3. Click a button to see average speed, volume, and occupancy using a 5-minute rolling average from the detector;

4. Get a summary report of the detectors and their operational status (online, offline, failed).

5. The system should display average throughput, speed, and occupancy when the mouse is moved over a hot/congested spot.

7.3.1.3 Use Case TMD-3: Monitoring AVI Vehicles Using AVL

CapTOP provides the user the ability to intuitively monitor the status of all AVI equipped vehicles (e.g., ROPS). The user can easily perform the following:

1. Select a map layer that displays the real-time movement of all AVL-equipped-vehicles.
2. Select an AVI-equipment vehicle from a drop down list, display and track the vehicle's location in real-time using the map display;
3. Provide accurate vehicle location information when requested;
4. The map display allows the operator to perform recording and playback of AVL data trajectory data when desired.
5. The map display allows the user to easily turn on/off the AVL tracking features;
6. Get a summary report of all AVI-equipped vehicles and their operational status (moving, stationary, etc.).

7.3.2 Traffic Control

7.3.2.1 Use Case TCD-1: Monitoring and Controlling Signals

CapTOP provides the user the ability to intuitively monitor all signalized intersections. The system will monitor the current controllers, which are 170E controllers, and in the future will also support 2070 controllers. Note: traffic signal timing plan changes can only be made by the Maintenance Supervisor using the Traffic Signal System (separate from CapTOP). The user while performing normal traffic operations, incident management, or special event management is able to perform the following:

Intersection Monitoring

1. Select an intersection from either a map display icon, or from a drop down list or a device tree sorted alphabetically by quadrant and street name;
2. View a graphic of intersection detail, showing all lanes (thru, turning) and the locations of the signals;
3. View the current timing plan in effect at an intersection;
4. View real-time status of the signals (red, yellow, green) and pedestrian devices at an intersection or along an arterial;
5. View the status of any controller and any detectors at an intersection;
6. View a live or snapshot video of the intersection;

7. View ancillary controller data (maintenance function only).

Control (Maintenance Technician only)

Note: control of signals is performed outside of CapTOP. It is described below for completeness only.

1. For signal timing changes the Operator coordinates with the Maintenance Supervisor. The Maintenance Supervisor (not the Operator) can change the timing plan for a single intersection or a group of intersections using the Traffic Signal System (not CapTOP).

2. The Maintenance Supervisor can put an intersection into standalone manual mode as required;

3. For the existing 170E controllers, the Maintenance Supervisor can select a time of day or actuated (i.e., traffic response) signal timing schemes for a single intersection or a group of intersections;

4. For 2070 controllers (future) the Maintenance Supervisor can select the time of day, actuated (i.e., traffic response), or traffic adaptive (future) signal timing schemes for a single intersection or a group of intersections;

5. The Maintenance Supervisor can power on/off the controller remotely;

6. The Maintenance Supervisor is provided access to any controller diagnostics software;

7. Report an outage to the Maintenance Staff or Contractor on-call.

Reports

1. A report of all intersections and operational status (online, offline, failed) for issues;

2. A full diagnostic report on a controller (requires Maintenance Technician privilege).

FIGURE 34 and FIGURE 35 provide an illustration of the existing intersection monitoring capability. Note: in FIGURE 35 real-time vehicle and pedestrian actuations are illustrated.

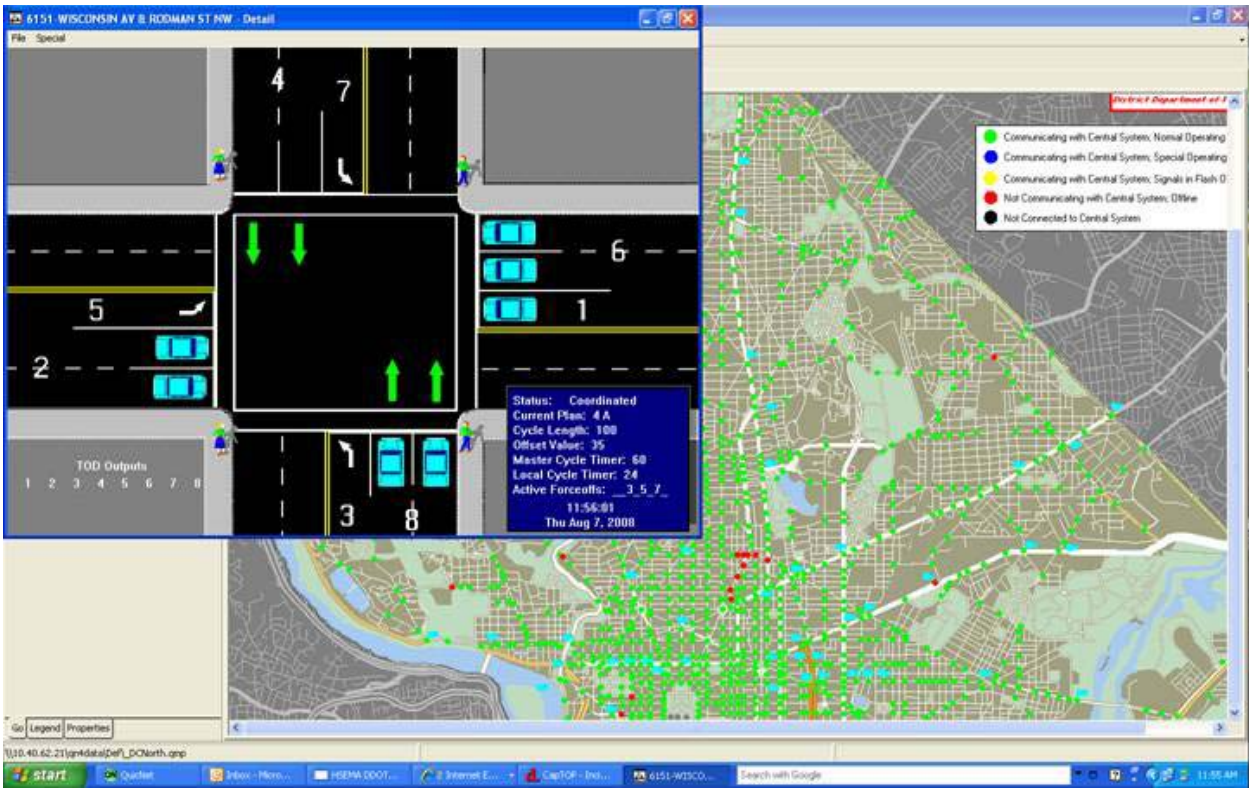


FIGURE 34 Example of Intersection Monitoring Capability with Real-Time Signal Status

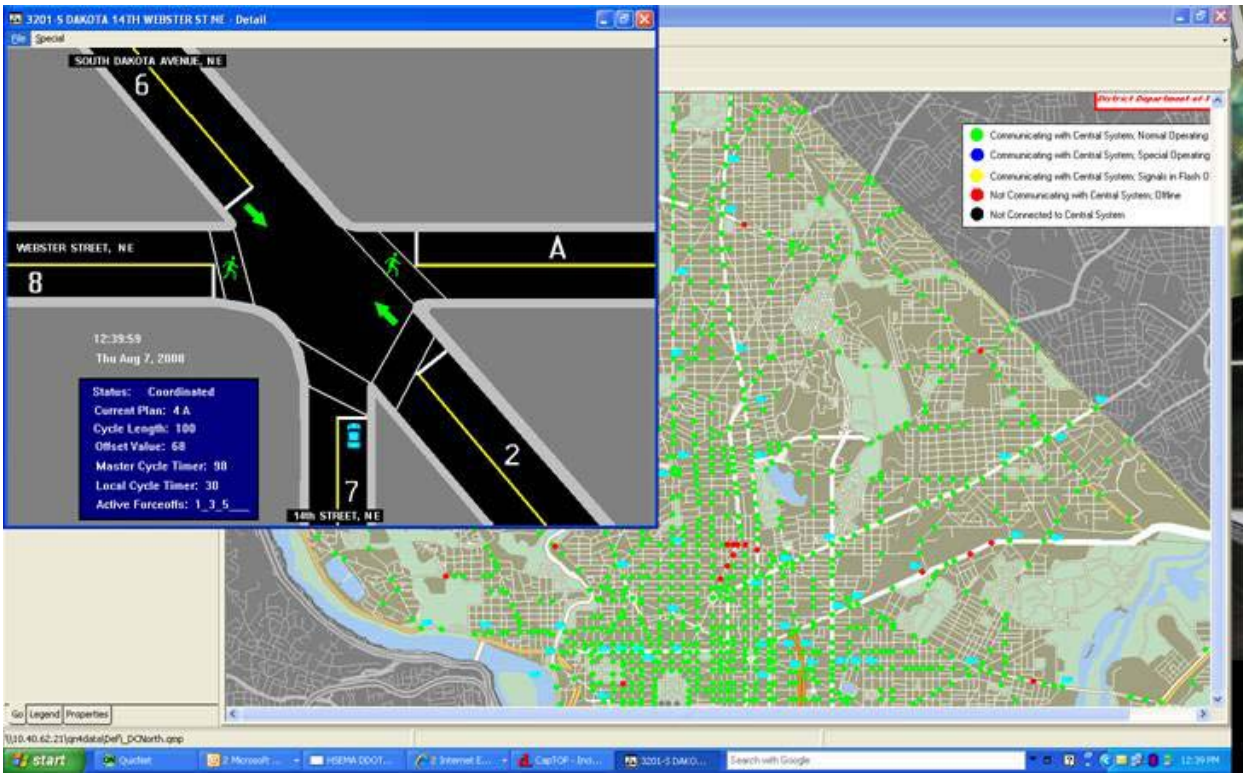


FIGURE 35 Example of Real-Time Intersection Monitoring Capability with Actuations

7.3.2.2 Use Case TCD-2: Monitoring and Controlling DMS/PDMS

CapTOP provides the user the ability to intuitively monitor and control all DMS/PDMS devices. The system will monitor and control those DMS and PDMS that have network or wireless access. The user while performing normal traffic operations, incident management, or special event management is able to perform the following:

DMS Monitoring

1. Select an DMS or PDMS from either a map display icon, or from a drop down list; Note: because the PDMS are mobile, only those units that have GPS receivers will be displayed on the map display;

2. View a graphic of the DMS that represents the sign characteristics (e.g., dimensions, full matrix, line matrix) and shows the actual message as it appears on the sign;

3. View real-time status of the controller (online, offline, communications failure, message displayed, or sign blank);

4. View ancillary controller data.

Control

1. Change the message displayed on the DMS or PDMS (requires TMC Manager approval) by selecting a message from the message library or by typing a free-form message that will be spell checked, dirty word checked, and approved by the TMC Manager;

   Note: Changing messages shall be verified and approved by an authorized shift lead or the TMC Manager.

2. Schedule a message to be displayed on the DMS or PDMS (requires TMC Manager approval);

3. Configure the default message;

4. Change the order of messages in the schedule priority queue (critical, incident, default);

5. Power on/off the DMS/PDMS controller remotely;

6. Provide access to any controller diagnostics software (Maintenance Technician only).

Reports

1. A report of all DMS/PDMS with operational status (online, offline, failed);

2. A full diagnostic report on a controller (requires Maintenance Technician privilege).

7.3.2.3 Use Case TCD-3: Monitoring and Controlling HAR

CapTOP provides the user the ability to intuitively monitor and control all HAR devices. The system will monitor and control those HARs that have network or wireless access. The user while performing normal traffic operations, incident management, or special event management is able to perform the following:

DMS Monitoring

1. Select a HAR from either a map display icon, or from a drop down list;
2. View real-time status of the HAR (online, offline, communications failure, message playing, or blank message);
3. View ancillary controller data.

Control

1. Change the message being broadcast (requires TMC Manager approval) by selecting a message from the message library, recording a new message, editing an existing message, or by typing a message and having the system perform a text-to-speech conversion;
2. Schedule a message to be broadcast (requires TMC Manager approval);
3. Configure the default message;
4. Change the order of messages in the schedule priority queue (critical, incident, default);
5. Power on/off the HAR controller remotely;
6. Provide access to any controller diagnostics software (Maintenance Technician only).

Reports

1. A report of all HARs with operational status (online, offline, failed);
2. A full diagnostic report on a controller (requires Maintenance Technician privilege).

7.3.2.4 Use Case TCD-4: Posting Web Updates

In the course of conducting normal traffic operations, incident management, or special event management the system is configured to post information to the DDOT web site. The CapTOP software provides an automated process for posting traffic condition data, confirmed incident and special event information, and video information to the web server interface. This information includes the following:

1. Traffic condition maps show speed, volume, occupancy, and travel time data;

2. Incident information (e.g., accidents, construction, lane closure);
3. Special event information;
4. Video;
5. Current device status (e.g., DMS/PDMS messages, HAR messages, etc.).

This software is an integrated part of the CapTOP software. When the CapTOP software is installed and configured, the System Administrator configures the software to define what data is posted on the web site. The system automatically transmits, without operator intervention, information to the web site at defined intervals, or as events occur.

In addition to the above, Web information also provides static information to the traveling public including:

1. Truck routes;
2. Truck height, weight, and access restrictions;
3. Bike routes;
4. Park and ride locations;
5. Links to other Web Sites (e.g., WMATA, RITIS).

7.3.2.5 Use Case TCD-5: Sending Alerts

During incidents or special event situations, the user has the ability to post traffic alerts. Alerts can take the form of text messages, e-mail messages, or paging messages to various entities using e-mail addresses, phone numbers, or distributions lists.

7.3.2.6 Use Case TCD-6: Tunnel Operation and Control

CapTOP provides the user the ability to intuitively monitor and control all of the tunnel devices at the 3rd Street and 12th Street tunnels. The user while performing normal traffic operations, incident management, or special event management is able to perform the following:

- Monitor CO2 levels, fire, ventilation, lane control signals, and DMS using and interface between CapTOP and the Supervised Control Data Acquisition (SCADA);
- Monitor the tunnel video using CCTV cameras and smart-cameras available via the CIPS. This may also include license plate reading (to note passage of sought after vehicles), detection of stopped vehicles, and the capability to identify/detect stationary objects (other than vehicles);

- Respond to warnings or alarms when the CIP system detects suspicious activity (e.g., stopped vehicles, packages in roadway, etc.);

- Coordinate tunnel control with DDOT's Infrastructure Project Management Administration (IPMA). DDOT's IPMA is responsible for primary monitoring and control of the tunnels. The tunnels are monitored and controlled by a Contractor, under IPMA's supervision from a small control room in the Labor Department building;

- Manage traffic during incidents at areas in and around the tunnels, and coordinate with the Capital Police, MPD, and IPMA, as required.

Reference SL-2: Incident Management and MISC-6: Critical Infrastructure Protection for additional information.

7.3.2.7 Use Case TCD-7: Building Response Plans

CapTOP provides the TMC Manager the ability to intuitively build, in an offline environment, a response plan to be used with incident management and special event management. The response plan should be associated with three (3) aspects of an incident or event: a) incident or event type (e.g., accident, marathon, etc.), b) severity, and c) location. Using the response plan editor, within the Incident Management subsystem, the TMC Manager devises a response plan for various types of incidents. As part of incident and special event management, the TMC Manager is responsible for keeping the plans update to date and accurate for future use. All plans are stored in the Configuration Management system and are version controlled. A new response plan can be created from scratch, an existing plan can be modified, or an existing plan can be used as-is. The operator has the ability to save and retrieve any response plan.

The plan consists of an online version of a standard operating procedure for each type of incident and a pre-built incident response (or traffic control) plan, consisting of the following:

1. Recommended messages for DMS/PDMS;

2. Recommended messages for HAR;

3. Recommended signal timing plan changes or other changes such as reversing lanes to accommodate ingress/egress;

4. Recommended messages sent out via text messages, e-mail messages, or paging messages to WMATA, DC UCC, 511, RITIS, RICCS, CHART, Public Safety agencies, NCR Emergency Response, Prince George's County, WMATA, CVISN, VDOT, and other agencies;

5. The plan also identifies the following:

    a. the geographic location of the incident or special event on a map;

b. the location of the DMSs (portable or fixed) that will be used on a map with icons;

c. the location of the cones, barriers, DMS, tow trucks, and SUVs with arrow boards;

d. the location of the no parking areas that will be established on a map with icons (special events only);

e. the location of traffic control officers, if required, on a map with icons;

f. the location of the command vehicles (e.g., Capital Police, MPD, Fire) and media vehicles that will used on a map with icons (special events only). This will be static information. No real-time tracking is required.

After the plan is created and associated with an incident/event it is available for recall during operations. When the plan is executed, the TMC Manager will be prompted for each recommendation. The system will not take any action automatically. Only a user with TMC Manager can send the control directives to DMS or HAR. Note: traffic signal timing plan changes can only be made by the Maintenance Supervisor through the Traffic Signal System.

7.3.3 Administration Functions

7.3.3.1 Use Case MGR-1: Creating/Editing User Accounts.

During the course of TMC operations, user accounts will need to be added, deleted and changed. This capability requires TMC Manager or System Administrator privileges. Using the CapTOP account management features, the user will be able to perform the following:

1. Create, edit, delete user accounts;

2. Assign usernames and passwords;

3. Create, edit, delete groups for each class of user: TMC Operator, TMC Manager, Maintenance Supervisor, Maintenance Technician, Operations Manager, ROP, Traffic Engineer, and System Administrator;

4. Assign users to groups;

5. Modify group privileges for each group;

6. Assign group privileges for each subsystem (read-only, control, override).

The CapTOP online maintenance manual provides step-by-step procedures for how to create, edit, or delete user accounts.

7.3.3.2 Use Case MGR-2: Performance Measurement

Performance measures provide accountability and are useful to the public (e.g., residents, visitors), DC government, and DDOT personnel. Performance measures enhance communication between the various stakeholders of the system. They can aid in setting policy, allocating resources, justifying expenditures, improving responsiveness, and reporting on results. The TMC Manager, Maintenance Supervisor, or Operations Manager will utilize the CapTOP software to produce reports useful for generating measures of effectiveness. This may include the following type of metrics produced on a weekly, monthly, quarterly, or annual basis:

1. Total number of incidents of all type;
2. Total number of incidents by type (e.g., accidents, construction, special event, etc.);
3. Time between detection and verification for incidents detected automatically;
4. Average incident duration;
5. Number of ROP supports;
6. Number and type of resources required (e.g., ROPs involved, equipment required, field staff required, etc.);
7. Trends of recurring congestion intervals;
8. System down-time;
9. Subsystem/device down-time;
10. Average time to repair devices;
11. Staff performance.

For each metric an estimate or predicted value would be compared to the actual value. These metrics are then used by management to (a) document the need for additional resources and budget, (b) identify potential opportunities for increasing productivity and effectiveness (e.g., improved incident response plans, signal timing plans, etc.), and (c) identify and reward good performance for individuals and for units.

7.3.3.3 Use Case MGR-3: Asset Management

Maintenance Supervisors and Maintenance Technicians utilize the Asset Management software to control and mange mobile and fixed assets. The software is used to centrally manage the inventory of assets (including spare parts), their location, the users of them, configuration and warranty information, and all costs associated with the various assets. The user enters all necessary tracking information when assets are added, changed, or removed from the system. Information is available to be queried, displayed, updated and printed in the form of reports.

7.3.3.4 Use Case MGR-4: Configuration Management

TMC Managers and System Administrators utilize the Configuration Management software to manage the source code baseline, and data products including traffic control plans, response plans, signal timing plans, and other documentation. The user manages the various baselines using version control, with version numbers, and descriptions to identify what is changed for each product. The user enters configuration items into the repository and provides the time, date, and description of change during check-in. Configuration items are checked-out by individual users and associated with an issue that describes the change. The system locks the object so that it can't be modified by others, as long as the item is checked out. Groups of objects are associated together to form a thread (or release) that describes the content of a build.

7.3.3.5 Use Case MGR-5: Work Order Management

TMC Managers, TMC Operators, Maintenance Supervisors, and Maintenance Technicians utilize the Work Order Management software to provide the following:

1. The ability to enter and track the status of work orders;
2. The ability to enter and track customer complaints, such as signal outages;

   Note: in the current version of CapTOP, an incident must be created to report an outage or complaint. This deficiency will be addressed in the new system, by providing a direct interface to the work order management system.

3. The ability to query, update, display, and print reports;
4. The ability to e-mail trouble tickets to maintenance technicians while in the field through the use of PDAs or wireless enabled laptops.

Maintenance Supervisors utilize the Work Order Management software to provide the following:

1. To schedule all preventive and corrective maintenance activities.
2. To enter, review, and update work orders (Maintenance Technician function);
3. The ability to enter all necessary work order information when work orders are added, changed, or removed from the system;

Maintenance Technicians utilize the Work Order Management software to provide the following:

1. To enter, review, and update work orders;
2. The ability to enter all necessary work order information when work orders are added, changed, or removed from the system;

FIGURE 36 below provides an illustration of the existing CapTOP service request form.

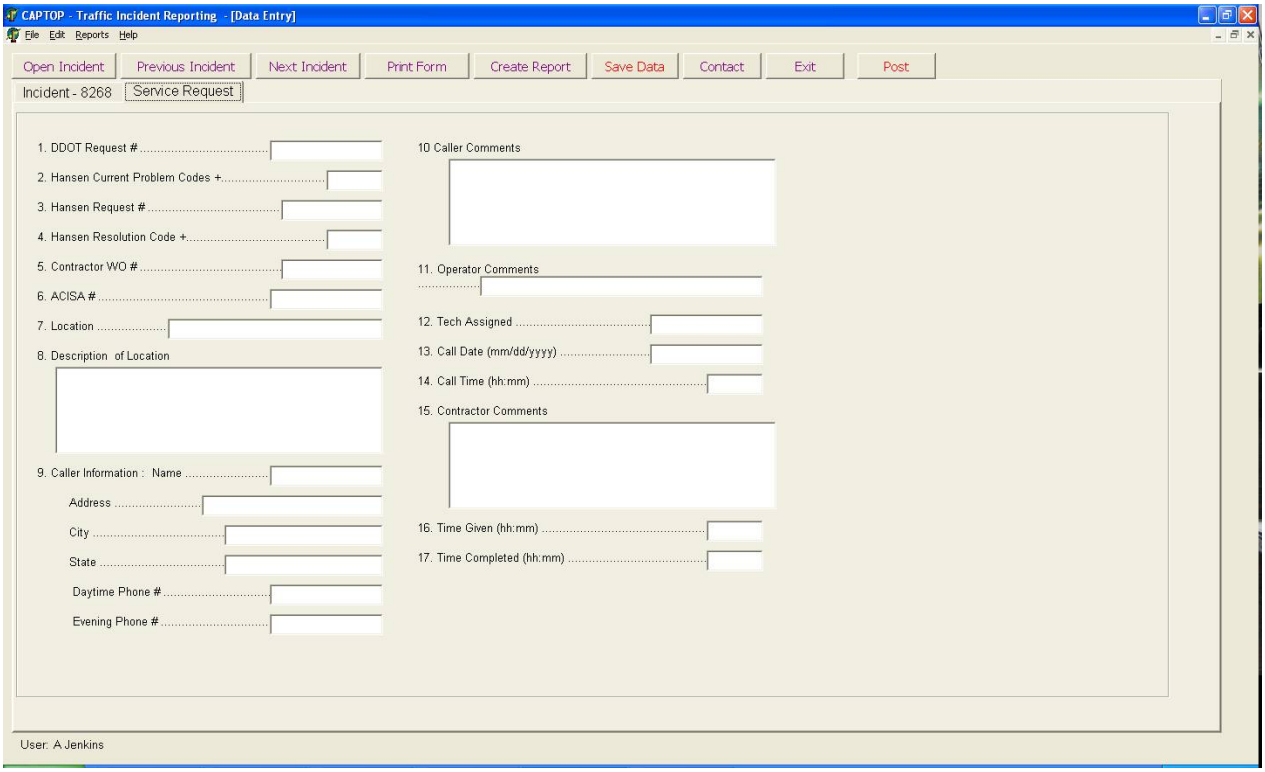


FIGURE 36 Example of Existing CapTOP Service Request Form

7.3.3.6 Use Case MGR-6: Restarting Software

Upon a detected failure of the CapTOP software, the TMC Manager or System Administrator uses the Software Monitor to perform the following:

1. Confirm the necessary software processes are running;
2. Alert operators of potential outages;
3. Start, stop, or restart any CapTOP software process.

The CapTOP online maintenance manual provides step-by-step procedures for how to stop/stop/restart each software process.

7.3.3.7 Use Case MGR-7: Add/Deleting Devices

As new equipment is added, removed, or replaced, the System Administrator will need to update the CapTOP configuration. The System Administrator adds/changes/deletes devices in the system (e.g., CCTV, DMS/PDMS, RWIS, Vehicle Detector, HAR, Signal), as required. The CapTOP online maintenance manual provides step-by-step procedures for how to perform each function for each subsystem that includes all details unique to each type of device (e.g., device ID, location, protocol, address, manufacturer, etc.).

7.3.4 Traffic Engineering

7.3.4.1 Use Case TEN-1: Data Collection and Analysis

Data collection and analysis is an important activity that is useful for many purposes, including traffic engineering, incident analysis, and performance monitoring. The user has access to applications that provide access to historical traffic, incident, and performance data. The user also has access to tools that support graphical displays, statistical analysis, and data mining. Traffic Engineers, TMC Managers, Maintenance Supervisors and Operations Managers use this subsystem for the following:

1. To collect, archive, and produce data that can be used to measure the performance (outcomes and output) of the TMC and the incident management efforts. The outputs include the number and type of incidents, and the outcomes include how well operations were managed;

2. To collect, archive, and produce reports that document statistics for TIM activities. For example, the number, type of incidents, magnitude of responses, duration of responses, and the number and type of resources required (e.g., ROPs involved, equipment required, field staff required, etc.);

3. To collect, archive, and produce reports that document historical traffic trends (speed, volume, occupancy, traffic queues, congestion over time) useful for Traffic Engineering;

4. To collect, archive, and produce reports for vehicle detectors (via local field controllers) that are useful to the Traffic Engineer, for signal performance monitoring and calibration purposes. The Traffic Engineer reviews the traffic throughput and MOEs, and coordinates with the Maintenance Supervisor to adjust the signal parameters, if needed, to achieve optimal traffic flows. Archived vehicle detector data also provides average daily traffic information for future planning purposes;

5. The data collection, integration, and archiving features provide support in producing performance related information in regards to the overall management and response to incidents, including special events;

6. The data collection, integration, and archiving features provide support for understanding the performance of TMC Operations staff. The TMC Operations staff performance is measured in terms of outputs and outcomes (e.g., metrics) related to the work of specific shifts and individual staff;

7. To provide the ability to collect and organize data needed to produce comprehensive reports for each incident. A robust report generation capability should be included.

8. To provide the ability to export traffic detector data. For example, the user can select the detectors, a time period, and an update interval (e.g., 1 min, 5 min, etc) when data are needed). The default format is a .csv format or others that can be imported into Microsoft Excel.

Refer to TEN-3: Data Warehousing and Archiving for additional information.

7.3.4.2 Use Case TEN-2: Perform Traffic Simulations and Generate New Traffic Control Strategies, Tactics and Plans

DDOT's existing traffic signal system is centrally controlled by the McCain QuicNet system with Model 170E controllers in the field. The majority of the signals run pre-timed and semi-actuated operation with the minor streets and pedestrians providing actuations. Only a few intersections run fully-actuated operation. Offsets are setup to maximize the bandwidth and facilitate coordination on the arterial streets. A user can modify and monitor the signal timing from the TMC. However, any change to the phasing scheme requires the technician to modify the hardware at the field level (e.g., change wiring orientations).

Traditionally, DDOT modifies the signal timing on a case-by-case basis, by fine-tuning specific intersections/corridors as the need arises. A Traffic Engineer requires historic traffic data for periodic modification of traffic signal schemes as well as development of plans for special events and new signals. This is done through an off-line process. This data is manually collected (automatically collected in the new system) for different time periods (e.g., AM, PM, off-peak, weekend, etc.), and the DDOT Traffic Engineer for the Ward develops a set of corresponding signal schemes, using tools such as Synchro. The signal schemes go through an approval process. Once approved, it can be implemented by the Maintenance Supervisor or his/her designee. The Traffic Engineer for the Ward, with the assistance of TMC operators, gains access to the traffic control information stored in the TMC central computer and local field controllers, and is able to update the approved modifications.

In future, the Citywide Synchro networks and manually collected traffic data can be stored, archived, retrieved, and analyzed through the CapTOP system using the Data Collection and Analysis, and Data Warehousing and Archiving subsystems.

Automated traffic information from the system detectors (via local field controllers) is also useful to the Traffic Engineer, for signal performance monitoring and calibration purposes. The Traffic Engineer can review the traffic throughput and adjust the signal parameters, if needed, to achieve a smoother traffic flow. Archiving the system detector information provides average daily traffic information for future planning purposes.

Traffic Engineers utilize CapTOP's offline simulation capabilities to develop, test, and evaluate optimized traffic control strategies. Using a suite of offline simulation tools and equipment, the Traffic Engineer is able to perform the following:

1. Obtain copies of current control parameters (e.g., signal parameters) in the central software and field controllers using software and equipment in the simulation environment;

2. Coordinate with the Maintenance Supervisor to modify signal control parameters in the central software and field controllers using software and equipment in the simulation environment;

3. Utilize Synchro and other simulation packages to access the effectiveness of traffic control strategies, tactics, and individual timing plans on simulated traffic networks;

4. Analyze MOEs, optimize parameters, and observe visual simulations to development new traffic control strategies, tactics, and individual timing plans;

5. Develop coordinating signal timing strategies simulation various control settings, including split, cycle and offsets of adjacent controllers;

6. Coordinate with the Maintenance Supervisor or his/her designee to implement the new signal timing plans by downloading them from the central system. Note: as mentioned above, changes to signal phasing scheme can only be done from the field.

7.3.4.3 Use Case: TEN-3: Data Warehousing and Archiving

Data warehousing and archiving provides complementary services to the data collection and analysis services discussed above. Data warehousing and archiving provides a repository for electronically stored data. This subsystem includes software and hardware that support electronic storage and retrieval of traffic data, response plans, timing plans, ITS device status, system event log, measures of effectiveness and other data. This subsystem supports various reporting and analysis functions, and provides a means to retrieve and analyze data, to extract, transform, load, and display data.

Refer to TEN-1: Data Collection and Analysis for additional information.

7.3.5 Other Use Cases

7.3.5.1 Use Case: MISC-1: Traffic Information Dissemination

Traffic Information Dissemination is achieved by the TMC Operator transmitting messages to DMS/PDMS and HAR devices. Dissemination of traveler information also occurs through pushing traveler information to the Internet and Private Sector companies such as Traffic.Com (who get their information from sources such as RITIS). Refer to the following Use Cases for more information:

1. TCD-2: Monitoring and Controlling DMS/PDMS;

2. TCD-3: Monitoring and Controller HAR;

3. TCD-4: Posting Web Updates;

4. SL-5: Center-to-Center Operations.

7.3.5.2 Use Case: MISC-2: Emergency Management

Emergency management is similar to incident and special event management, but there is more of a focus on the emergency agencies (e.g., police, fire, and rescue). Emergencies differ from incidents in that the ultimate responsibility for developing strategies and managing the broad range of responses is the responsibility of agencies with emergency management missions. The role of DDOT and the TMC is to support these operations, to provide information about the status and availability of transportation systems and resources, and to implement and monitor transportation-related control plans and strategies. Many of the functions and capabilities of CapTOP's incident and special event management subsystems will apply during Emergency Management and Evacuation needs. However, CapTOP does provide several specific capabilities specific to Emergency Management, including:

1. Providing an interface with emergency management agencies to exchange information on the evacuation and the status of roadway/transportation network;

2. Visually displaying evacuation routes on a GIS-based map;

3. Monitoring and controlling reversible lanes implemented during emergencies;

4. Monitoring and displaying the status of signals at intersections, including locations where signals are set to flash mode and/or police traffic control is needed during evacuations;

5. Providing an interface for information sharing with WMATA to support emergencies. Information shared with WMATA includes the status of the roadway system, which could be used to determine if changes in bus routes are required.

7.3.5.3 Use Case: MISC-3: Roadway Operation Patrols

ROPs provide courtesy roadway patrol assistance to police and emergency personnel in responding to roadway incidents, preventing illegal stops and deliveries, and providing assistance with traffic control for special events in the Central Business District (CBD). ROPs serve as the in the field "eyes and ears" of TMC operators, and keep abreast of conditions and traffic incident management activities. These efforts are aimed at improving traffic flow, decreasing congestion, and improving air quality.

CapTOP provides the ability for the ROP Technicians to connect to CapTOP via laptop computers in their vehicles to perform the following:

1. Identify incident locations;

2. Locate other ROP vehicles;

3. Exchange information interactively with TMC operators;

4. Provide an interface to update the incident log;

5. Provide mobile video from the ROP vehicle back to the TMC;

6. Log activities where support was provided.

7.3.5.4 Use Case: MISC-4: CVISN Integration

In the course of conducting normal traffic operations, incident management, or special event management the system is configured to send and receive information from CVISN. From the CVISN locations, access is provided to CapTOP for the following purposes:

1. Viewing traffic condition data, confirmed incident and special event information;

2. Viewing the traffic condition map to display speeds and congested areas;

3. Viewing the map display to provide truck routes;

4. Viewing the map display to provide height, weight, and access restrictions.

This same information is available to the public (e.g., truck dispatchers) via the Web site. In addition to the above, the CapTOP software provides an electronic interface to CVISN for the following purposes:

1. To obtain weigh in motion data;

2. To obtain notifications of any HAZMAT materials traveling through D.C.;

3. To obtain over weight and over height alerts.

7.3.5.5 Use Case: MISC-5: Snow Operations

During snowstorms, the TMC acts in a supporting role to the Snow Center for the following purposes.

1. To provide access to live video of DC's transportation network;

2. To provide access to the traffic condition map;

3. To provide access to incident information, including accidents, construction, and road closures;

4. To provide access to traffic volumes and speeds;

5. To provide road weather information, such as air temperature, road surface temperature, wind velocity, precipitation, etc.

6. To post traveler advisories to DMSs/PDMSs, HARs, and the web site.

In addition to the above, CapTOP provides an interface for the operators to get read-only access of the StormTrak system for the purpose of analyzing snow/ice accumulations, and salt truck deployments.

7.3.5.6 Use Case: MISC-6: Critical Infrastructure Protection

In the course of conducting normal traffic operations, incident management, or special event management the Operator may receive alerts from the CIP System. The CapTOP software provides an electronic interface for the purpose of receiving incident notifications from the CIPS. Once received, this information is treated like a normal incident. That is, a TMC Operator alert is provided and the incident management process begins. Reference SL-2: Incident Management and TCD-6: Tunnel Operation and Control for additional information.

APPENDIX A – TRACEABILITY MATRIX

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	C2C-1	C2C	Need interface with RITIS to share real-time data including incident and traffic with CHART and VDOT.	1	SL-5
ITS	C2C-2	C2C, RTC	Need to link/interface with RITIS for information sharing through regional ATIS web site (RITIS).	1	SL-5
ITS	C2C-3	C2C, SYS	Center-to-center data communications should follow NTCIP. That means the data dictionary for traffic/incident information should follow the specifications of NTCIP.	2	SL-5
ITS	C2C-4	C2C, SYS	Need to use the XML technology to transfer data.	1	SL-5
MS	C2F-1	C2F	Need to streamline functions to transmit the data downloaded from the field to TMC database.	2	SL-5, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	C2F-2	C2F, DOC	Need interface to be able to communicate with the legacy ITS devices as well as new devices. Seamless data integration is required.	1	SL-5, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	CIP-1	CIP	Alert TMC Operators when "smart cameras" detect suspicious activity in tunnels.	1	SL-2, MISC-6
TO	CIP-2	CIP	Need to monitor heavy truck traffic at critical infrastructure (13th Street tunnel).	2	SL-2, MISC-6
TO	CIP-3	CIP	Need to provide TMC Operators with access to video feeds/smart cameras from tunnels/critical infrastructure monitoring stations.	2	SL-2, MISC-6
ITS	CIP-4	CIP, GUI	Need interface with CIP system to receive CIP alerts (data and video).	1	SL-2, MISC-6
ITS	CIP-5	CIP, GUI, TOPS	Need interface to access video cameras in tunnels (monitoring), monitor status/conditions in tunnels	2	SL-2, MISC-6
ITS	CIP-6	CIP, GUI, TOPS	Need interface with SCADA system which provides monitoring and control for tunnels (3rd Street and 12th Street).	2	SL-2, MISC-6
ITS	CIP-7	CIP, IM	Need map interface with Video Incident Detection System and display incident status.	2	SL-2, MISC-6
ITS	CIP-8	CIP, IM	TMC Operators should receive alerts or alarms when the system detects suspicious activity (stopped vehicles, packages in roadway).	2	SL-2, MISC-6
ITS	CIP-9	CIP, MMC	Need interfaces to exchange information with other DDOT divisions for Tunnel Operations.	2	SL-2, MISC-6

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	CMM-1	CMM	Need a interface with DPW database to access work zone data.	2	SL-2
TO	CMM-2	CMM	Need interface to access to information about other "authorized" full or partial road closures associated with long-term construction zones (buildings), infrastructure repair, road obstructions (downed trees, power lines, etc).	2	SL-2
TO	CMM-3	CMM	Need interface with DPW to access information regarding current work zones, including information about approved times for setting up/taking down, and information about appropriate work zone setup.	2	SL-2
TO	CMM-4	CMM	Need to know and record roadway closures if scheduled construction last longer than six days.	2	SL-2
TO	CMM-5	CMM	Need to provide automated "reminders" to TMC operators when needed to monitor setup/take-down times of specific work zones	2	SL-2
TO	CMM-6	CMM, GUI	Need to display the locations of work zones on GIS map displays	1	SL-2
TO	CMM-7	CMM, MMC	Need multiple agency review/coordination prior to and during construction. Provide TMC with information that includes: allowable work hours and lane closure times.	2	SL-2
OT	CMM-8	CMM, MMC	Need to coordination of local agencies (DPW) to improve for major construction or roadway maintenance events.	1	SL-2
TO	CVSN-1	CVSN	Alert TMC Operator if an over height vehicle is detected by an over height detector.	2	MISC-4
ITS	CVSN-2	CVSN	Need interface with CVISN E-Screening Program to get WIM information.	2	MISC-4
TO	CVSN-3	CVSN	Need to create report on real-time truck information (e.g. overweight from WIM system)	2	MISC-4
ITS	CVSN-4	CVSN	Needs interface to receive information from truck height sensors and to identify location of truck over-height sensors	2	MISC-4
TO	CVSN-5	CVSN, CIP	Need to provide TMC Operators with access to information regarding height/weight restrictions, and/or routes that are inappropriate for heavy and/or oversize vehicles. (May be provided by CVIEW)	2	MISC-4
ITS	CVSN-6	CVSN, GUI	Need a map-based interface to display truck routes and/or height/weight/access restrictions on map.	2	MISC-4

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	CVSN-7	CVSN, GUI	Need an interface with CVISN's Roadside Operations Computers (ROCs). This interface would provide access to CVISN's following information: video clips, vehicle data (e.g. speed, volume, classification and weight), over height vehicle alarms, messages displayed on CVISN's DMS signs, AVI data for monitoring movement at the TMC for things like HAZMAT movements or oversized/special permit vehicle movements.	1	MISC-4
ITS	CVSN-8	CVSN, GUI, DWA	Need function to send MPD and other agencies alerts and notifications when the determination is made there may be a security threat associated with commercial vehicles such as unauthorized, illegally bypass an inspection station, and HAZMATs that are in proximity of a critical infrastructure asset.	1	MISC-4
MS	DDM-1	DDM	Need a formalized asset management system for managing and tracking maintenance activities including issuance, tracking, and resolution of work orders/problem reports.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-10	DDM	Need a Work Order Tracking System that could track all preventive and corrective maintenance from the time it is reported until it is closed. The system could also be used for new work (like installing DMS, cameras, etc.).	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-11	DDM	Need either to integrate (interface with) or to incorporate Asset Management capabilities with CapTOP; particularly assets related to traffic operations and incident management.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-12	DDM	Need Interface with McDean (contractor) TIMS System. CapTOP should interface with and display data from McDean's TIMS system using the ACISA #s.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-13	DDM	Need means to integrate citizens' complaints about signals issues. Some of these capabilities may be supported by new Citiworks features, but interface (information sharing) needs to be part of CapTOP.	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-14	DDM	Need streamlined process for TO inform signal contractors of a problem, to reduce time for dispatch	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-15	DDM	Need to accommodate DSL Circuit diagnostics for Twisted Pair communications and diagnostics/status for fiber optics communication for future.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	DDM-16	DDM	Need to be able to add, remove and configure devices in the system.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	DDM-17	DDM	Need to be able to easily query for device information, including model, series number, etc.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-18	DDM	Need to be able to e-mail trouble tickets to maintenance technicians while in the field through the use of PDAs or wireless enabled laptops.	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-19	DDM	Need to be able to enter, close and update work orders remotely.	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-2	DDM	Need to be able to generate the work order and reports from the Work Order Tracking System, which will be used to analyze the trends to determine problematic devices.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-20	DDM	Need to be able to manage assets and track spare parts inventory.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-21	DDM	Need to be able to test and diagnose problems remotely.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-22	DDM	Need to be notified of equipment malfunctions in a timely manner.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-23	DDM	Need to create electronic inventory system for spare parts. The system would provide information on parts availability for the two major facilities: DDOT stock room and contractor (McDean) stock room.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-24	DDM	Need to develop on-line electronic version of daily traffic signal problem log that meets DDOT requirements for record-keeping.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	DDM-25	DDM	Need to notify system manager when high priority system or device malfunctions.	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-26	DDM, C2C	Need interface to receive and display CCTV images through traffic.com.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-27	DDM, C2F	Monitor and check the status of signals and communications through CapTOP (interface with QuicNet).	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-28	DDM, C2F	Need Center to Field and Field to Center features to facilitate ability to communicate new assignments, real-time dispatch, status of current efforts, and to check/confirm device status/functions.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-29	DDM, C2F	Need to alert maintenance staff of device malfunctions by various ways.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-3	DDM	Need to prevent entry of duplicate work orders issued to Contractor for the same location/problem.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-30	DDM, C2F	Need to facilitate information exchange-communications with direct peer-to-peer for specific types of activities. Currently, maintenance/problem reports and all requests (regardless of how small) must go through several layers of organizations by phone.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-31	DDM, C2F	Need to improved communication and sharing information between maintenance staff and TMC operators with regard to device problems, status of repairs, work order requests	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-32	DDM, C3F, SIG	Need communicate with Signal Conflict Monitor and provide indication of why signals may have gone to “flash” mode.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-33	DDM, DWA, PM	Need to be able to generate ITS device maintenance reports customized specifically for each ITS subsystem for maintenance staff. Each report would include device status (online, offline, failed).	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	DDM-34	DDM, GUI	Need interface to initiate work order requests through Hansen (or Citiworks) which are then sent to the contractor database maintained by the contractor.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	DDM-35	DDM, GUI	Need interface with new Citiwork program. Specific details of all capabilities to be included in CitiWorks are not clear yet.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-36	DDM, GUI	Need to be able to add new ITS devices from different manufacturers to the GIS map.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-37	DDM, GUI	Need to be notified or reflect on status map after malfunctioning ITS devices repaired.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-38	DDM, IM	Need to locate the DMS that are priority of uses and return to previous location when “incident/emergency” is resolved.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DDM-39	DDM, IM, DWA	Need to track the status of maintenance trucks and teams during emergencies, and log activities and status for individuals and for shifts.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-4	DDM	Need to produce reports that identify status of problem areas that have not yet been resolved.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	DDM-40	DDM, PM	Need to be able to track maintenance activity by asset for performance and budget purposes.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	DDM-41	DDM, SYS	Need a seamless interface with Citiworks features relevant to traffic/asset management	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	DDM-5	DDM	Need to provide alerts/warnings to TMC Operators of ITS device malfunctions	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7

Stakeholder	Number	Area	Description	Priority	Use Cases
MS	DDM-6	DDM	Need to run tests to identify and troubleshoot malfunctioning devices.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-7	DDM	Need to send alert to TMC Operators when device status change and/or communications, system or device malfunctions.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-8	DDM	Provide notification to TMC when status of DMS changes (technical/communications problem)	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DDM-9	DDM	Submit trouble report /work order request to maintenance staff.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-1	DOC	Need to be able to poll/query ITS devices to determine operational status such as functioning/not functional or in use/not in use.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-10	DOC, C2F, GUI	Need to be able to view location, status, home-base location and identification information for portable DMS locations on a map.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DOC-11	DOC, DDM	Need to be able to query devices of all types to determine current status (cameras, signals, WIM devices, VMS, and more).	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DOC-12	DOC, DDM	Need to facilitate communication between TMC and utility company (e.g. PEPCO) to notify power outages directly to point person contract.	2	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-13	DOC, DWA	Log all TMC Operators actions/commands associated with DMS messages into incident report.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-14	DOC, DWA	Need to be able to create favorites list of cameras and to scan cameras according to a schedule, enter action into incident log.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-15	DOC, DWA	Need to produce a report listing location, status, and use of DMS devices during specified periods of time.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
OT	DOC-16	DOC, EM	Need to support centralized DMS control for regional emergency evacuation	2	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	DOC-17	DOC, GUI	Need a map interface to display the location and status of traffic signals and ITS devices (DMS, cameras, HAR, etc)	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	DOC-18	DOC, GUI	Need a map-based interface to display locations/status of DMS accessible through CapTOP in TMC or remotely (via web interface)	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-19	DOC, IM	Need to send alarm/reminder to TMC Operator to confirm or change DMS messages at regular time intervals and in response to a change in incident status.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-2	DOC	Need to direct video images to Video Wall in TMC or just to operator desk top.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-20	DOC, IM	Remind Operators to request portable DMS to be returned to previous location with incident/event is over.	2	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ROP	DOC-21	DOC, ROP	Need to provide TMC Operators with reminders when DMS messages need to be changed, or devices need to be moved.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-22	DOC, SEPM	Allow portable DMS devices to be "reserved" for use during special events or incidents.	2	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-23	DOC, SEPM	Need to define camera "tours" ahead of time to support special events or tailored for specific incidents.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-24	DOC, TID	Need to establish schedule for confirming/updating messages when messages are posted.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-25	DOC, TID	Need to add, change or remove messages from portable DMS from within the TMC or by logging remotely onto CapTOP.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
OT	DOC-3	DOC	Need to establish communications, maintain communications, and report and receive assessments and status information.	2	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-4	DOC	Need to establish/recommend priority of applications/uses for DMS when portable DMS should be moved in response to higher-priority.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DOC-5	DOC	Need to integrate HAR operations as system component of CapTOP.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DOC-6	DOC	Need to maintain a library of pre-define lists of devices needed to support operations under various conditions.	2	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	DOC-7	DOC	TMC Operators issue electronic request (work order) to staff responsible for moving DMS.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	DOC-8	DOC, C2F	Need to know current status of all ITS devices (e.g. in use, or not functioning, etc.)	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	DOC-9	DOC, C2F, GUI	Need to monitor the operational status of fixed and portable DMS.	1	TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
OT	DWA-1	DWA, TDCA	Need to be able to merge/integrate and interpret information from multiple sources. The data interpretation and integration process requires some level of operator intervention.	1	TEN-3
TO	DWA-10	DWA, GUI	Need a common GIS mapping system and a data warehouse for storing data collected from ITS field devices.	1	TEN-3
TO	DWA-11	DWA, MMC, IM	Need to create and maintain a database for incidents involving non-DC agencies including WASA, Verizon, CSX, Pepco. Documentation should include contact information, tracking, status updates, confirmation that notification of incident was received by POC, features and reminders for follow-up to ensure “things happen”.	1	TEN-3
ITS	DWA-12	DWA, PM	Need to log users’ activities, archive data, analysis data, generate reports for developing and tracking performance measures at all levels	1	TEN-3
ITS	DWA-13	DWA, PM	Need to produce reports based on archived data for evaluating the performance including document statistics for Traffic/Incident/Event management activities—number, type, magnitude of responses, duration of responses, number and source of resources required (ROP, equipment, field staff, etc), and more.	1	TEN-3
TO	DWA-14	DWA, PM	Need to track system users' activities that includes when users log onto and off of the system and what actions they performed while logged on	1	TEN-3
TO	DWA-2	DWA	Need access to the system various data (incident, volume, weather) in real-time.	1	TEN-3
ITS	DWA-3	DWA	Need all spatial data (i.e., DC street network) conform to citywide GIS standards to enable seamless information exchange with citywide spatial databases.	2	TEN-3
TO	DWA-4	DWA	Need one master repository for incident information (includes special events, construction lane closures, accidents) to ensure consistency of data as it is input and distributed, and to improve coordination between different events or incidents.	1	TEN-3

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	DWA-5	DWA	Need to archive traffic/incident data and provide access to archived database with user privilege.	2	TEN-3
ITS	DWA-6	DWA	Need to be able to create customized reports using standard query tools.	1	TEN-3
TO	DWA-7	DWA	Need to capture information needed to support a comprehensive log of activities for each event/incident in the system including: phone calls, incident detection, verification, clearance, DMS updates.	1	TEN-3
MS	DWA-8	DWA	Need to gather and archive information from a variety of sources about event including traffic volumes (from count stations, etc), traffic operations, transit use, attendees, staff/equipment resources used, event characteristics, and more.	1	TEN-3
TO	DWA-9	DWA, EM	Need to automatically log receipt of alerts and notifications from outside sources (EMA, CHART, V- STCs)	1	TEN-3
ITS	EM-1	EM	Need to receive updated info from emergency management responders: location, type of incident, incident duration.	1	SL-2, MISC-2
OT	EM-2	EM, C2C	Need to support Public Emergency Notification System (public address system for pedestrians and motorists under emergency conditions)	2	SL-2, MISC-2
TO	EM-3	EM, GUI	Need to pull up evacuation routes on GIS map. This would help TMC Operators respond to information requests.	1	SL-2, MISC-2
ITS	EM-4	EM, GUI, NMC	Need map-based interface with EMA to exchange evacuation information and display evacuation routes	1	SL-2, MISC-2
ITS	EM-5	EM, IM	Send video images from TMC to other dispatch centers to aid with dispatch.	1	SL-2, MISC-2
ITS	EM-6	EM, RTC	Need to be able to coordinate during Emergency Response activities and Special Events.	1	SL-2, MISC-2
MS	EM-7	EM, RTC	Need to support coordination of signal changes for emergency evacuation.	1	SL-2, MISC-2
ITS	EM-8	EM, RTC	Need to support emergency operations and to provide information about the status and availability of transportation system and resources, and to implement and monitor transportation-related plans and strategies	1	SL-2, MISC-2
ITS	EM-9	EM, TOM	Need to monitor and control reversible lanes and signal flash during evacuation	1	SL-2, MISC-2

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	GUI-1	GUI	Allow operator to select specific types of information to be displayed on map	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-10	GUI	Eliminate need to re-enter information into different systems is a major impediment to increasing the productivity (output) of TMC operators	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-11	GUI	Need a common map interface to monitor and display all ITS devices.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	GUI-12	GUI	Need a map interface to display of special event locations, work zones, traffic incidents, & other activities	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-13	GUI	Need a web-based interface to support access to CapTOP from outside the TMC from a Laptop computer.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	GUI-14	GUI	Need an unified interface where all functions are integrated in a common user interface.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	GUI-15	GUI	Need interface reserved for future Configuration Management System (CM)	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-16	GUI	Need provide a common user interface, and facilitate information sharing and coordination between Maintenance and TMC Operations	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-17	GUI	Need to add geography/terrain map overlays on the intersection maps	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	GUI-18	GUI, C2C	Need web-based interface with Unified Command Center to exchange information	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	GUI-19	GUI, CMM	Need a map interface to display work zone including the construction location and status.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-2	GUI	Need to address confusion related to intersections "mirrored" in more than one city quadrant.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
MS	GUI-20	GUI, CMM	Need map interface to show utility repairs on the roadway.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	GUI-21	GUI, CMM, SEPM	Need a map interface to display lane closure with the status (which lane or lanes are currently closed) and the starting and (expected) ending times for the lane closure.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-22	GUI, DOC	Allow Operators to view multiple cameras at once on desktop monitors.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	GUI-23	GUI, DOC	Need an interface reserved for future new CCTV server that supports digital video (codec)	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-24	GUI, DOC	Need to be able to set up camera "tours" that present views of multiple cameras in pre-defined sequences .	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-25	GUI, DOC, C2F	Need to be able to view field device status on the CapTOP map by their icon.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-26	GUI, DOC, DDM	Provide visual message alerts when system/device status change.		SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-27	GUI, DOC, DDM, C2F	Display status information for all signals/ITS devices on a GIS map.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	GUI-28	GUI, DOC, PM	Need to be able to record all activities for portable DMS operations (e.g., “when”, “from where”, “to where”, “by whom”, “how” and “why”) and to generate the related reports for performance evaluation. If a PDMS has GPS devices installed, the locations of PDMS need to be updated and displayed on the map in real time.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-29	GUI, IM	Allow users to enter the location of new incidents using a variety of different approaches (e.g. GPS and geocoding), and make it easier to confirm that the location selected on the map is correct. This should significantly reduce overall clearance time	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-3	GUI	Need to address location problems associated with quadrant "boundary" roadways (like North Capital Street)	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-30	GUI, IM	Data entry forms must be able to require entries for specific fields, and where appropriate, validate the data entered	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-31	GUI, IM	Make extensive use of icons to represent types of events/incidents, incident status, and other information	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-32	GUI, IM	Minimize the likelihood of duplicate incident records inadvertently entered for the same incident from different sources.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	GUI-33	GUI, IM	Need a form interface to require users entering key data items before create a record (e.g. incident record) and to provide options for over-riding and document the reason for over-riding or by-passing.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-34	GUI, IM	Need a map search feature to quickly locate an incident site or a specific incident by entering intersection street names and/or street addresses or pointing/clicking on map	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-35	GUI, IM	Need to display and view detail incidents on the GIS map.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	GUI-36	GUI, IM	Prevent empty incident records from being saved (or purge empty records).	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-37	GUI, IM	Need to address location information for incidents/problems located away from intersections (mid-block).	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	GUI-38	GUI, IM, EM	Need map interface to update and display alternative routes when a major road is blocked due to incident/event.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-39	GUI, IM, SEPM	Ability to display roadway status information for special events, incidents, and emergencies on color-coded maps that reflect type/nature of event and current traffic conditions.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	GUI-4	GUI	Need to develop Map-based GUI to display status/characteristics of transportation infrastructure systems and elements.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
SO	GUI-40	GUI, MMC, WEM	Snow Center needs access to information about incidents, traffic volume, road closures (view roadway condition map),	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-41	GUI, SIG	Need interface to interact with the signal system, receiving alarms and alerts, and signal timing plans, through the CapTOP.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
SO	GUI-42	GUI, TID	Need map interface to display a roadway condition map and disseminate the map to the public.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-43	GUI, TOM	Need to display lane closures on the GIS map using icon to indicate type of event	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
SO	GUI-44	GUI, WEM	Need to receive and display road conditions status reports from TMC	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	GUI-5	GUI	Need to identify signalized intersection on a GIS map and fill related info automatically such as location and direction.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-6	GUI	Need to provide a map interface that can integrate information/data from multiple sources on different map layers.	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-7	GUI	Need to provide text confirmation that helps operator confirm that location information entered is correct.	1	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	GUI-8	GUI	Need web-based interface to access to specific types of information tailored to the needs of different user groups	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
TO	GUI-9	GUI	Provide menu of "pre-defined" map-based displays for specific purposes	2	SL-1, TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7
ITS	IM-1	IM	Need a e-mail or message board component that can communicate messages or alerts to individuals or distribution lists using the City's existing email system.	2	SL-2, SL-5
TO	IM-10	IM	Need a function to close (or otherwise unlock) incident records if the operator is away from their station for any period of time.	1	SL-2, SL-5
TO	IM-11	IM	Need all (incoming) email updates appear in CapTOP Window, Including updates from EMA, and elsewhere.	1	SL-2, SL-5
TO	IM-12	IM	Need end of shift "pass over" functions to ensure pending items are addressed and critical information is passed on to next shift.	1	SL-2, SL-5
ITS	IM-13	IM	Need interfaces to provide direct access to specific types of information to partners in other jurisdictions (e.g. VDOT, CHART, PG County, WMATA).	1	SL-2, SL-5
TO	IM-14	IM	Need to alert for incidents by instance message, e-mail, or other means, filtered by location, road type, time of day, severity, and type.	1	SL-2, SL-5
TO	IM-15	IM	Need to be able to confirm receipt of outgoing (CapTOP generated) alerts and notifications sent electronically to specific distributions lists are received/acknowledged.	1	SL-2, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	IM-16	IM	Need to be able to pull up an incident type and the associated list of contacts at agencies or others that need to be called or involved.	1	SL-2, SL-5
TO	IM-17	IM	Need to be able to track an incident from detection, how response, to when it is cleared, including all intermediate status changes.	1	SL-2, SL-5
TO	IM-18	IM	Need to be able to work on the same incident in the system at the same time without conflicts.	1	SL-2, SL-5
TO	IM-19	IM	Need to develop on-line log form (legal document) and create log report	1	SL-2, SL-5
ITS	IM-2	IM	Need to display status of transportation system, elements of strategies/plans being implemented	1	SL-2, SL-5
ITS	IM-20	IM	Need to disseminate alerts tailored to the details of each incident/event	1	SL-2, SL-5
TO	IM-21	IM	Need to ensure that critical information about incidents is entered at the time incident are entered	1	SL-2, SL-5
TO	IM-22	IM	Need to generate tailored contact lists automatically based on incident/event location and characteristics.	2	SL-2, SL-5
TO	IM-23	IM	Need to maintain updated distribution lists for specific kinds of alerts.	1	SL-2, SL-5
TO	IM-24	IM	Need to produce reports that identify un-resolved (open) incident reports	1	SL-2, SL-5
TO	IM-25	IM	Need to provide "templates" for different types of alerts/updates tailored to type of event and the needs of the specific distribution list.	1	SL-2, SL-5
ITS	IM-26	IM	Need to provide incident detection capability on arterial network/urban roadways.	1	SL-2, SL-5
TO	IM-27	IM	Need to provide on-line access to resources/information needed by operators – including contact lists, SOPs, help functions	1	SL-2, SL-5
TO	IM-28	IM	Need to provide reminders/alerts for follow-up actions; particularly closing incidents, notifications, and updates/alerts	1	SL-2, SL-5
TO	IM-29	IM	Need to remove (or prevent) entry of “empty” incident records, or to prevent or identify duplicate entries for the same incident	1	SL-2, SL-5
TO	IM-3	IM	Need to support the “handover” of incidents from one shift to another. Make sure that operator has closed the loop on open incidents, updated logs, and passed the open incidents on to next shift.	1	SL-2, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
ROP	IM-30	IM ROP	Provide ROP drivers with more specific information about the nature of some "non-emergency" trouble reports. Drivers are sometimes sent to look for a minor problem at a location, but do not have enough information to figure out where and what the problem is/was.	1	SL-2, SL-5
TO	IM-31	IM, CMM	Need better means of monitoring and closing the loop on repairs/incidents involving utility companies and other private-sector organizations that may be involved in incidents.	1	SL-2, SL-5
ITS	IM-32	IM, CVSN, DWA, GUI	Need to provide incident information that is tailored for the CVO community, including: Incident (accidents, construction or congestion) information along main truck routes, Information on alternate routes in the event of major incidents, Special event that may affect truck routes (need advance notification and alternate routes to be published), Maximum vehicle heights at low bridges/underpasses, Weight restrictions displayed by road/location, Pre-trip information via the internet to dispatchers, En-route information to truckers via ITS devices such as DMS or HAR,	2	SL-2, SL-5
TO	IM-33	IM, DOC	Need to automatically reset all ITS devices to pre-incident/event status when closing an incident/event.	1	SL-2, SL-5
TO	IM-34	IM, DWA	Need a stakeholder database that can identify Points of Contact for all agencies/organizations involved in traffic incident management and response.	1	SL-2, SL-5
TO	IM-35	IM, DWA	Need the query and search functions for incidents or events by criteria such as incident type and location.	1	SL-2, SL-5
ITS	IM-36	IM, DWA	Need to generate daily Activity Reports describing characteristics and status of events/incidents addressed during shift and for the day.	1	SL-2, SL-5
ITS	IM-37	IM, DWA	Need to generate special event/incident reports tailored to the needs of different stakeholders – (elected officials, senior management, etc).	1	SL-2, SL-5
TO	IM-38	IM, DWA	Need to log of all "messaging" and "alerts" that includes a time stamp, identifies the operator who generated the message, the content of message, and other details. Outgoing messages should show DDOT as the sender	1	SL-2, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	IM-39	IM, DWA	Need to provide functions to support all phases of incident management including after-the-fact analysis and reporting incident and management activities including location and type of incidents, # of ROPS utilized, Equipment used, including # of DMS, cones, barriers and other equipment deployed, incident duration (start date/time, end date/time), HARs with messages used, DMSs with messages posted, traffic signal changes, traffic alerts posted (including e-mails or text messages transmitted), website updates implemented, MPD and Fire Dept. involvement, and involvement of other agencies	1	SL-2, SL-5
TO	IM-4	IM	Need to track operators' status of activities, to-do lists, and follow-up needed during incidents	1	SL-2, SL-5
TO	IM-40	IM, DWA	Need to retrieve and report all information about a past or active incident in specific file formats.	1	SL-2, SL-5
TO	IM-41	IM, DWA, PM	Needs to have a status log for incidents that identifies each command entered into CapTOP by operator. Identifies operator who made change, time update made, etc. Log entries that cannot be altered after the fact.	1	SL-2, SL-5
ROP	IM-42	IM, DWA, SMM, ROP	Allow ROP drivers to view incident/event logs/records from remote locations and to review event/incident logs to ensure correct information was input. Specific examples include details regarding location of incident and involved parties (responders and victims).	1	SL-2, SL-5
ROP	IM-43	IM, DWA, SMM, ROP	ROP drivers need access to information and the ability to keep a detailed, up-to-date log of actions during specific events and incidents, and allow ROP drivers to access and review incident logs after the incident is closed	1	SL-2, SL-5
TO	IM-44	IM, GUI	Allow Operators (or other users with rights) to see contents of incident records currently open by another operator.	1	SL-2, SL-5
ITS	IM-45	IM, GUI	CapTOP need to be able to geocode the incident locations on GIS map and to search location by a street address or an intersection.	1	SL-2, SL-5
ITS	IM-46	IM, GUI	Need a map interface (map layer) to display up-to-date bus routes to determine the location where a incident occurs on a bus route.	1	SL-2, SL-5
ITS	IM-47	IM, GUI	Need map interface to display location of current incidents and status of roadway (e.g. lane and intersection closures).	1	SL-2, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	IM-48	IM, GUI	Need map-based interface to display the schedule and status of reversible lanes for reversible lane operations and monitoring.	2	SL-2, SL-5
TO	IM-49	IM, GUI	Need remote access to CapTOP and TMC information via laptop from command centers during incidents/events.	1	SL-2, SL-5
TO	IM-5	IM	Need to track the status of available personnel and equipment resources to respond to planned and unplanned events and incidents on a daily basis.	1	SL-2, SL-5
ITS	IM-50	IM, GUI	Need to be able to directly receive GPS data from the field and retrieve longitude/latitude coordinates of an incident location from the field and display it on the map.	1	SL-2, SL-5
ITS	IM-51	IM, GUI	Need to be able to map incident location using highway mile point.	1	SL-2, SL-5
TO	IM-52	IM, GUI	Need to provide on-line templates for creating “text message” alerts/updates on different types of events. Alerts should be compatible with PCs as well as cell phones (text messaging), Blackberry, PDAs, and other devices.	2	SL-2, SL-5
TO	IM-53	IM, GUI	Provide on-line access to Standard Operating Procedures for all types of incident/events.	2	SL-2, SL-5
TO	IM-54	IM, GUI	Provide ROP drivers with ability to directly enter some information from incident scenes.	1	SL-2, SL-5
ITS	IM-55	IM, GUI	When an incident record is created either manually or by geocoding, the CapTOP need to store the incident’s location (longitude/latitude coordinates), and share the location info with other agencies.	1	SL-2, SL-5
ROP	IM-56	IM, GUI, ROP	Need an interactive interface between ROP drivers and TMC operators that can guide TMC Operators recording information and data from ROP and directing ROP actions at the scene of incident, and allow ROP drivers to review/confirm information entered into incident report/log.	1	SL-2, SL-5
TO	IM-57	IM, MMC	Need feature to allow staff from related agencies (contacts) to sign up for email notifications, and to receive automatic notification of incident information.	1	SL-2, SL-5
TO	IM-58	IM, MMC	Need to be able to generate and send incident alerts to multiple agencies and individuals in multiple formats, including instant messaging, email to computers and PDAs (Blackberry-type devices), phone, pager, and web.	1	SL-2, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	IM-59	IM, MMC	Need to be able to identify resources quickly such as who (what agency) might have specialized equipment available (like cranes or heavy-duty tow trucks) for dealing with incidents involving heavy vehicles.	1	SL-2, SL-5
TO	IM-6	IM	Need tools to help TMC Operators identify and then follow Standard Operating Procedures (SOPs) for different kinds of incidents and special events.	1	SL-2, SL-5
TO	IM-60	IM, MMC	Need to be able to identify who (what agency) might have specialized equipment available (like cranes or heavy-duty tow trucks) for dealing with incidents involving heavy vehicles.	1	SL-2, SL-5
ITS	IM-61	IM, MMC	Need to facilitate real-time information exchange to support coordination of activities in support of planned events with other agencies. The information includes incident, DMS message, and accept/reject actions.	1	SL-2, SL-5
TO	IM-62	IM, MMC	Need to show all agencies currently in the loop for each specific incident, who is currently on scene, etc., and resources requested (from whom, time request made, and the status –e.g. on the way, on the scene, etc.	1	SL-2, SL-5
TO	IM-63	IM, MMC, C2C	Display alerts from various outside sources including ROP, MPD, Amber Alert, other dispatch centers in a window on the CapTOP interface. Operator should not have to manually log into separate systems or manually check for incoming messages. Receipt of alert should be noted in activity log.	1	SL-2, SL-5
TO	IM-64	IM, ROP	Need function to direct drivers to specific incidents, prioritize activities, find the ROP vehicles close to the incident site, know how many vehicles are available, etc.	1	SL-2, SL-5
TO	IM-65	IM, ROP	Need to dispatch ROP to the scene of an incident and track their activities using GPS.	1	SL-2, SL-5
ROP	IM-66	IM, ROP	Provide TMC operators with quick, easy access to information which can be relayed to ROP drivers. This could include information about actions related to a specific incident; to make sure something has been done.	1	SL-2, SL-5
ITS	IM-67	IM, ROP, GUI	Need map interface to share images from wireless portable CCTV cameras used by ROP operators.	1	SL-2, SL-5
ITS	IM-68	IM, ROP, GUI	Need to track and display current location with GPS and status of ROP resources (vehicles and staff) at all times.	2	SL-2, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
OT	IM-69	IM, RTC, DWA, C2C	Need standard formats and common code-naming system for incidents for sharing with other agencies (CHART and VDOT)	2	SL-2, SL-5
ITS	IM-7	IM	Provide a structured user menu to reflect the characteristics of the incident/event management procedure. Status/Checklists for Operators to keep track of status of activities, to-do lists, and follow-up needed during incidents.	1	SL-2, SL-5
ITS	IM-70	IM, SEPM	Integrate SOP checklists to guide operators through needed actions and communicate priority actions. A library of "actions" could be defined and refined over time to respond to the specific characteristics of incidents and events	1	SL-2, SL-5
TO	IM-71	IM, SEPM	Need to create and run sequence routines for incidents and planned events based on incident/special event response plans.	1	SL-2, SL-5
TO	IM-72	IM, SEPM	Need to provide a checklist of specific actions in priority including who needs to be contacted, and what information should be shared with them when event/incident record is initiated in CapTOP.	1	SL-2, SL-5
ITS	IM-73	IM, SEPM	Need to provide a means of confirming that alerts/notifications have been received and acknowledged by key partners	1	SL-2, SL-5
ITS	IM-74	IM, SEPM	Need to provide alerts/reminders to TMC operators, others, to ensure timely follow-up on specific activities	1	SL-2, SL-5
TO	IM-75	IM, SEPM	Need to provide reminder message when incident/special event updates need to be generated, what information should be transmitted (e.g. changes in status, etc) and who the messages should go to.	1	SL-2, SL-5
TO	IM-76	IM, SEPM	Need to track and assess resources needed/called upon in response to specific events and incidents such as staff hours, equipment, and performance measures of all sorts.	1	SL-2, SL-5
TO	IM-77	IM, SEPM	Need to track current status, location, and availability of key resources during events/incidents.	1	SL-2, SL-5
ITS	IM-78	IM, SEPM	On-line access to lists of organizations and points of contact identified in SOPs for various types of planned and unplanned incidents	1	SL-2, SL-5
TO	IM-79	IM, SEPM	Prompt TMC Operator when an incident or special event is about to close or expire to make sure that incidents are properly closed out.	1	SL-2, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	IM-8	IM	Provide alert to operators when incident records have remained open for some specified period of time.	1	SL-2, SL-5
TO	IM-80	IM, SEPM	Provide checklists that step TMC Operators through SOPs for specific types of incidents/events.	2	SL-2, SL-5
ITS	IM-81	IM, SEPM, DWA	Need to collect and organize incident/event data to provide comprehensive reports that address different stages/elements of process.	1	SL-2, SL-5
ROP	IM-82	IM, SEPM, ROP, GUI	ROP needs to access and view traffic/incident information to complete paperwork and/or ensure that follow-up has been done, and to keep informed detailed and up-to-date log of actions during specific events and incidents.	1	SL-2, SL-5
ITS	IM-83	IM, SYS	Need to use the incidents definitions and codes that are compatible with CHART and VDOT for exchange incident information.	2	SL-2, SL-5
TO	IM-84	IM, TID	Need to provide traffic hot line to report major local incidents, traffic information, and roadway conditions. These messages should be updated frequently in TMC (e.g. 30 min).	1	SL-2, SL-5
TO	IM-85	IM,GUI	Allow selected users (ROP drivers) to view incident/event logs/records from remote locations	1	SL-2, SL-5
ITS	IM-86	IM,SEPM,PM,TDCA,DWA	Need to collect and archive incident/event data to develop, evaluate, and refine strategies and scenarios for different types of events/incidents under different conditions.	1	SL-2, SL-5
TO	IM-87	IM. GUI	Need pull-down menu/select organization chart/contact list	1	SL-2, SL-5
ITS	IM-88	IM. RTC, TID	Need to disseminate incident/special event information to local media (those familiar with DC), and for press/media from other places (and other countries).	1	SL-2, SL-5
ITS	IM-9	IM	Support end-of-shift pass over functions or TMC Operators– ensuring that loose ends are tied up and information needed to brief next shift operators is complete and available.	1	SL-2, SL-5
MS	MMC-1	MMC	Need interface with Capital Police to support for signals and ITS devices that are under the control of Capital Police, including operation and maintenance of signals, pop-up barriers, preempt signal capability at pop-up barrier locations.	2	SL-5
OIT	MMC-10	MMC, SMM	Any interfaces to external entities outside of the District requires coordination with OITI and OCTO	1	SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
OIT	MMC-11	MMC, SMM	Any wireless communication that is planned for use in TMC requires special coordination with OITI and OCTO.	1	SL-5
OIT	MMC-12	MMC, SMM	Applications involving any type of streaming video must be coordinated with OITI and OCTO	1	SL-5
OIT	MMC-13	MMC, SMM	Both OITI and OCTO should like to be kept apprised of the CapTOP design and would like to see the project plan when it is available.	2	SL-5
OIT	MMC-14	MMC, SMM	Integration of new wireless applications requires coordination with OITI and OCTO	2	SL-5
OIT	MMC-15	MMC, SMM	OITI manages the network connection, e-mail, and file/print servers for the TMC.	2	SL-5
OIT	MMC-16	MMC, SMM	OITI needs to be kept in the loop if anyone outside the TMC gets access to the system or its data. For any wireless applications, OITI and OCTO need to be consulted. Historically, the TMC has been somewhat of an “island” where they do their own thing.	1	SL-5
OIT	MMC-17	MMC, SMM	OITI needs to provide any new network gear for the CapTOP to ensure interoperability with the DDOT network. OITI would like the CapTOP Contractor to provide network gear specifications and OITI will supply the appropriate hardware.	1	SL-5
OIT	MMC-18	MMC, SMM	OITI supports the network and domain configuration. The TMC switch has two (2) T-1 circuits to the outside world.	1	SL-5
OIT	MMC-19	MMC, SMM, SYS	OITI prefers to have a unitary login and for the CapTOP application to tie into Active Directory	2	SL-5
MS	MMC-2	MMC	Need interface with DDOT on-line Emergency Permit Request website set up for utility companies to request permits when emergency repairs are needed.	1	SL-5
MS	MMC-3	MMC	Need interface with DDOT permitting office to get information about “permits” for lane/road closures for utility repairs.	2	SL-5
MS	MMC-4	MMC	Need interface with MPD and Capital Police to provide directly view status of roadways, including signals and devices, roadway blockages, and information.	2	SL-5
MS	MMC-5	MMC	Need to be able to get data/information from WMATA about transit ridership.	2	SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
MS	MMC-6	MMC	Need to be able to share information with WMATA about roadway conditions/incident/events that may impact WMATA operations (such as bus routes).	1	SL-5
MS	MMC-7	MMC	Need to provide means for TMC to be notified when Capital Police activate pop-up barriers or initiate other measures that block or restrict access on roadways in that area, so that DDOT can act to mitigate impacts.	2	SL-5
SO	MMC-8	MMC, GUI, WEM	Snow Center needs to be able to view live video and receive incident information from the system.	1	SL-5
OIT	MMC-9	MMC, SMM	Workstations/Servers or any new hardware have to be scanned before plugging into the network and then scanned once/day. Workstations are patched once/month, while servers are patched only at maintenance intervals. Currently, the TMC does its own patching.	2	SL-5
TO	TOM-10	TOM, DWA	Need a wide range of detailed reports by Operator, by shift, and for the TMC. Outputs – number and type of incidents/events, Outcomes – how well operations were managed.	1	
ITS	PM-1	PM	Need to integrate performance measures with CapTOP as an integral part of features defined for all operational areas	1	MGR-2
ITS	PM-10	PM, DWA	Need to achieve data for system performance monitoring and checking system reliability.	1	MGR-2
ITS	PM-11	PM, DWA	Need to archive and store incidents/events data for some period of time to support measures of system performance.	2	MGR-2
ITS	PM-12	PM, DWA	Need to create a report that summaries an special event/incident including a timeline of all system activity including messages, call logs, operator notes, MOE data, traveler information disseminated, etc.	1	MGR-2
MS	PM-13	PM, DWA	Need to create performance reports from maintenance activity logs and to allow flexible report formatting as requirements vary by agencies	1	MGR-2
OT	PM-14	PM, DWA	Need to define what measures will be tracked and used to measure the performance including personnel, system, and devices or equipment, and the methods to collect and analyze/track performance measures.	1	MGR-2

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	PM-15	PM, ROP	Need to collect and report information on “outputs” of ROP driver activities, including miles traveled, number and type of incidents responded to responses, etc.	1	MGR-2
MS	PM-16	PM, TDCA	Need to be able to query information from count stations to provide information to support development of reports and performance measures.	1	MGR-2
ITS	PM-2	PM	Need to log users’ activities, archive data, analysis data, generate reports for developing and tracking performance measures at all levels	1	MGR-2
ITS	PM-3	PM	Need to measure Staff/Operational unit (ITS system/subsystem) performance, document the need for additional resources, budget;	1	MGR-2
ITS	PM-4	PM	Need to organize and generate reports to support FHWA performance measures for incident management and traffic management	1	MGR-2
TO	PM-5	PM	Need various reports for system performance and for Operator/ROP productivity/performance.	1	MGR-2
ITS	PM-6	PM, DWA	Need to integrate performance measures with CapTOP as an integral part of features defined for all operational areas.	1	MGR-2
MS	PM-7	PM, DWA	Need to produce post-event reports that outline resources used	1	MGR-2
ITS	PM-8	PM, DWA	Need to produce standard performance measure reports at regular intervals from archived data and system log.	1	MGR-2
MS	PM-9	PM, DWA	Need to track communications outages, restoration of services, measures of system/device reliability, maintenance staff activities (outputs and outcomes) for performance measures.	1	MGR-2
TO	ROP-1	ROP	Allow ROP drivers to "sign in" at field offices when they begin and end their shift.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	ROP-10	ROP	Need function to support decision making for ROP assignments based on location of truck, priority of current activity (if any).	2	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-11	ROP	Need general Computer Aided Dispatch and/or fleet management-type capabilities for ROP. Allow tracking of location of trucks (via GPS), and information about current assignment status	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-12	ROP	Need to assign incidents to the ROP vehicles closest to the incident location.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
ITS	ROP-13	ROP	Need to develop reports to document resource needs, expenditures, productivity of ROP units.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
ITS	ROP-14	ROP, C2F	Need function to receive and process portable, wireless video and display and capture these images.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	ROP-15	ROP, GUI	Need a map-based interface to display showing location and assignment status of ROP resources.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-16	ROP, IM	Need streamlined way for ROP operators to communicate status/changes in status to TMC Operators; particularly for "regular" or "common" activities and to communicate key events as incidents unfold. ROP may be too busy dealing with incident to make phone calls, but TMC Operators may need specific information in response to requests from others. One example would be to have pre-defined text messages or code to communicate status or change of status.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-17	ROP, IM	Need to be able to confirm location of incident, and route driver to incident site as quickly as possible. Also help in locating incidents that are hard to find..	2	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-18	ROP, MMC	Need to support for communicating and log-in requests for assistance/equipment from MPD and others.	2	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
ITS	ROP-19	ROP, PM	Capture and organize statistics on "outputs" for ROP operations including the number, type of events responded to, miles traveled, etc.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	ROP-2	ROP	Need to produce daily reports for all ROPs.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
ITS	ROP-20	ROP, PM	Develop performance measures using data from ROP logs -- for ROP units (drivers), shifts, and the overall operation.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
ITS	ROP-21	ROP, PM	Need tools to effectively manage and evaluate ROP operations, personnel, etc.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-22	ROP, PM	Produce activity reports for ROP operations on a daily, weekly, and monthly basis for management purposes.		TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
ITS	ROP-23	ROP, PM, IM	Need log/records of ROP activities during incident/events including time stamps logging arrival on scene, departure from scene, and details about the incident and incident response activities	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	ROP-3	ROP	Need to provide "status" reports to TMC Operators showing status/availability of ROP trucks and drivers for each shift.		TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-4	ROP	Need to provide a standardized data input form for non-emergency reports to ensure critical information is collected (interface to Hansen and/or Citiworks?)	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-5	ROP	Need to provide an "end of shift" activity report for each ROP driver/unit.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-6	ROP	Provide ROP drivers with remote access to CapTOP from a Laptop computer.	2	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-7	ROP	ROP actions/requests should be entered into incident/event record log. Need time stamp for activities that include: 1) initiation of call, 2) arrival on scene, 3) verification of incident details, 4) status updates to TMC, 5) departure from scene,	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	ROP-8	ROP	ROP drivers need to notify TMC when they arrive at a location, communicate details about the incident, request assistance/equipment/resources, note when resources arrive and depart, and document changes in status and other activities/events relevant to traffic management for the incident.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	ROP-9	ROP	ROP needs easier means of communicating with TMC operators for reporting (checking) in at various stages such as arrival at a scene, updates, departure, requests for resources, etc.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	RTC-1	RTC	Need more structured way to ask for help with VMS from VDOT and MD. Currently TMC Operators must make phone calls. Need to use various electronic means such as e-mail, message board, and web access to speedup and smooth the process, track when the request was made, and receive response –about availability of VMS (e.g. that it can be done), and then to notify VDOT/MD when message is no longer needed.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
ITS	RTC-10	RTC, C2C	Interfaces with other partners should be through a “common interface” --that does not need to be customized for each partner (other than defining user rights).	2	SL-5
ITS	RTC-11	RTC, C2C	Need to be able to share information, cooperate and coordinate with both “internal” and “external” partners	1	SL-5
TO	RTC-12	RTC, C2C	Need to build on the existing network and establish communication paths for traffic/incident related video and data between the regional transportation agencies: VDOT, MDOT, DDOT, MWCOG, emergency management agencies	1	SL-5
ITS	RTC-13	RTC, C2C, SEPM	Need interface with VDOT and MDOT to be able to identify the locations and status of DMS in Maryland and Virginia that may be available to support special event management and what their messages are through GIS map of CapTOP.	1	SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	RTC-14	RTC, DWA	Need to send electronic "requests" to VDOT, CHART when use of DMS and other devices may be needed. System should log time request made, verify receipt of message, and response to DC request.	1	SL-5
OT	RTC-15	RTC, DWA, C2C	Need an automated way to share data and information with other agencies.	1	SL-5
OT	RTC-16	RTC, DWA, SYS	Need regional GIS standards for accessibility and sharing information in a GIS format.	1	SL-5
OT	RTC-17	RTC, EM, C2C	Need to support regional (DC Metro area) video surveillance and detection system for both traffic and security monitoring purpose	2	SL-5
OT	RTC-18	RTC, EM, CMM	Need to provide features to coordinate with the various District agencies, private utilities, federal and regional agencies, and private interests to determine status of construction and other work developments that could impact traffic along designated emergency routes, gateways, and regional routes.	1	SL-5
ITS	RTC-19	RTC, EM, IM, SEPM	Need interface with other agencies (e.g. EMA) to support implementation of evacuation plans/strategies, changes in traffic patterns for special events, and weather-based issues (such as flooding, ice, trees down, or other hazards on roadways where these capabilities may be available)	1	SL-5
TO	RTC-2	RTC	Need to establish interagency transportation network for information sharing.	2	SL-5
TO	RTC-20	RTC, MMC	Need to bring video detection images back to TMC and to share these images with other agencies.	1	SL-5
MS	RTC-21	RTC, MMC	Need to provide the capabilities that support online teleconferencing with video (e.g. virtual round-table discussions) for team members during emergencies when they cannot be in the same location.	2	SL-5
ITS	RTC-22	RTC, TID	Need to be able to easily and effectively cooperate with regard to traveler information about incidents/events in DC before drivers reach DC (and vice versa).	1	SL-5
SO	RTC-23	RTC, WEM	Need regional coordination on weather incident management with Virginia and Maryland.	2	SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
OT	RTC-24	RTCM, MMC, DDM	Need to share device status, including: communications status (connected, disconnected, failed); operational status (working, not-available); and current operational state information (mode of operation), among TMC staff (operators, maintenance technicians, and managers) and DDOT agencies (e.g. snow removal and EMA)	2	SL-5
MS	RTC-3	RTC	Need to provide a more formalized, structured means of making requests for cooperation and support between DC and neighboring jurisdictions. One example - requests to display messages on VMS to drivers approaching DC.	1	SL-5
TO	RTC-4	RTC	Need to provide communications with other systems such as CHART to get traffic information (traffic direction, capacity, etc.)	1	SL-5
OT	RTC-5	RTC	Need to support integrated regional traffic control coordination between freeways in VDOT and MDOT and surface street traffic control (DDOT)	2	SL-5
TO	RTC-6	RTC	Provide electronic (e-mail or message board) process for TMC Operators to request use of DMS in VA and MD.	2	SL-5
TO	RTC-7	RTC	TMC Operators share video feeds (fixed frame images and video streaming) with responders, other government agencies, and non-government users (media)..	1	SL-5
ITS	RTC-8	RTC, C2C	Need to link/interface with CapWIN for exchange traffic/incident information	1	SL-5
OT	RTC-9	RTC, C2C	Need to support information sharing and integration with MDOT, DDOT, and WMATA.	2	SL-5
TO	SEPM-1	SEPM	Create "notification" distribution list(s) of everyone who should receive regular electronic updates during the special event.	1	SL-3, SL-5
TO	SEPM-10	SEPM	Estimate staff and equipment resources needed to support special event traffic management	2	SL-3, SL-5
TO	SEPM-11	SEPM	Identify and track available resources for TMC Operators and other involved in implementing traffic plans and managing traffic elements during the event	1	SL-3, SL-5
TO	SEPM-12	SEPM	Maintain a detailed log for all actions/activity associated with the event. All log entries should show time stamp and who took an action.	1	SL-3, SL-5
TO	SEPM-13	SEPM	Need feature to deal with multiple events take place at the same time at different places in the city, and to support for managing resources, and developing strategies for multiple events, that may impact each other.	1	SL-3, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	SEPM-14	SEPM	Need information about key Points of Contact/assignments from various agencies and organizations relevant to the special events of all types.	1	SL-3, SL-5
ITS	SEPM-15	SEPM	Need interface to access to POCs for agencies/others involved in responding to/managing incidents.	1	SL-3, SL-5
TO	SEPM-16	SEPM	Need to be able to enter detailed information about transportation/traffic management impacts for special events into CapTOP. Including estimates of attendance.:	1	SL-3, SL-5
TO	SEPM-17	SEPM	Need to be able to send and receive instant messages (IM) to other users (internal or external).	1	SL-3, SL-5
TO	SEPM-18	SEPM	Need to change and update transportation messages for HAR and DMS before, during, and at end of event.	1	SL-3, SL-5
TO	SEPM-19	SEPM	Need to create a detailed, comprehensive Point of Contact list for each event --that includes organizers, contacts at event venue(if appropriate), and individuals in various DC agencies and their responsibilities during each event.	1	SL-3, SL-5
TO	SEPM-2	SEPM	Need to create a library of plan "elements" that can be selected from a menu, for different types of events and different locations.	1	SL-3, SL-5
TO	SEPM-20	SEPM	Need to create approved special event record including information about planned (future) events that have been approved by Mayor's committee	1	SL-3, SL-5
MS	SEPM-21	SEPM	Need to develop, evaluate, implement special signal timing plans for special events.	2	SL-3, SL-5
TO	SEPM-22	SEPM	Need to establish a detailed "schedule" of actions and assignments for the day of the event, that includes times preparations start, specific milestones during the event, when the event will end, and when traffic should be restored to normal operation.	1	SL-3, SL-5
TO	SEPM-23	SEPM	Need to identify cameras/devices that should be checked more frequently by TMC Operators during event.	2	SL-3, SL-5
TO	SEPM-24	SEPM	Need to provide a checklists based on SOPs and/or traffic management plans for special events to guide operators through sequence/priority of activities.	1	SL-3, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	SEPM-25	SEPM	Need to provide decision support and resources to guide TMC operators through processes and procedures associated with a wide range of special events.	1	SL-3, SL-5
TO	SEPM-26	SEPM, C2C	Need communications and information connection to Unified Command Unit (i.e. link to QuicNet or camera images).	1	SL-3, SL-5
TO	SEPM-27	SEPM, C2C	Need real-time transit information (e.g. bus location and passenger) at special event locations.	1	SL-3, SL-5
TO	SEPM-28	SEPM, C2F	Need up-to-date information about the location and status of portable VMS (including where portable devices are based) in DC and even about VMS operated by VDOT or CHART of SHA that could inform drivers headed into the city.	1	SL-3, SL-5
MS	SEPM-29	SEPM, DDM	Need to be able to query or determine status/location of equipment/resources needed for special event operations.	1	SL-3, SL-5
TO	SEPM-3	SEPM	Need to provide Operators with quick access to points of contact/staff assignments for each event.	1	SL-3, SL-5
MS	SEPM-30	SEPM, DOC	Need to automatically identify/partition signals, cameras, and other devices that may be part of special events management for specific events.	1	SL-3, SL-5
MS	SEPM-31	SEPM, DOC	Need to be able to “lock” or “dedicate” specific kinds of resources for use in support of specific events.	1	SL-3, SL-5
MS	SEPM-32	SEPM, DOC	Need to be able to help operations staff “leverage” ITS devices that may be needed to supports specific types of events, and for different venues.	1	SL-3, SL-5
ITS	SEPM-33	SEPM, DWA	Need ability to develop and generate reports that would address questions and requests for post-event information that often come from the media or from elected officials.		SL-3, SL-5
ITS	SEPM-34	SEPM, DWA	Need functions to track and present information related to DDOT personnel and other costs associated with supporting special events. This capability is a high priority for DDOT.	1	SL-3, SL-5
ITS	SEPM-35	SEPM, DWA	Need to archive or store the traffic control plans that are retrievable and available for reuse for similar future incidents.	1	SL-3, SL-5
ITS	SEPM-36	SEPM, DWA	Need to archive traffic/transportation management plans (and plan elements) as a resource to be refined over time or be used as knowledge.	1	SL-3, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	SEPM-37	SEPM, DWA	Need to be able to send text messages or email alerts and logs to DDOT departments as well as to external agencies.	1	SL-3, SL-5
ITS	SEPM-38	SEPM, DWA	Need to gather and archive special event information needed to refine plans (including costs and resources needed) for recurring special events based various factors (day of week, etc). Examples include National stadium. Document information needed to assess and demonstrate staffing needs.	1	SL-3, SL-5
ITS	SEPM-39	SEPM, DWA	Need to generate post-event report that would include resources needed to manage event (staff hours, equipment resources, etc), statistics about the event that would help assess how well traffic management strategies worked, identify successes and needed areas for improvement).	1	SL-3, SL-5
TO	SEPM-4	SEPM	Need to record information about special events including type of event, key contacts, traffic management strategy, setup time, event time, take-down time, and more.	1	SL-3, SL-5
ITS	SEPM-40	SEPM, DWA	Need to generate the special event reports that provide information with regards to the number of events over a specified time period, the number of events of a particular type, the number of resources (e.g., DDOT employees, equipment, etc.), etc.	1	SL-3, SL-5
ITS	SEPM-41	SEPM, DWA	Need to log the actions and “commands” of TMC operators during management of traffic for special events.	1	SL-3, SL-5
ITS	SEPM-42	SEPM, DWA	Need to record special event date in CapTOP database including event ID, description, start date/time, end date/time, # of DDOT employees involved, #signs used, #cones used, the type and quantity of other equipment used.	1	SL-3, SL-5
ITS	SEPM-43	SEPM, DWA	Track and archive information on about the actual activities, resources used, staff involved, for specific events		SL-3, SL-5
ITS	SEPM-44	SEPM, DWA, PM	Need to collect and log special event information to support post-event analysis and performance measures.	1	SL-3, SL-5
ITS	SEPM-45	SEPM, DWA, TDCA	Need to capture and archive information about transportation demand, traffic conditions, and other data during special events, to learn about the characteristics/needs of specific events, and as the basis for performance measures.	2	SL-3, SL-5
TO	SEPM-46	SEPM, GUI	Allow Operators to "update" status if conditions change unexpectedly.	1	SL-3, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	SEPM-47	SEPM, GUI	Need a map interface to show the specific locations where are expected to be closed and/or re-opened.	1	SL-3, SL-5
TO	SEPM-48	SEPM, GUI	Need a map-based interface to identify location of special event and location(s) impacted by event.	1	SL-3, SL-5
TO	SEPM-49	SEPM, GUI	Need GIS map interface to display special event locations/routes and details about the events that affect transportation (road closures, parking restrictions etc) available for TMC Operators and others.	1	SL-3, SL-5
TO	SEPM-5	SEPM	Need to store and pull up staffing assignments and points of contact for planned special events.	1	SL-3, SL-5
ITS	SEPM-50	SEPM, GUI	Need map interface to display the routes for events like charity walks, runs, bicycles; as well as updates on locations/issues related to demonstrations for use by TMC and other involved in planning and managing event. .	1	SL-3, SL-5
TO	SEPM-51	SEPM, GUI	Need map-based interface to display status (location) along expected routes for "moving" events (walks or runs).	2	SL-3, SL-5
ITS	SEPM-52	SEPM, GUI	Need map-based interfaces to identify and display the locations of a special event (e.g., if a marathon, identify the course), no parking areas, DMSs, traffic cones/barriers with attributes such as the linear feet and number of required cones, traffic control officers, the command vehicles (e.g., MPD, Fire) and media vehicles.	1	SL-3, SL-5
ITS	SEPM-53	SEPM, GUI	Need to display traffic control strategies and changes in traffic circulation (e.g. road closures, turn restrictions) on map for special events planning.	1	SL-3, SL-5
TO	SEPM-54	SEPM, GUI	Need to provide on-line access to details about planned events (location, type of event, duration of event, start them and end time, etc) to different types of users.	2	SL-3, SL-5
ITS	SEPM-55	SEPM, GUI, TID	Need to make maps illustrating information for the public about traffic plans/impacts ahead of time. Information for those who are attending and those who want to avoid the area.	2	SL-3, SL-5
TO	SEPM-56	SEPM, IM	Need quick, effective, on-line access to information regarding all elements of special events to reduce TMC Operators reliance on hard-copy notebooks with information about contacts and SOPs for various types of planned and unplanned incidents.	1	SL-3, SL-5

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	SEPM-57	SEPM, IM	Need to develop incident response or special event plans on an off-line system, perform dry runs or simulation	1	SL-3, SL-5
TO	SEPM-58	SEPM, MMC	Need interface with MPD and EMA to support Mobile Command Unit	1	SL-3, SL-5
TO	SEPM-59	SEPM, MMC	Need interface with transit agencies to collect info about bus ingress and egress routes.	2	SL-3, SL-5
ITS	SEPM-6	SEPM	Need to support for implementation of special event plans and traffic control strategies	1	SL-3, SL-5
TO	SEPM-60	SEPM, MMC	Need to disseminate information/status for specific events (alerts and updates) to specific groups (distribution lists) appropriate for each planned event.	1	SL-3, SL-5
TO	SEPM-61	SEPM, PM	Need to collect and archive information needed to refine response plans (including costs and resources needed) for recurring special events based various factors (day of week, etc), and to assess and demonstrate staffing needs.	1	SL-3, SL-5
TO	SEPM-62	SEPM, PM	Need to create post-event report that includes resources needed to manage event (staff hours, equipment resources, etc), statistics about the event that would help assess how well traffic management strategies worked, identify successes and needed areas for improvement).	1	SL-3, SL-5
ITS	SEPM-63	SEPM, TID	Need to disseminate traveler special event information using HAR and DMS	1	SL-3, SL-5
ITS	SEPM-64	SEPM, TOM	Need to monitor and support use of traffic control strategies involving lane controls, reversible lanes, and turning restrictions during special events	1	SL-3, SL-5
ITS	SEPM-7	SEPM	Need to support in generating response plans for special events. The response plans could be knowledge or rule based.	1	SL-3, SL-5
TO	SEPM-8	SEPM	Need track the activities of mobile special event units (or mobile command unit) dispatched to conduct traffic management and control.	1	SL-3, SL-5
TO	SEPM-9	SEPM	Provide TMS Operators with a list of special events (of all types) planned/underway when their shift begins. Locations of events and areas impacted shown on map.	1	SL-3, SL-5
MS	SIG-1	SIG	Need to provide access to or share information about signal status (cycle lengths, etc) on specific routes	2	TCD-1

Stakeholder	Number	Area	Description	Priority	Use Cases
MS	SIG-2	SIG, C2F	Need to receive and track the operation status of transit signal priority.	2	TCD-1
TO	SIG-3	SIG,GUI,DOC,DDM	Need map interface with QuicNet to show camera/traffic signal locations and monitor their status	1	TCD-1
ITS	SMM-1	SMM	Need electronic guard to control system access including role- and user-based access	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
MS	SMM-10	SMM	Need to address software and system maintenance and support needed for an expanded CapTOP	2	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-11	SMM	Need to be able to create, remove and make changes to user accounts.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
MS	SMM-12	SMM, DOC, SYS	Interface needs to accommodate integration of future upgraded ITS devices (e.g. moving to 2070 controllers)	2	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
OT	SMM-13	SMM, DWA	Need to support data security including authentication of data source and permission class.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-14	SMM, SYS	Need the CapTOP system that is stable and reliable (i.e., it does not crash), especially under peak load.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-15	SMM, SYS	Need to be able to administer the system remotely.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
TO	SMM-16	SMM, SYS	Need to integrate or streamline data entry into various systems (QuicNet, Hansen, other ITS device servers) through unified interfaces.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-17	SMM,DWA, SYS	Need a backup system that will not lose database records or transactions in case of a crash.	2	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-2	SMM	Need to be able to easily maintain, upgrade, configure and add software and devices to the new system.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-3	SMM	Need to be able to grant or restrict permission to different system functions and modules by user or user group.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-4	SMM	Need to be able to track user activity, including when users log onto and off of the system, and what actions they performed while logged on.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-5	SMM	Need to document all system activities including upgrades, configuration, troubleshooting and general maintenance.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-6	SMM	Need to provide different levels of access to different users based on user roles (operator, supervisor, and maintenance technician)	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	SMM-7	SMM	Need to support multiple user levels, including system administrator, manager, supervisor, TMC operator, maintenance technician, ROP driver	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-8	SMM	Need to support software security for user access control with specific rights assigned to different types of users, and to provide for tailored user access privilege for different user groups, that include (but are not limited to) technicians, operators, management, and others.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SMM-9	SMM	System administrators need to be automatically notified if the system goes down.	1	MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7
ITS	SYS-1	SYS	All new devices added to TMC need to be NTCIP compliant for center to center and center to field communications.	1	All Use Cases
ITS	SYS-10	SYS, GUI	CapTOP should provide interfaces in two ways; Windows-based interfaces that can be accessed from TMC workstations and web-based interfaces that can be accessed remotely.	1	All Use Cases
ITS	SYS-11	SYS, GUI	Need web-based interface to allow access to CapTOP from remote locations	2	All Use Cases
ITS	SYS-12	SYS, SMM	Need system admin to be able to maintain and troubleshoot the CapTOP.	1	All Use Cases
TO	SYS-2	SYS	Integrate training/skills development to support CapTOP implementation and use, as well as operational subsystems (e.g. incident management)	1	All Use Cases
ITS	SYS-3	SYS	Need a backup ATMS system to maintain operations capability even if the system goes down.	1	All Use Cases
ITS	SYS-4	SYS	Need a highly modular open system with a well-defined and documented application programming interface (API) or protocol interface to facilitate integration with external systems, including commercial off-the-shelf (COTS) components.	1	All Use Cases
ITS	SYS-5	SYS	Need build-in or online help capabilities to support training CapTOP users	1	All Use Cases
ITS	SYS-6	SYS	Need CapTOP system made up of components that are modulized and open-architecture system	1	All Use Cases
ITS	SYS-7	SYS	Need CapTOP to be open and modulized system that be able to accommodate legacy systems and to facilitate integration of new systems	1	All Use Cases

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	SYS-8	SYS	Need to provide the interfaces that serve for integration of various underlying software applications of ITS devices and subsystems, including QuicNet, Hansen, CitiWorks, contractor work-order tracking system (for signal maintenance), and future applications	1	All Use Cases
ITS	SYS-9	SYS	Need to take an event-driven approach to develop CapTOP that especially incorporate event response planning, event tracking and recording, and event visualization	1	All Use Cases
ITS	TDCA-1	TDCA	Need streamline process to collect and format traffic and incident data for direct use in analysis applications such as Synchro.	2	TEN-1
ITS	TDCA-2	TDCA	Need to import formatted data from controllers and other devices and then "package" data for different applications and users.	2	TEN-1
ITS	TDCA-3	TDCA, GUI	Need interface with detection stations (128) to get and display traffic speed, volume, and occupancy data.	1	TEN-1
ITS	TDCA-4	TDCA, GUI	Need map interface with SpeedInfo to receive and display speed data by XML (50 solar-powered radar detectors supported by SpeedInfo provide speed data every 15 seconds to DDOT using XML schema).	1	TEN-1
ITS	TDCA-5	TDCA, GUI	Need web-based interface with Traffic.com to get and display speed, volume, occupancy, and classification data.	1	TEN-1
ITS	TID-1	TID	Need an automated system to alert other agencies and media of incidents, weather conditions, emergencies, and other events affecting roadway operations	1	TCD-2, TCD-3, TCD-4, MGR-1
TO	TID-10	TID, DOC	Allow TMC Operators to add, remove, or change a message on fixed DMS through CapTOP.	1	TCD-2, TCD-3, TCD-4, MGR-1
TO	TID-11	TID, DOC	Allow TMC Operators to view and verify current message on a portable DMS.	1	TCD-2, TCD-3, TCD-4, MGR-1
TO	TID-12	TID, DOC	Allow TMC Operators to view and verify the current message on fixed DMS from CapTOP interface..	1	TCD-2, TCD-3, TCD-4, MGR-1
TO	TID-13	TID, DOC	Ensure that messages on both of DMS and HAR within DC are consistent.	1	TCD-2, TCD-3, TCD-4, MGR-1
MS	TID-14	TID, DOC	Need libraries of messages for use with HAR and DMS	1	TCD-2, TCD-3, TCD-4, MGR-1
MS	TID-15	TID, DOC	Need to coordinate (ensure consistency) of information posted via HAR and DMS	1	TCD-2, TCD-3, TCD-4, MGR-1

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	TID-16	TID, IM	Need to provide direct access to appropriate information for specific outside users before and during events, and during the recovery period to reduce the need for TMC operators to answer specific types of questions repeatedly and personally.	1	TCD-2, TCD-3, TCD-4, MGR-1
TO	TID-17	TID, IM	Need to provide or suggest message options based on characteristics/severity/details of incident/event.		TCD-2, TCD-3, TCD-4, MGR-1
TO	TID-18	TID, RTC	Coordinate consistency of messages displayed in DC, MD and VA (when appropriate).	1	TCD-2, TCD-3, TCD-4, MGR-1
ITS	TID-2	TID	Need to alert motorists of problem areas and provide users with travel time information.	1	TCD-2, TCD-3, TCD-4, MGR-1
TO	TID-3	TID	Need to be able to post traveler information about routes, road closures, congestion or other transportation-related information for pre-planned events, construction, maintenance, incidents, and emergencies on webpage	2	TCD-2, TCD-3, TCD-4, MGR-1
ITS	TID-4	TID	Need to disseminate traveler information to three different kinds of "customers", travelers within DC, travelers who are either passing through, and travelers with either an origin or destination in DC and traveling to, from (or through) VA or MD.	1	TCD-2, TCD-3, TCD-4, MGR-1
ITS	TID-5	TID	Need to distribute or traffic information to other agencies/partners involved in planning, conducting, and managing incidents (WMATA, Regional partners, DDOT management, elected officials, Media and the general public)	2	TCD-2, TCD-3, TCD-4, MGR-1
TO	TID-6	TID	Need to post, remove, and schedule HAR messages from a HAR message library.	1	TCD-2, TCD-3, TCD-4, MGR-1
TO	TID-7	TID	Need to provide updates/information to local media (those familiar with DC), and for press/media from other places (and other countries).	1	TCD-2, TCD-3, TCD-4, MGR-1
TO	TID-8	TID, DOC	Need to maintain a library of DMS messages with the ability to add, edit and delete messages.	1	TCD-2, TCD-3, TCD-4, MGR-1
MS	TID-9	TID, DOC	Need to remind or alert TMC staff to change messages when conditions change	1	TCD-2, TCD-3, TCD-4, MGR-1

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	TOM-1	TOM	Need an interface with QuicNET to monitor traffic signals and access partial functions	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	TOM-2	TOM	Need to provide activity reports for individual operators, for shifts, and for daily activities	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
ITS	TOM-3	TOM, DOC	Need interface to verify status of all active devices supporting reversible lanes (may be through interface with QuicNet) and/or visual verification through CCTV	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	TOM-4	TOM, DWA	Need features to generate traffic reports linked to live traffic web	2	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3

Stakeholder	Number	Area	Description	Priority	Use Cases
ITS	TOM-5	TOM, GUI	Need a map interface to display and monitor time-based operations on roadways including reversible lane facilities and lane/turning restrictions	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
ITS	TOM-6	TOM, GUI	Need map interface to identify locations and current configuration for reversible lanes and other time-based traffic regulations and restrictions	2	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	TOM-7	TOM, GUI	Need to display color-coded maps that reflect real-time traffic conditions	2	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
ITS	TOM-8	TOM, MMC	Needs interface to receive the request from the transit agency and direct QuicNet to set signals	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3

Stakeholder	Number	Area	Description	Priority	Use Cases
OT	TOM-9	TOM, RTC	Need to coordinate with its regional counterparts regarding traffic-signal timing and overall surface-street strategies to ensure consistency.	1	TMD-1, TMD-2, TMD-3, TCD-1, TCD-2, TCD-3, TCD-4, TCD-5, TCD-6, TCD-7, SL-1, SL-5, SL-6, MGR-1, MGR-2, MGR-3, MGR-4, MGR-5, MGR-6, MGR-7, TEN-1, TEN-2, TEN-3
TO	WEM-1	WEM	Interface to receive and display data from ScanWeb	1	SL-4, MISC-5
TO	WEM-10	WEM	Need interface to access and view atmospheric and road weather-related information from RWIS	1	SL-4, MISC-5
ITS	WEM-11	WEM, C2C	Need interface with StormTrak system through CapTOP to view roadway condition.	1	SL-4, MISC-5
SO	WEM-12	WEM, GUI	Need interface with StormTrak system to exchange information.	2	SL-4, MISC-5
ITS	WEM-13	WEM, GUI	Need map interface through CapTOP to display Snow Operation routes and status (need for treatment, when last treated, etc).	2	SL-4, MISC-5
ITS	WEM-14	WEM, GUI	Need map interface to display/track location of snow removal vehicles by AVL, display assigned snow removal routes on map.	2	SL-4, MISC-5
TO	WEM-2	WEM	Need interface with snow management system (StormTrak) to track snow event	2	SL-4, MISC-5
TO	WEM-3	WEM	Need real-time weather related information.	1	SL-4, MISC-5
TO	WEM-4	WEM	Need RWIS provider to notify operators when temperature conditions fall below a specific level.	2	SL-4, MISC-5
TO	WEM-5	WEM	Need to provide rated roadway conditions reports for Snow Operations every 20 – 30 minutes. The weather conditions of roadways were identified by Observations made through looking at cameras are based on the videos from 128 cameras and 5 RWIS.	1	SL-4, MISC-5
TO	WEM-6	WEM	Need to provide roadway condition video clip to snow center for confirming status of roadways (plowed/not plowed) on request.	1	SL-4, MISC-5
TO	WEM-7	WEM	Need to track and view AVL-equipped snow plow vehicles and routes on the GIS map.	2	SL-4, MISC-5
SO	WEM-8	WEM	Need to use DMS during snow events.	2	SL-4, MISC-5

Stakeholder	Number	Area	Description	Priority	Use Cases
TO	WEM-9	WEM	Needs interface to receive and display data from RWIS	1	SL-4, MISC-5