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USDOT Integrated Corridor Management (ICM) Initiative

System Requirement Specification for the I-270 Integrated Corridor Management System (ICMS) in Montgomery County, Maryland

March 31, 2008
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U.S. Department of Transportation
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Integrated Corridor Management Program

Maryland I-270 Corridor

System Requirements Specification

Stage 1 Final

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In association with

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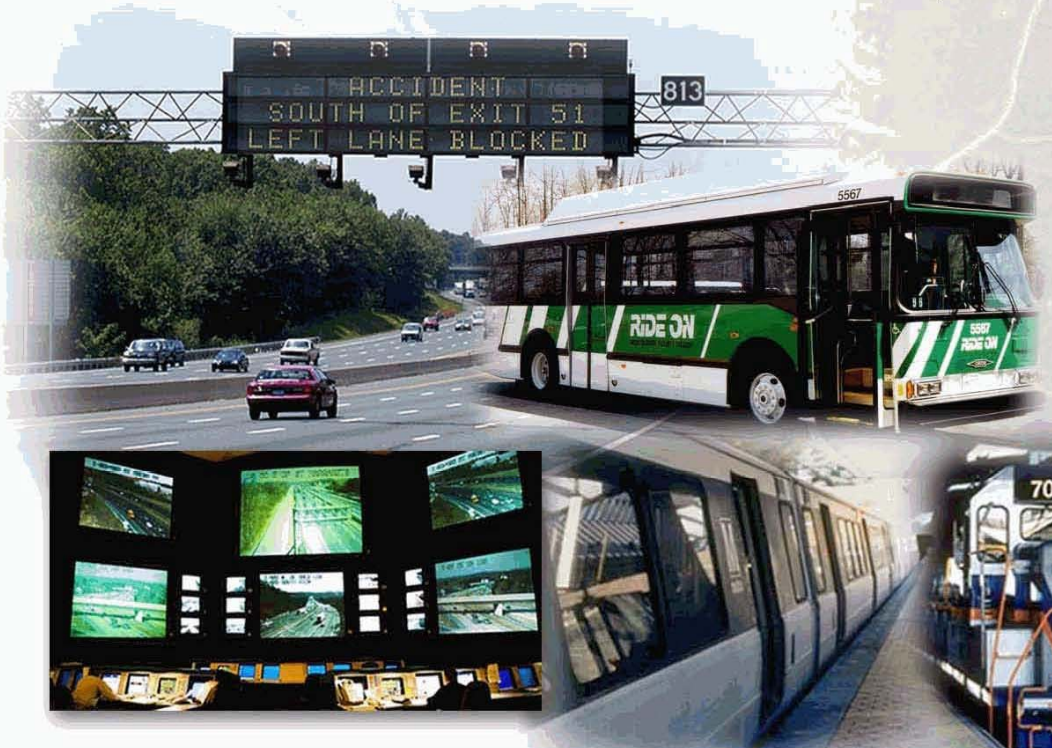

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16. Abstract

This document presents a revised System Requirements Specification (SyRS) for an Integrated Corridor Management (ICM) System along the Interstate-270 Corridor in Montgomery County, Maryland. It provides a description of the planned ICM System and delineates high-level and detailed requirements for the system. Section 1 introduces the document, provides background information on the I-270 ICM corridor, and defines the purpose and scope of the System Requirements Specification. Section 2 provides a general description of the planned I-270 Integrated Corridor Management System (ICMS), including the overall context of the system, major system capability groupings, user characteristics, and examples of how the system will be used. Section 3 provides a summary of the physical attributes of the system, performance characteristics, security, information management, operational factors, applicable organizational policies, and system performance evaluation factors. Section 4 summarizes the requirements for the interfaces among different components of the system and defines the types of data to be collected and stored in the system. Section 5, the predominant portion of this document, presents the I-270 ICMS needs and detailed requirements.

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1. Introduction

This document presents a revised System Requirements Specification (SyRS) for an Integrated Corridor Management (ICM) System along the Interstate-270 Corridor in Montgomery County, Maryland. It provides a description of the planned ICM System and delineates high-level and detailed requirements for the system.

The document was prepared for the U.S. Department of Transportation (USDOT) under the Integrated Corridor Management Program (Cooperative Agreement No. DTFH61-06-H-00042). It was developed by the Maryland Department of Transportation in association with Montgomery County and the Washington Metropolitan Area Transit Authority. Telvent Farradyne Inc. and the University of Maryland's Center for Advanced Transportation Technology assisted with the preparation of this report.

The document is organized as follows:

- Section 1 introduces the document, provides background information on the I-270 ICM corridor, and defines the purpose and scope of the System Requirements Specification.
- Section 2 provides a general description of the planned I-270 Integrated Corridor Management System (ICMS), including the overall context of the system, major system capability groupings, user characteristics, and examples of how the system will be used.
- Section 3 provides a summary of the physical attributes of the system, performance characteristics, security, information management, operational factors, applicable organizational policies, and system performance evaluation factors.
- Section 4 summarizes the requirements for the interfaces among different components of the system and defines the types of data to be collected and stored in the system.
- Section 5, the predominant portion of this document, presents the I-270 ICMS needs and detailed requirements.

1.1 I-270 ICM Corridor Boundaries, Networks, and Stakeholders

A comprehensive description of the I-270 Corridor is provided in the Maryland I-270 ICMS Concept of Operations (ConOps) document, dated June 18, 2007, and is summarized below.

The I-270 Corridor is located in Montgomery County, Maryland just outside Washington, D.C. The corridor measures approximately 20 miles in length and consists of a variety of transportation networks, including:

- The Freeway Network (including I-270),
- The Arterial and Connector Route Network (including MD-355),
- The MARC Commuter Rail Network,
- The Metrorail Network,
- The MTA Commuter Bus Network,
- The Metrobus Network, and
- The Ride On Local/Commuter Bus Network.

A map of the I-270/Montgomery County Corridor is presented in Figure 1 on the following page. The major boundaries of the corridor include the following:

- Northern Boundary – The Frederick County/Montgomery County Line;
- Southern Boundary – I-495 (Capital Beltway);
- Western Boundary – South to north: River Road, Falls Road, Wooten Parkway, Great Seneca Highway, and the MARC Brunswick Line; and
- Eastern Boundary – South to north: Viers Mill Road, MD-355, Shady Grove Road, Airpark Road, and Woodfield Road.

The corridor is part of the broader Metropolitan Washington Council of Governments (MWCOG) region.

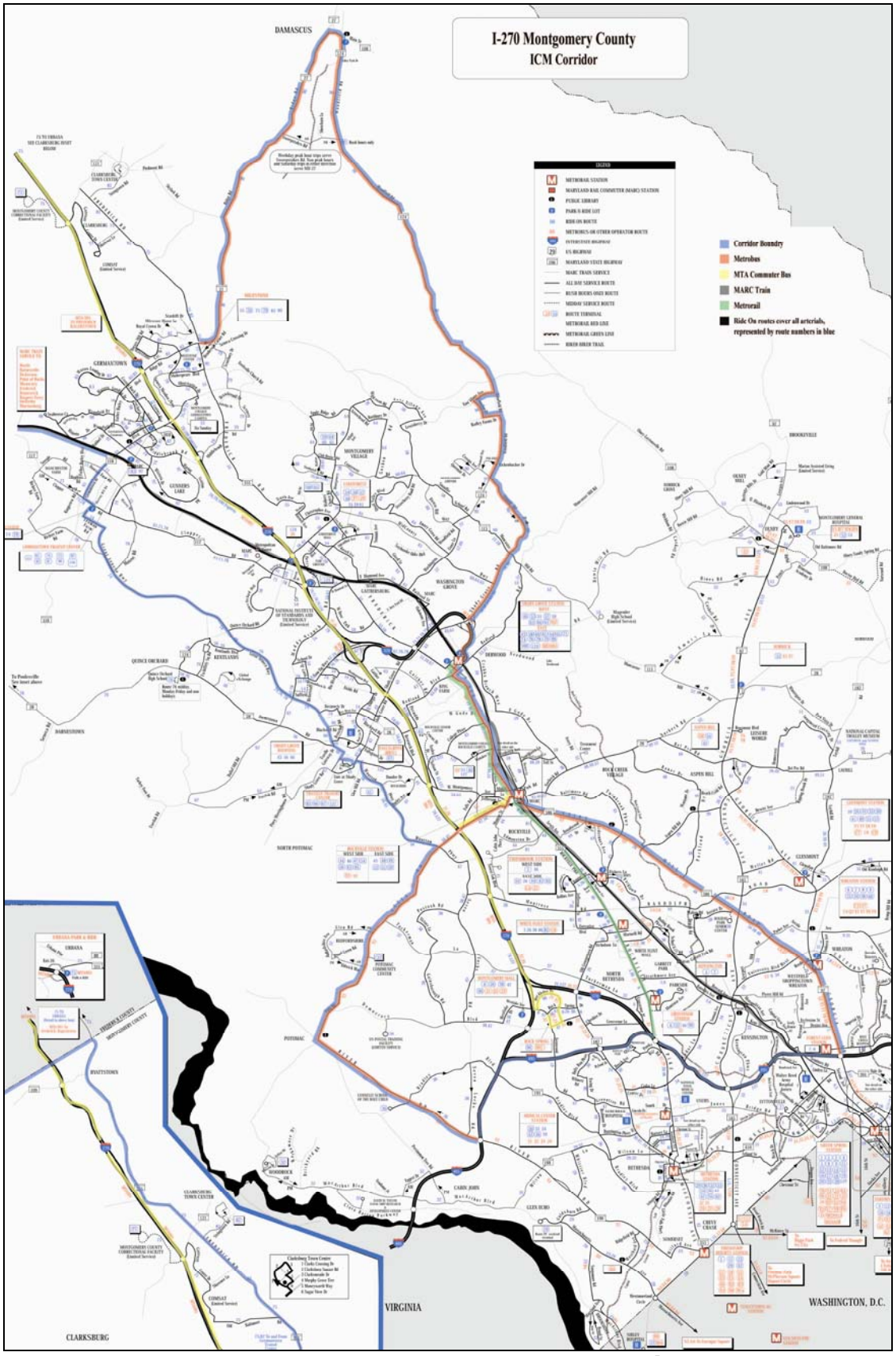

Figure 1 – I-270 Montgomery County ICM Corridor Map

Image Source: Montgomery County Department of Public Works and Transportation

Key stakeholders in the I-270 Corridor are identified in Table 1, below.

Table 1 – I-270 Corridor Stakeholders

Partnering Agencies

Agencies partnering for Phase I of the U.S. Department of Transportation's (USDOT) Discretionary Cooperative Agreement for Integrated Corridor Management include:

- Federal Highway Administration (FHWA)
- Federal Transit Administration (FTA)
- Research and Innovative Technology Administration (RITA)
- Maryland State Highway Administration (MDSHA)
- Maryland Transit Administration (MTA)
- Montgomery County Department of Public Works and Transportation (DPWT)
- The University of Maryland (UMD)
- Washington Metropolitan Area Transit Authority (WMATA)

Stakeholders

Other agencies with a stake in the outcome of the USDOT's Discretionary Cooperative Agreement for Integrated Corridor Management of the I-270 Corridor include:

- City of Gaithersburg
- City of Rockville
- Commercial Vehicle Companies
- CSX Rail
- Event Promoters
- Federal Emergency Management Agency
- Frederick County Department of Public Works and Transportation
- General Public
- Maryland Emergency Management Agency (MEMA)
- Maryland National Capital Park and Planning Commission (MNCPPC)
- Maryland State Police (MSP)
- Maryland Transportation Authority (MdTA)
- Metro Transit Police

- Montgomery County Fire and Emergency Medical Services (EMS)
- Montgomery County Police
- Montgomery County Public Schools (MCPS)
- National Capital Region Transportation Planning Board
- National Institute of Standards and Technology (NIST)
- North Bethesda Transportation Management District
- Private Sector Information Service Providers
- Regional Media Outlets
- Towing Industry
- University of Maryland Center for Advanced Transportation Technology
- United States Department of Energy (DOE)
- Virginia Department of Transportation (VDOT)
- Traveling Public

1.2 System Purpose

The overall purpose of the Maryland I-270 ICM System (ICMS) is to achieve the goals and objectives set forth in the I-270 ICM Concept of Operations in a manner that will ensure the combined stakeholder vision of having transportation operations within the I-270 ICM corridor operate at peak efficiency by optimizing the use of the capacities of the transportation modes in the corridor. For the I-270 ICMS to be successful, it is imperative that its development and operation be driven by the following ICM goals and related objectives[1]:

- **Optimize Mobility, Reliability, and Safety** by reducing overall trip and person travel-time; improving travel predictability and reliability; reducing the probability of secondary crashes by responding expeditiously to incidents; maximizing inter-modal activity (through enhanced inter-modal transportation system performance); empowering customers to make intelligent travel choices; and continuous measurement, monitoring, and assessment of transportation system performance.

- **Strengthen Corridor Level Decision Support** by upgrading the multi-modal system information exchange infrastructure and furnishing decision support tools that: optimize identification of incidents and adverse conditions; enhance the exchange of accurate, timely information among partners; emphasize corridor management and decision making based on data and factual circumstances; and improve rapid multi-modal response to changing traffic, incident, and weather conditions.

- **Enhance Reliable, Real-time Information to Customers** by expanding and standardizing the types of information available to travelers; emphasizing dissemination of real-time conditions and status data across modes; and furnishing adequate information to travelers so they can make informed travel decisions (on routing, modal shifts, etc.).

[1] These goals and objectives are summarized from Table 1-3 of the Maryland I-270 ICMS Concept of Operations, Revised Draft, June 18, 2007.

- **Promote Multi-Modal Transportation System Use** including increased used of transit by emphasizing bus and rail as practical alternatives to roadway travel; promoting park-and-riding and park-and carpooling; and simplifying inter-modal transfers.

The I-270 ICMS will focus on traveler and operations management decision support by emphasizing corridor transportation systems management, traveler information dissemination, and systems evaluation by leveraging, and improving upon, current data collection, fusion capabilities, and corridor transportation system integration. By consolidating, disseminating, and archiving transportation-related data from stakeholder agencies in the corridor, the I-270 ICMS will:

- provide improved information for a variety of purposes, including corridor transportation planning, management, traveler information, and emergency response;

- provide corridor transportation data fusion to allow an overall view of the corridor's transportation network;

- upgrade transportation data exchange capabilities of participating agency systems in the corridor as well as the region;

- upgrade the multi-modal transportation systems management capabilities of the stakeholder jurisdictions for corridor transportation operations;

- upgrade traveler information dissemination capabilities at the corridor system level;

- upgrade corridor multi-modal incident response and emergency preparedness capabilities; and

- provide the means to easily access corridor transportation data and produce corridor-level performance measures reports for decision makers.

1.3 System Scope

The system to be developed under the Maryland I-270 Integrated Corridor Management Program is the Maryland I-270 Integrated Corridor Management System (abbreviated as Maryland I-270 ICMS or I-270 ICMS as referred to throughout this document).

In determining the I-270 ICMS scope, it is important to consider the identified needs of the Maryland ICM stakeholders. The following are needs identified from the Maryland I-270 Concept of Operations that are specific to the I-270 ICMS. Note that these are system-specific needs as opposed to those that are not system related; for example, the need "update Freeway Incident Traffic Management (FITM) plans" is a non-technical coordination function. For a list of all needs, refer to the Maryland I-270 Concept of Operations.

<u>I-270 ICMS Data Collection and Data Fusion Needs</u>

- Need to collect transit, traffic, and other transportation data of regional interest from stakeholders in the corridor for use in enhancing regional traveler information and transportation management functions performed by member agencies.

- Need to define common data collection frequency intervals among all stakeholders for data standardization and timeliness purposes.

- Need to fuse collected transportation data into regional information to enhance regional traveler information and transportation management functions performed by member agencies.

I-270 ICMS Decision Support Needs

- Need tools and procedures to assist stakeholder agencies with operational decision-making for improved transportation management within the corridor.

- Need to provide suggested modifications to messages on traveler information field devices (e.g., Dynamic Message Signs (DMS), Highway Advisory Radio (HAR)) to owning agencies to ensure accurate corridor-wide information is provided to motorists.

I-270 ICMS Data Exchange/Dissemination Needs

- Need to exchange real-time information on road and transit conditions with the corridor's managing partners and stakeholders to improve transportation management efficiency and traveler information dissemination.

- Need to establish connections with key corridor stakeholders to automate data exchanges between the I-270 ICMS and external systems.

- Need a Communications System with sufficient capacity and speed to support real-time data exchanges with stakeholder systems.

- Need to use common definitions for all data elements exchanged between the different software central systems operated by the I-270 ICM stakeholders so that there is a clear, unambiguous understanding between the interfaced centers as to the meaning of these data.

- Need to utilize applicable Intelligent Transportation Systems (ITS) standards to achieve consistency among corridor stakeholder systems and improve overall corridor operations and maintenance efforts.

- Need to exchange data with corridor stakeholder agency systems in a secure manner.

- Need to log all data exchanges and alarm notifications for audit and evaluation purposes.

I-270 ICMS Traveler Information Dissemination Needs

- Need to expand corridor-wide information sharing to help disseminate reliable and real-time traveler information to commuters.

- Need on-demand access to information comparing travel times by automobile and transit in real-time to help travelers make better informed travel decisions.

- Need to provide travelers access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route, to enable travelers to make better informed travel decisions.

- Need to provide real-time, corridor-based traveler information to the media and other Advanced Traveler Information System (ATIS) providers via standards-based and standard data distribution interfaces to facilitate improved access to current transportation information.

- Need to provide pre-trip and en-route real-time corridor traveler information to travelers for access to up-to-date transportation information.

- Need to share notification-based information (e.g., incident alerts) that is accessible pre-trip and en-route to provide travelers with real-time access to information impacting the transportation network.

- Need to provide travel conditions at decision points to provide motorists with decision-making information, particularly travel times using one or another travel mode choice.

- Need to avoid releasing sensitive information to non-authorized information outlets so as not to disrupt transportation management operations or alarm the public unnecessarily.

- Need to provide travelers with reliable information in getting from one location to another location within the corridor.

I-270 ICMS Data Archiving and Data Analysis Needs

- Need to archive data for data mining and performance measuring purposes.

- Need corridor-level performance measures to determine the effectiveness of the I-270 ICM strategies and operations in comparison to corridor goals and objectives.

- Need reporting/query tools for data analysis and research purposes.

I-270 ICMS User Interface Needs

- Need a secure agency user interface available only to corridor stakeholder agency users for transportation management purposes.

- Need an easily accessible public user interface for traveler information purposes.

- Need a secure System Administration user interface for system configuration and maintenance purposes.

I-270 ICMS ITS Device Control and Monitoring Needs

- Need for traffic signals to be able to respond to changing conditions on affected arterials and adjacent roadways, including I-270, to maintain optimal traffic flow.

- Need to provide alarm notifications for incidents, etc. to stakeholder systems to improve transportation management operations.

- Need to coordinate with corridor stakeholder agencies in utilizing appropriate traveler information devices (DMS, HAR, 511) for broadcasting/displaying appropriate corridor transportation messages.

I-270 ICMS Needs – Other

- Need ICMS backup and restore capabilities to minimize system downtime.

- Need to operate in a 24x7 environment, as corridor transportation management needs to operate continuously.

- Need to automatically notify the System Administrator when a System failure occurs to minimize system downtime.

The I-270 ICMS will consist of a number of major sub-systems designed to address the above needs as follows:

- Data Collection Sub-System – Retrieves and stores raw corridor transportation network data from external stakeholder agency systems based on established data exchange interfaces. Data may include the following categories:
    - Event data
    - Work Zone data
    - Surveillance data (including video)
    - Transit-Specific data
    - Travel Options data
    - Parking data

- Data Fusion/Integration Sub-System – Organizes, correlates, and processes all collected corridor transportation network data for subsequent analysis and dissemination.

- Decision Support Sub-System – Analyzes processed transportation data to develop recommendations for improved traffic/transit management within the corridor.

- Data Dissemination Sub-System – Disseminates the following data to stakeholder agency systems within the corridor: (1) pertinent corridor transportation data that originated from other contributing external systems, and (2) recommendations for implementing coordinated traffic/transit management improvements.

- Traveler Information Dissemination Sub-System / Internal Information Service Provider – Disseminates processed corridor transportation information to the general public through various means, such as a web-based trip planner and e-mail/fax/pager-based subscription services.

- Data Archiving Sub-System – Archives raw and processed corridor transportation data for future data analysis.

- Data Analysis and Performance Measurement Sub-System – Provides capabilities for data analysis on collected corridor transportation data, including querying, reporting, performance measurement calculations, etc.

- User Interface Sub-System – Provides user interfaces for (1) stakeholder agencies to view and configure pertinent ICMS information and data exchange interfaces, (2) the public to view corridor traveler information processed through the ICMS, (3) ICMS operations staff to monitor and maintain the ICMS.

The I-270 ICMS will exchange data with several external corridor stakeholder agency systems (listed below) that will continue to perform traffic/transit management and ITS device control functions, but will operate collectively in a more coordinated fashion given the data provided to them by the ICMS. Note that the ITS field devices are NOT included within the ICMS scope as there will be no direct data exchange interfaces between the devices and the ICMS. Data exchanges will be in a single direction or bi-directional depending on the system.

- MD Coordinated Highways Action Response Team (CHART) Freeway System
- Montgomery County Advanced Transportation Management System (ATMS)

- Montgomery County Traffic Signal Control System (most likely an interface via the Montgomery County ATMS)
- Montgomery County Ride On Bus Computer-Aided Dispatch / Automatic Vehicle Location (CAD/AVL) System
- WMATA Metrorail Rail Operations Control System
- WMATA Metrobus CAD/AVL System
- MARC Commuter Rail CAD/AVL System
- WMATA Metrorail Parking Management System (prototype)
- MARC Commuter Rail Parking Management System (future system)
- Montgomery County Public Safety CAD/911 System
- MD State Police Computer-Aided Dispatch / Records Management System (CAD/RMS) (future system)
- Capital Wireless Information Net (CapWIN) System
- Emergency Operations Center Systems
- Third-Party Traffic Flow Data Systems
- Information Service Provider (ISP) Systems[2]

1.4 Definitions, Acronyms, and Abbreviations

Below is a list of acronyms referenced in this document.

Acronym	Description
ADMS	Archived Data Management System
ADUS	Archived Data User Services
APC	Automatic Passenger Counter
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information System
ATMS	Advanced Transportation Management System
AVL	Automatic Vehicle Location
BOCC	Bus Operations Control Center
CAD	Computer-Aided Dispatch
CapTOP	Capital Transportation Operations Platform
CapWIN	Capital Wireless Integrated Net
CATT	Center for Advanced Transportation Technology
CCTV	Closed Circuit Television
CHART	Coordinated Highways Action Response Team
CIMS	Crisis Information Management Software
ConOps	Concept of Operations
CORBA	Common Object Request Broker Architecture
CPS	Continual Preparedness System
DBMS	Database Management System
DC	Data Content
DDOT	District Department of Transportation
DE	Data Exchange
DMS	Dynamic Message Sign
DOE	United States Department of Energy
DPWT	Montgomery County Department of Public Works and Transportation

[2] ISP's are included within the scope as partnerships/contracts will have to be implemented with them for delivery of certain traveler information distribution capabilities (e.g., delivery of traveler information to in-vehicle devices).

DS	Decision Support
DQ	Data Quality
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EORS	Emergency Operations Reporting System
ERG	Emergency Response Guide
ERU	Emergency Response Unit
FHWA	Federal Highway Administration
FIPS	Federal Information Processing Standards
FITM	Freeway Incident Traffic Management
FTA	Federal Transit Administration
GIS	Geographic Information System
HAR	Highway Advisory Radio
HazMat	Hazardous Materials
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
HRI	Highway Rail Intersection
ICC	Intercounty Connector
ICD	Interface Control Document
ICM	Integrated Corridor Management
ICMS	Integrated Corridor Management System
IEEE	Institute of Electrical and Electronics Engineers
IMS	Incident Management System
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
IVR	Interactive Voice Response
JMS	Java Messaging Service
MARC	Maryland Rail Commuter Service
MATOC	Metropolitan Area Transportation Operations Coordination
MC	Montgomery County
MCPS	Montgomery County Public School
MDOT	Maryland Department of Transportation
MDSHA	Maryland State Highway Administration
MDT	Mobile Data Terminal
MdTA	Maryland Transportation Authority
MEMA	Maryland Emergency Management Agency
MILES	Maryland Interagency Law Enforcement System
MNCPPC	Maryland National Capital Park and Planning Commission
MSE	Mobile Subscriber Equipment
MSP	Maryland State Police
MTA	Maryland Transit Administration
MWCOG	Metropolitan Washington Council of Governments
NASA	National Aeronautical Space Administration
NIMS	National Incident Management System
NIST	National Institute of Standards and Technology
NLETS	National Law Enforcement Telecommunications System
NTCIP	National Transportation Communications for ITS Protocol
NWS	National Weather Service
PDA	Personal Digital Assistant
PM	Performance Measures
PSDS	Public Safety Data System
PTZ	Pan-Tilt-Zoom
RAID	Redundant Array of Independent Disks

RITA	Research and Innovative Technology Administration
RITIS	Regional Integrated Transportation Information System
RMS	Records Management System
RSS	Real Simple Syndication
RTMS	Remote Traffic Microwave Sensor
RWIS	Road Weather Information System
SAE	Society of Automotive Engineers
SD	Surveillance and Detection
SHA	State Highway Administration
SLA	Service Level Agreement
SMS	Short Message Service
SOP	Standard Operating Procedure
SS	System Security
SyRS	System Requirements Specification
TAR	Traveler Advisory Radio
TCIP	Transit Communications Interface Profile
TI	Traveler Information
TM	Traffic Management
TMC	Transportation Management Center
TMDD	Transportation Management Data Dictionary
TRIP	Transportation Response Information Partnership
TSSM	Traffic Signal System Modernization
UI	User Interface
UMD	University of Maryland
USDOT	United States Department of Transportation
VDOT	Virginia Department of Transportation
VPN	Virtual Private Network
WAN	Wide Area Network
WAP	Wireless Application Protocol
WMATA	Washington Metropolitan Area Transit Authority
XML	Extensible Markup Language

1.5 References

Below is a list of documents containing additional information pertaining to this project as well as those documents that have been referenced herein.

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2. General System Description

The I-270 ICMS is comprised of eight (8) specific sub-systems (see Figure 2, Maryland I-270 ICMS Component Diagram, on the following page), which are described in the sub-sections that follow. The foundation of the I-270 ICMS is the existing Regional Integrated Transportation Information System (RITIS), a system conceived and guided under the auspices of the Metropolitan Area Transportation Operations Coordination (MATOC) partnership and developed by the University of Maryland's Center for Advanced Transportation Technology. Building upon the RITIS foundation will allow for expedited I-270 ICMS development and deployment by leveraging synergistic system development efforts that have been underway in the Washington Metropolitan area since 2004 and that are planned as part of the MATOC initiative. Further, as RITIS is a regional system, the modifications and enhancements to build the I-270 ICMS will allow for a more rapid deployment of Integrated Corridor Management systems in other corridors in the region. However, while several I-270 ICMS sub-systems already exist as part of RITIS, upgrades will be needed to achieve all the functionality defined in this ICMS Requirements document. In addition to the eight sub-systems, the I-270 ICMS involves critical data exchange interfaces with the external systems identified in the Component Diagram. While some of these exchanges currently exist through RITIS, the majority must be developed. In addition, some external systems have not yet been developed, but interfaces to these systems will be established as they are implemented.

Additional details regarding existing RITIS functionality are provided in Section 2.2.1, ICMS Internal Sub-Systems.

2.1 System Context

Figure 2, on the following page, depicts the Maryland I-270 ICMS Component Diagram which provides the overall system context in which the I-270 ICMS will exist. Specifically, the Component Diagram identifies high-level components that comprise the entire ICMS and, importantly, the boundaries between the I-270 ICMS and both existing and new external systems.

The left side of the diagram identifies the I-270 ICMS sub-systems. The right side shows the external systems that will be required to interface with the I-270 ICMS. Existing systems and sub-systems are shown as clear boxes, while new systems and sub-systems to be developed appear as orange boxes. Data flows shown with black lines currently exist, whereas orange colored lines represent new data flows to be implemented.

Specific details about each of the components in the diagram are provided in subsequent sections of this document.

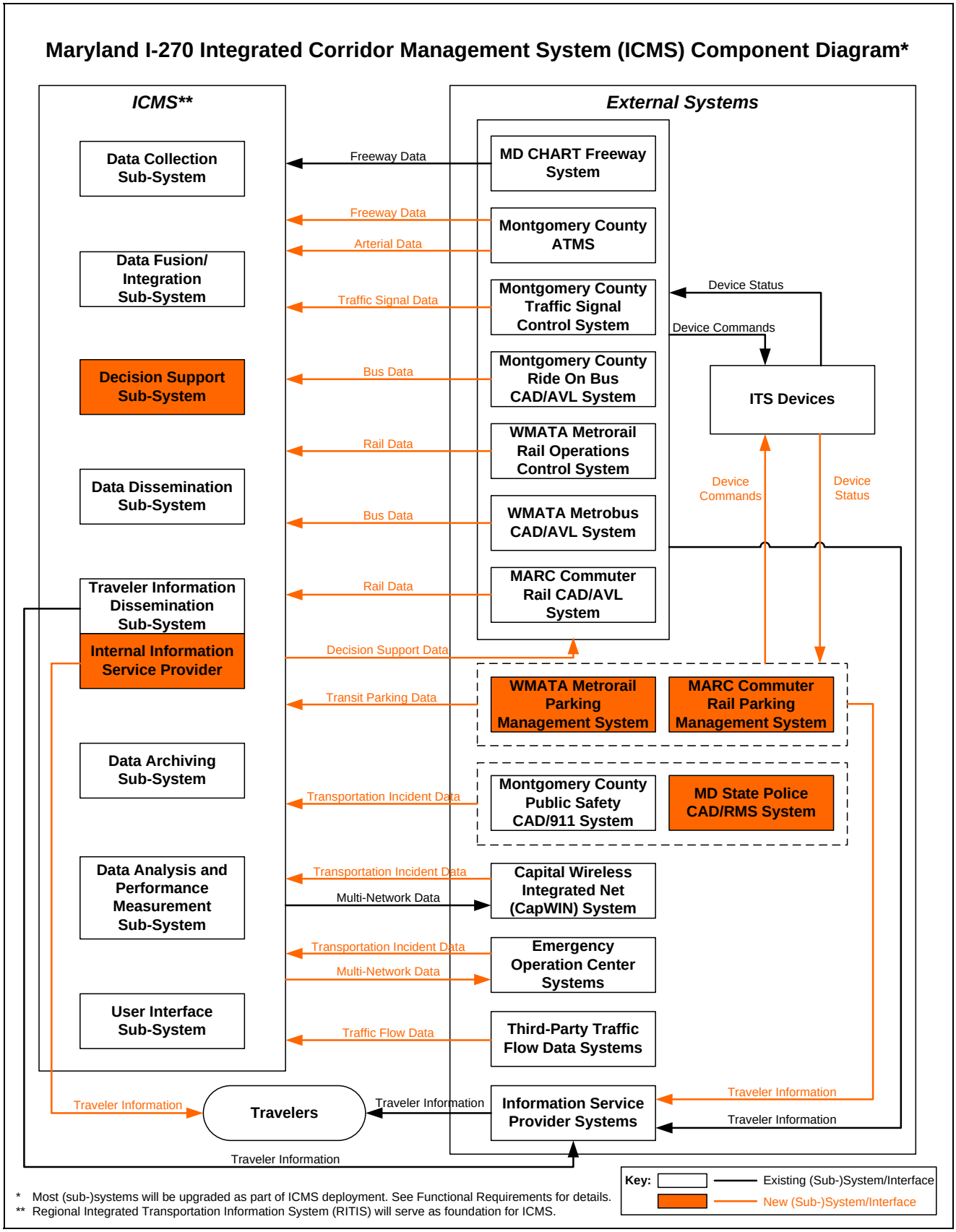

Figure 2 – Maryland I-270 ICMS Component Diagram

Image Source: Telvent Farradyne

2.2 Major System Capabilities

Below is a description of the major capabilities of each I-270 ICMS sub-system as identified in Figure 2, Maryland I-270 ICMS Component Diagram. Taken together, the descriptions provide an overview of the major system capabilities for the entire I-270 ICMS.

2.2.1 ICMS Internal Sub-Systems

The I-270 ICMS consists of the following internal sub-systems, as discussed below:

- Data Collection Sub-System
- Data Fusion/Integration Sub-System
- Decision Support Sub-System
- Data Dissemination Sub-System
- Traveler Information Dissemination Sub-System / Internal Information Service Provider
- Data Archiving Sub-System
- Data Analysis and Performance Measurement Sub-System
- User Interface Sub-System

The description of each ICMS sub-system is followed by a discussion of current corresponding RITIS functionality, where applicable.

Data Collection Sub-System – This I-270 ICM Sub-System retrieves and stores corridor transportation network data from external stakeholder systems based on established data exchange interfaces. Data may include:

- *Traffic Volume and Speed* – Information collected by agencies from roadway detectors and provided to the I-270 ICMS.

- *Probe Data* – Vehicle probe data that is raw or processed into corridor link information (e.g., travel times) and may be available from a private provider.

- *Incident Information* – Information entered by each agency into its own incident management system and provided to the I-270 ICMS. Data types include incident location, type, severity, vehicles involved, and responders; lane closures; and messages on dynamic message signs (DMS). Data on planned lane closures and special events will be included.

- *Weather Data* **–** Weather alerts and radar data from the National Weather Service (NWS). In addition, data on weather and pavement surface conditions that agencies gather from their roadway weather information systems (RWIS) is included.

- *Device Operational Status* **–** Operational status of roadway devices from each agency including detectors, DMS, traffic signals, Highway Advisory Radio (HAR), and CCTV cameras where available.

- *Managed Lane Status* **–** Should managed lanes be implemented in the I-270 corridor in the future, this will include data on the status of high-occupancy vehicle (HOV), high-occupancy toll (HOT), and reversible lanes.

- *Surveillance Video* **–** Closed circuit television (CCTV) video feeds. Agencies will be able to view cameras owned and operated by other participating agencies. Device control will not be shared.

- *Transit Alerts* **–** Transit system status alerts sent out by transit providers.

- *Automated Vehicle Locations* **–** Vehicle location data for Automated Vehicle Location (AVL)-equipped vehicles, including buses, emergency response vehicles, and freeway service patrols.

- *Signal Status* – Status of each signal, such as operational, maintenance mode, flashing, or offline.

- *Signal Timing Plans* – Signal timing plans and real-time information on the current timing plans implemented.

- *Traveler Information* – Messages that agencies relay through Dynamic Message Signs (DMS) and Highway Advisory Radio (HAR), as well as alerts that agencies send out to mobile phones, PDA's, or other personal and in-vehicle devices.

- *Parking Status* – Status (available capacity) of transit parking facilities.

- *Computer-Aided Dispatch (CAD) Information* – Appropriate transportation related information from public safety CAD systems.

- *Emergency Management* – Emergency alerts, Amber alerts, and evacuation plan information.

- *Static, Descriptive Information* **–** Information on roadway infrastructure and transit characteristics. For transit, this will include schedules, routes, and stops. For roadways, it will include information such as number of lanes, weight and height restrictions, speed limits, evacuation routes, and location of Intelligent Transportation System (ITS) devices.

Additional details regarding specific data collection requirements are shown in Table 3, I-270 ICM System Data Types.

RITIS currently collects various event and sensor data as follows:

- Incident and Construction Event Data – Real-time Traffic Management Center incident management and construction management data from the following systems:
    - VDOT – Statewide through the VAData Gateway, OpenTMS, VDOT IMS (Incident Management System), and other systems
    - MDOT – Statewide via the MD CHART system
    - District Department of Transportation (DDOT) – District-wide via the CapTOP (Capital Transportation Operations Platform) system
    - WMATA rail system disruptions

- Detector data, CCTV video, and other sensor data:
    - Speed, volume, and occupancy data from Remote Traffic Microwave Sensors (RTMS), inductive loops, acoustic detectors, radar, and other devices from VDOT, MDOT, SpeedInfo, and Traffic.com
    - Traffic signal system data from Prince Georges County's TRIP (Transportation Response Information Partnership) Center
    - CCTV feeds from MDOT-CHART and Prince Georges County (VDOT, DDOT, and Montgomery County coming soon)
    - RWIS data from MD CHART and VDOT
    - Dynamic message sign data from MD CHART and VDOT
    - Weather alerts from National Weather Service

- Weather radar from National Weather Service

Data Fusion/Integration Sub-System – This I-270 ICMS Sub-System organizes, correlates, and processes all collected transportation network data for subsequent analysis, dissemination, and storage as appropriate. To ensure data quality, this sub-system will perform data quality assessments, data imputations, and abnormality checks. Imputation refers to the replacement of missing data with a substitute that allows data analysis to be conducted without being misleading. During the design phase, an inventory of all available data sources will be made to determine the desired data precision and reliability and the best data adjustment methods to minimize distortion and maximize the usefulness of any substituted data. The selected method(s) will be internally consistent, efficient, traceable, and objective.

RITIS currently collects, fuses, and standardizes disparate data sets into all of the following standards:

- ITE Traffic Management Data Dictionary (TMDD) v2.1
- SAE J2354 Message Set for Advanced Traveler Information System (ATIS)
- IEEE IM 1512.1 Traffic Incident Management Message Sets for Use By Emergency Management Centers
- ASTM WK7604 Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data

Decision Support Sub-System – This I-270 ICMS Sub-System will be used to analyze real-time and archived multi-modal corridor transportation data to support (1) agency operational decisions, and (2) traveler decisions within the corridor. Operational decisions include I-270 ICMS recommendations for implementing system changes (e.g., changes to arterial signal system timing and DMS/HAR for diverted freeway traffic resulting from an incident). This sub-system will support traveler decisions by providing access to fused multi-modal data showing conditions and travel times by mode. Ultimately, this sub-system will interface with an intermodal corridor simulation model (to be developed) that can process both archived and real-time data in a manner that provides *recommended* route and mode choices.

Data Dissemination Sub-System – After processing and formatting the data, this I-270 ICMS Sub-System will broadcast the data to stakeholder agencies through a publish/subscribe capability. This capability will allow agencies to "subscribe" to particular data of interest. The ICMS then "publishes" the requested data as it becomes available. To ensure that Transportation Management Centers (TMC's) receive only data that they can use and to minimize the volume of data transferred, the ICMS will incorporate a mechanism for recording TMC data preferences. Each receiving agency will decide which data to accept. The ICMS will be able to filter data by selected characteristics or combinations of characteristics available in the system such as device type, geographic location, and incident severity.

All RITIS data is "cleansed" where appropriate and formatted for retransmission in the above mentioned standards to various agencies, third parties, individuals, and other groups depending upon security settings and permission levels. Data is made available through the following methods:

- A graphical, highly interactive web site with GIS capabilities and other visualization methods
- A mobile PDA/cell phone web site
- Subscription alerts via e-mail
- Subscription alerts via SMS (short message service)
- RSS feeds
- Poll HTTPS XML
- Publish/subscribe Java Message Service
- WebServices (coming soon)

Traveler Information Dissemination Sub-System / Internal Information Service Provider – This I-270 ICMS Sub-System provides the capability for the dissemination of processed corridor transportation information to corridor travelers via (1) a system-to-system interface between the Traveler Information Dissemination Sub-System and a third-party Information Service Provider (for redistribution to travelers via, for example, in-vehicle navigation devices), and (2) direct dissemination to travelers through an internal (I-270 ICMS) website and e-mail-, fax-, and pager-based subscription services. Regarding the latter direct dissemination method, the I-270 ICMS traveler information web site will provide access to real-time, corridor specific traveler information for the public. Users of this web site will be able to search for information of particular interest to them, including determining the best mode(s) for making a trip within the corridor. This website will also be able to push user-defined traveler information to an assortment of remote devices such as cell phones, PDA's, and pagers.

In RITIS, sensitive data (such as license plates, names, and certain first-responder information) is removed from data before it is made available to travelers via the following methods:

- 511 systems (through access to direct RITIS data feeds)
- Third-party traveler information service providers (through access to direct RITIS data feeds)
- Through the public RITIS web site
- Through the public RITIS mobile PDA/cell phone web site
- Public RSS feeds

Data Archiving Sub-System – This I-270 ICMS Sub-System archives raw and processed corridor transportation data. Archived data will serve as a source for both traditional and innovative corridor-level transportation analyses and as a valuable record of decisions made and actions taken for incidents and other scenarios in the corridor. This sub-system will allow users to better use the ICM system and respond to or manage future transportation scenarios. Additional archived data uses include transportation planning, multi-modal transportation system performance monitoring, corridor modeling and simulation, incident detection, roadway impacts, construction impact analysis, air quality analyses, transit management, and transportation emergency management planning.

All data that is collected by RITIS is archived indefinitely for use by planners, researchers, after-action review committees and other groups. The data is archived in several relational database management systems. All data is stored on RAID arrays and is archived at two physical locations to prevent data loss.

Data Analysis and Performance Measurement Sub-System – This I-270 ICMS Sub-System will allow ICMS users to have a web accessible, on-demand, one-stop shop for multi-agency, multidisciplinary, multi-jurisdictional data continuously accumulated from public and private transportation sources in the corridor. The web-based user interface will include tools for querying and reporting data in a wide variety of predefined and ad-hoc formats. Innovative graphical techniques will include creating performance reports such as, for example, three-dimensional (3D) data query and spatial/temporal graphing visualization tools and querying the incident databases to graph incident statistics, derive performance measures, and create graphical timelines of individual incidents.

All data within RITIS is made available through the RITIS web site that allows users to customize data queries and data requests. Users can download historical data for use in their own applications, or they can use the RITIS on-line tools to create graphical representations of the data. A number of pre-defined performance measurement reports and graphs can be quickly selected, or the user can specify strict filtering and reporting parameters.

User Interface Sub-System – This I-270 ICMS Sub-System provides user interfaces for:

- Operations – The agency operations user interface that allows access to ICMS information and tools if an agency has not yet integrated the ICMS data interface to allow access through their native

system application. This user interface includes administrative tools to configure ICMS information and the data exchange interface. Note that this user interface will allow access to the ICMS by operational agencies that don't have a control system or who do not desire a system-to-system interface.

- Traveler Information – The public user interface to view corridor traveler information processes through the ICMS and use ICMS trip-related decision support tools.

- Administration – This user interface allows ICM system administration staff to monitor, maintain, and configure the ICMS.

Following is a brief description of the external systems which comprise the right side of Figure 2, Maryland I-270 ICMS Component Diagram.

The RITIS web site features a wide range of highly interactive incident, detector, and weather event data visualization tools, including the following:

- A sortable list of incidents, construction, and special events that shows road name and location, lane status graphics, severity, type, and description (see Figure 3, below)

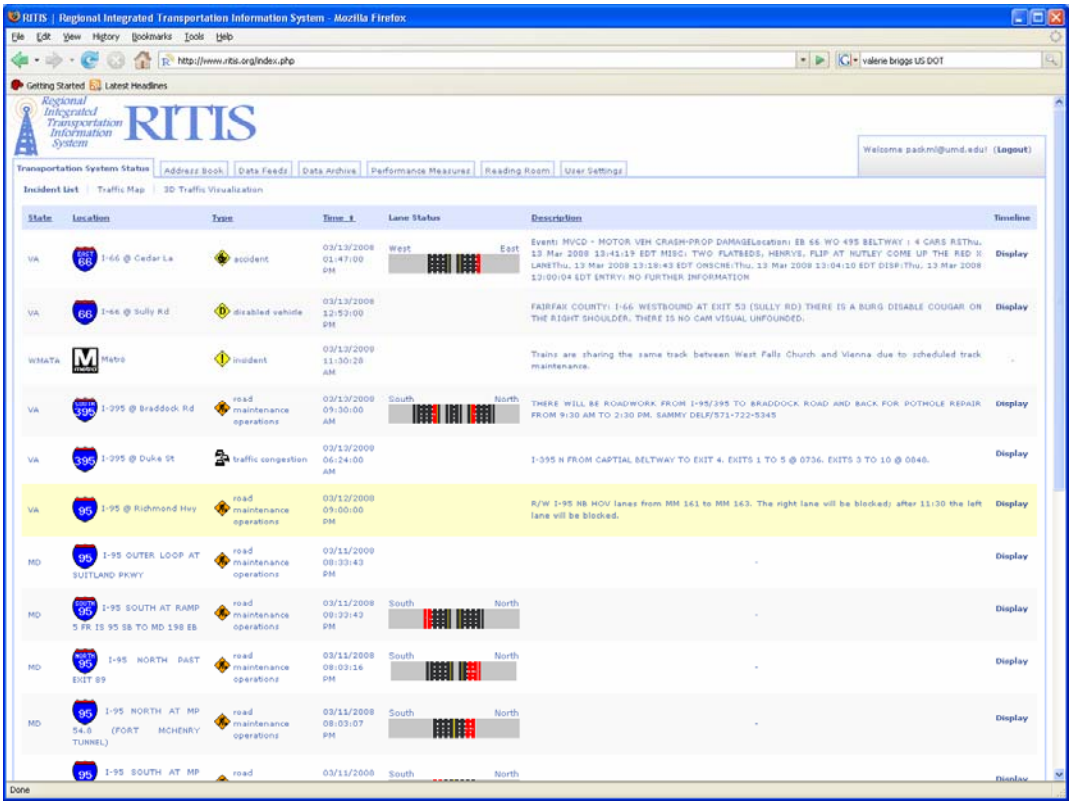

Figure 3 – RITIS Listing of Incidents, Construction, and Special Events

Image Source: University of Maryland Center for Advanced Transportation Technology (UMD/CATT)

- A GIS-based, interactive map showing incident locations with icons – Clicking on each icon displays details about the incident, including lane-status graphics (see Figure 4, below)

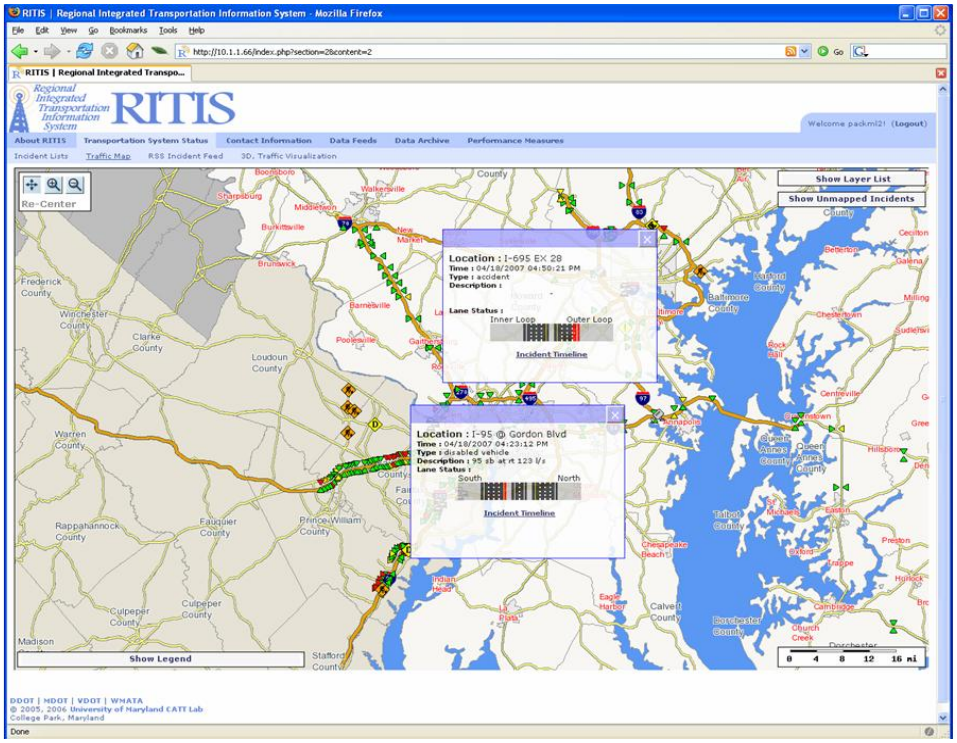

Figure 4 – RITIS Interactive Map of Incident Locations

Image Source: UMD/CATT

A GIS-based, interactive map showing detector data beacons – Clicking on the beacon brings up real-time graphs and per-lane data for that location (see

- Figure 5, below)

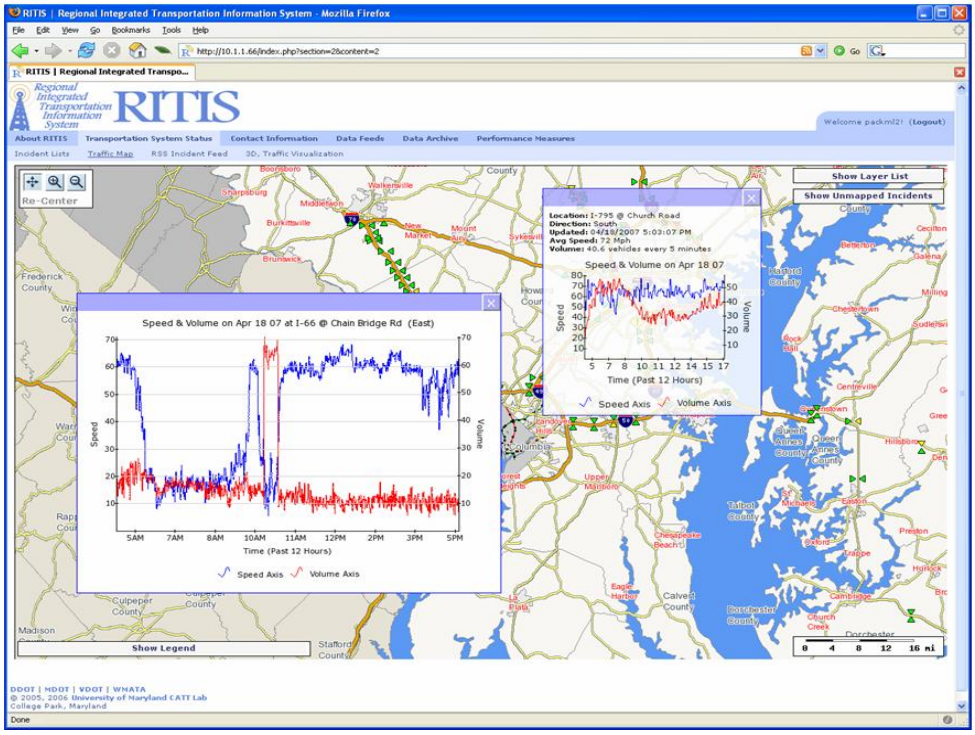

Figure 5 – RITIS Interactive Map of Detector Data Beacons

Image Source: UMD/CATT

- A GIS-based, interactive map showing National Weather Service alerts and radar image overlays (see Figure 6, below)

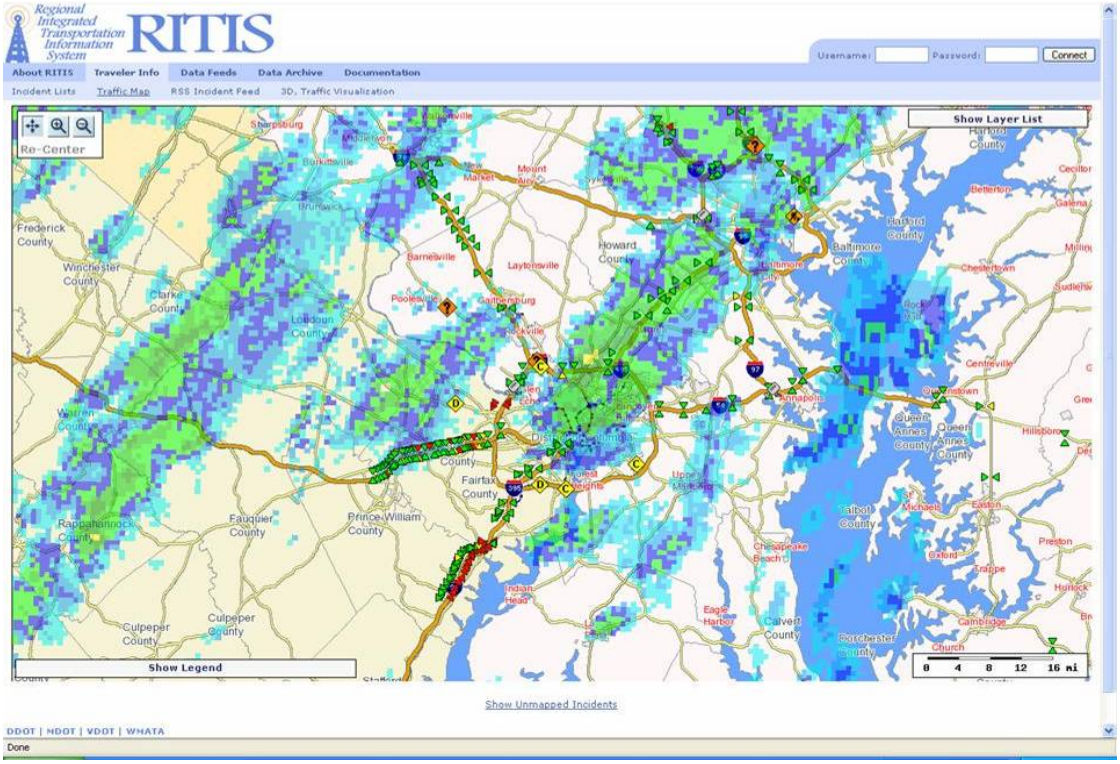

Figure 6 – RITIS Interactive Map of National Weather Service Alerts

Image Source: UMD/CATT

- A graphical real-time timeline of event, incident, and construction information (see Figure 7, below). This tool is a compact, interactive visualization of the temporal and spatial data associated with traffic incidents. All information is displayed on a one-screen overview, improving upon previous visualizations which often span six or more separate screens. Temporal data are represented as line segments of varying lengths and colors, while tooltips provide detailed information about each field. Each line is projected onto a graphical timeline representing the entire incident. An interactive map of the incident location allows the user to garner spatial significance while still providing temporal information. The Incident Timeline Tool reduces the chance of missing critical information, enables the user to correlate events, and reduces the time needed to comprehend the many simultaneous activities that occur during the course of an incident.

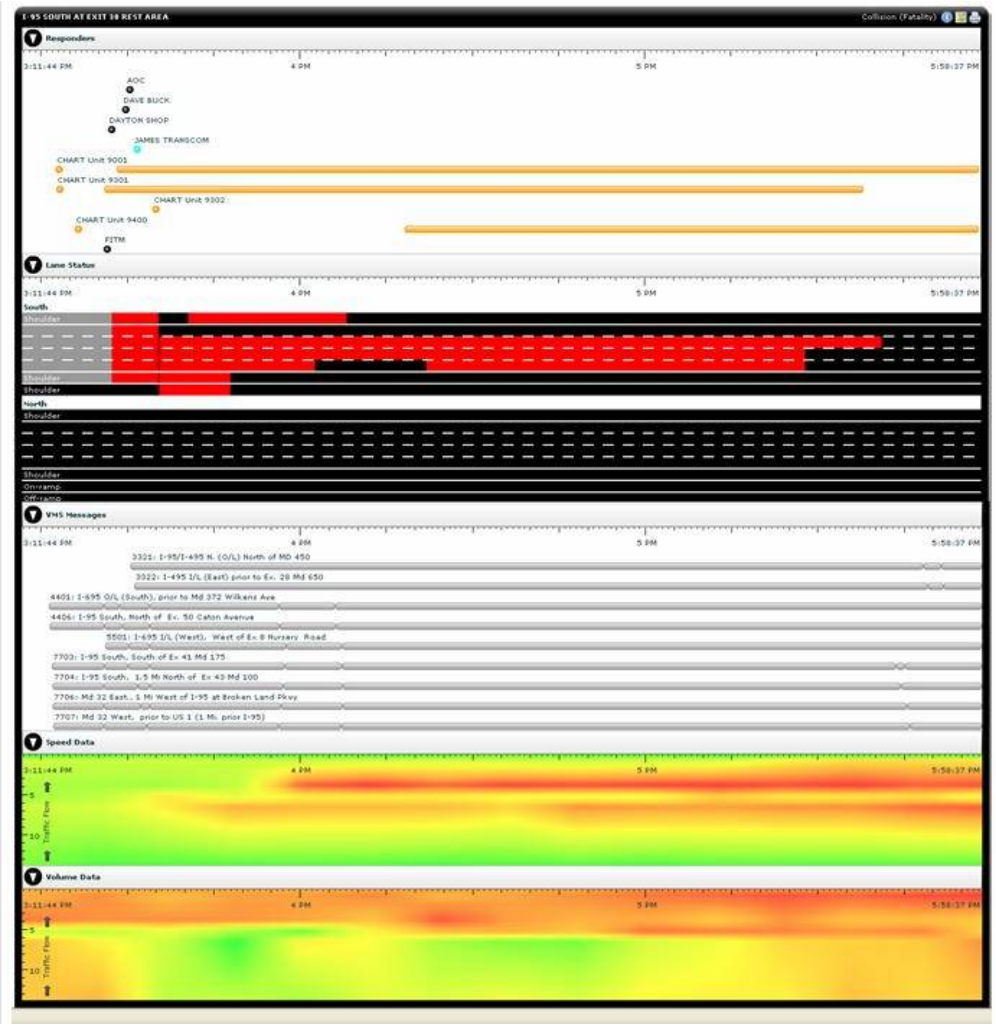

Figure 7 – RITIS Graphical Timeline of Event, Incident, and Construction Information

Image Source: UMD/CATT

2.2.2 ICMS External Systems

The I-270 ICMS will interface with a number of external systems, including:

- MD CHART Freeway System
- Montgomery County ATMS
- Montgomery County Traffic Signal Control System
- Montgomery County Ride On Bus CAD/AVL System
- WMATA Metrorail Rail Operations Control System
- WMATA Metrobus CAD/AVL System
- MARC Commuter Rail CAD/AVL System
- WMATA Metrorail Parking Management System
- MARC Commuter Rail Parking Management System
- Montgomery County Public Safety CAD/911 System
- MD State Police CAD/RMS System
- Capital Wireless Information Net (CapWIN) System
- Emergency Operations Center (EOC) Systems
- Third-Party Traffic Flow Data Systems

- Information Service Provider Systems

MD CHART Freeway System – The Maryland Coordinated Highways Action Response Team (CHART) system is the Maryland Department of Transportation's (MDOT) transportation management system which is primarily responsible for management of the freeway network in Maryland. The CHART system software is distributed in operation centers throughout the state based on Common Object Request Broker Architecture (CORBA). The CHART system software is currently undergoing a major upgrade that may include:

- Upgrading the video system to support IP-based video, which will allow CCTV video and data from CHART cameras to be distributed via the MDOT T1 Ethernet network to all facilities/centers/agencies connected to the CHART network.

- Potential new or enhanced capabilities such as:
    - A Center-to-Center Module (data exchange)
    - Integration with Smart Parking Systems – Providing information to truck stop and rest areas.
    - Cell Phone Probe Data – Integrating cell phone tracking data for speed and travel time information.
    - Enhanced Data Dissemination – Sharing information with the public through notification services (fax, pager, e-mail, Web-based Real Simple Syndication (RSS), WAP/PDA access, etc.).
    - Diversion Route Management – Providing alternative routing and loadings during incident management.
    - Signal Control – Incorporating arterial signal information and command and control support.
    - The Emergency Operations Reporting System (EORS) is Maryland State Highway Administration's (MDSHA) system for collecting and distributing maintenance, construction, and adverse weather operations information across the state. The system software is accessible on CHART system workstations but is being migrated to a web-based platform to make it easily accessible to all maintenance shops and other facilities on the MDOT network.

In addition to the CHART system software, ITS infrastructure in the corridor includes:

- Voice Radio Communications

- CCTV Cameras (5 existing in corridor)

- Dynamic Message Signs (4 existing, 2 planned), but not in advance of every cross network junction. National Transportation Communications for ITS Protocols (NTCIP) are used for DMS communications.

- Highway Advisory Radio (2 existing, 1 planned)

- SHAZAM Beacons (1 existing, 4 planned) – These beacons are used in conjunction with static signing informing motorists to tune to local HAR frequencies for traveler information.

- Loop Detectors (Automatic Traffic Recorders) (2 existing)

- Remote Traffic Microwave Sensors (RTMS) (8 existing, 7 planned)

- Road Weather Information System (RWIS) sites (2 existing)

- Highway Service Patrols (1-2 per shift)

- Private Sector Detection Infrastructure installed by Traffic.com and shared with CHART

Montgomery County ATMS – Montgomery County's Advanced Transportation Management System (ATMS) software is used in the Transportation Management Center (TMC) to facilitate management of the County's arterial network. The ATMS is used to control county CCTV cameras, DMS, and HAR assets and provides access to the Traffic Signal System and Ride On Bus CAD/AVL system. The TMC uses the County-owned cable television station to provide up-to-date transportation information. Another unique asset is the County-owned and operated traffic monitoring airplane which flies every morning and evening peak period. The airplane is equipped with a camera that can send real-time video back to the TMC.

County TMC operated ITS infrastructure assets in the corridor include:

- Traffic Signals (793 in total; 194 in the corridor)
- CCTV Cameras (185 in total; 47 existing in corridor)
- Traveler Advisory Radio (12 in total; 4 existing in corridor) – same as HAR devices
- Loop Detectors (190 counting stations in corridor)

Montgomery County Traffic Signal Control System – The County's existing traffic signal control system utilizes COMTRAC software running on a Data General platform. Montgomery County Department of Public Works and Transportation (DPWT) is in the process of updating the traffic signal system to include an actuated traffic signal strategy. The project will commence in the summer of 2008 with expedited deployment at intersections within the I-270 ICM corridor. Note that the capability to download timing plans in response to events taking place on I-270 already exists within the current traffic signal control system. Timing plans for these type of events are either existing or will be developed as a backup plan. The project is expected to finish between 2009 and 2013. Priority will be given to signals in the corridor.

Montgomery County Ride On Bus CAD/AVL System – Ride On is Montgomery County's local bus service that provides concentrated service within the I-270 Corridor. Bus service emphasizes connections to Metrorail, Metrobus, and MARC Rail. The current Orbital CAD/AVL operating system is being upgraded to OrbCAD XP. Upgrades to the Ride On Bus system will include:

- Bus stop annunciators
- Passenger counts with real-time communications to the central system
- A single "sign-on" for drivers to automatically program their route into destination signs
- Improved system reporting
- Improved communications using Wi-Fi data uploads and downloads to the buses while they sit in the yard at night
- Bus Priority – Part of the upgrade to the CAD/AVL system will include signal priority for buses starting with intersections in the MD-355 corridor.

Additional County Bus System ITS infrastructure includes:

- Fare payment system with SmarTrip compatible fare boxes
- Surveillance cameras on buses
- 10 DMS signs in selected bus shelters

WMATA Metrorail Rail Operations Control System – Metrorail's automatic train control system includes a computer-based operations control center and vital control equipment installed throughout the transit system to provide safe, automatic systems for train protection, operations, and supervision. WMATA also provides a web-based trip planning tool called the RideGuide which incorporates both rail and bus systems. Additional ITS infrastructure in the corridor includes:

- Platform DMS for next train arrivals and traveler information
- Surveillance at each station
- Biological and chemical detection sensors
- Radio Communications
- PA Traveler Announcement System
- Passenger Information Displays (10 existing)
- Fare payment system using SmarTrip

WMATA Metrobus CAD/AVL System – Metrobus is WMATA's regional bus transit network serving the Metropolitan Washington, D.C. area. The CAD/AVL system runs Orbital's OrbCAD communications and dispatch software in the Bus Operations Control Center (BOCC). Planned enhancements to the system include:

- Integration of the automatic vehicle location (AVL) system with route schedules so that route schedule adherence can be determined in real-time. This information will be sent from Metrobus vehicles to operators at the BOCC via the Mobile Data Terminals (MDT's).
- Integration of Automatic Passenger Counters (APC), AVL, and Cubic fare boxes with MDT's. This information will be sent to the BOCC through the MDT's.
- Development of a Transit Database that will become the central communications path and data interface for future Metrobus systems.

Additional Metrobus ITS infrastructure assets include:

- Mobile Data Terminals
- Automatic Passenger Counters
- Fare Payment System using SmarTrip
- Bus Annunciation

- Surveillance Cameras

MARC Commuter Rail CAD/AVL System – MARC, under the Maryland MTA, runs the commuter rail service in the corridor. MARC's monitoring and control system will include GPS train location and a schedule adherence and alert system. In addition, it includes the following capabilities and ITS infrastructure assets:

- Radio Communications
- PA Traveler Announcement System
- LED Traveler Information Display Signs
- Station Surveillance Cameras
- Fare Collection System using SmarTrip

WMATA Metrorail Parking Management System – WMATA is testing an advanced parking management system at the Glenmont Metro Station, which will potentially serve as a prototype for other Metro parking lots.

MARC Commuter Rail Parking Management System – MTA is considering the development of an automated parking management system at MARC Commuter Rail lots to monitor parking space availability on a real-time basis.

Montgomery County Public Safety CAD/911 System – Montgomery County's CAD/911 system provides CAD/AVL capabilities for both the police department and fire and rescue services. The Public Safety Data System (PSDS) includes the following capabilities:

- Computer-aided dispatch (CAD)
- Mapping
- Automatic Vehicle Location
- Mobile data communications
- Local Area Network/Wide Area Network
- Mobile Subscriber Equipment (MSE) – Vehicle mounting and communications equipment required to support mobile computers and radio equipment operations. MSE includes equipment such as Global Positioning System equipment, vehicular radio modems, and antennas.
- Approximately 1400 in-vehicle mobile computers equipped with mobile computer client software that provides in-vehicle data system capabilities, including CAD dispatches as well as access to the Maryland Interagency Law Enforcement System (MILES) and the National Law Enforcement Telecommunications System (NLETS), along with car-to-car messaging.

MD State Police CAD/RMS System – Maryland State Police is responsible for enforcement, security, and crash investigations on the freeway in the corridor. The State is currently in the planning stages of creating a consolidated Computer Aided Dispatch and Records Management System (CAD/RMS) to effectively coordinate statewide public safety information across the State agencies that have a police

force. As envisioned, this system will enable sharing of anti-terrorism and homeland security data, but equally important, it will replace multiple legacy end-of-life systems that do not interoperate. It will also facilitate quicker response times, improved officer safety, and improved records retention and analysis. The CAD/RMS will be developed in conjunction with agency stakeholders, including the Departments of General Services, Natural Resources, Transportation, Maryland State Police, and Maryland Aviation Administration. Currently, Maryland State Police is the biggest user of the CapWIN System (see below) which will be used to obtain transportation incident data from Maryland State Police in the corridor.

Capital Wireless Information Net (CapWIN) System – The Capital Wireless Information Net system and mobile software application suite enables:

- Incident management and coordination across agencies, regions, and public safety and transportation disciplines
- Secure one-to-one and group public and private “chat” communications
- A robust and searchable directory of individual first responders – a "411 Directory" for public safety and transportation individuals
- Access to operational data/resources, including regional transportation data (via RITIS) and multiple state/federal law enforcement criminal databases

The CapWIN system utilizes an open, standards based infrastructure in a secure (FIPS 140-2 certified) environment designed to easily adapt to rapidly evolving communication technologies and to ensure compatibility with existing agency systems by utilizing standard web services-based components. Key CapWIN system enabling technology includes:

- Web Services architecture
- Client application developed in C#/J2EE running on high performance AIX and Linux servers
- Jabber messaging server provides messaging capabilities
- Database services using a DB/2 server
- Directory services use standard lightweight directory access protocol (LDAP) software
- Private and internet Virtual Private Networks (VPN’s) connect to participating agency’s networks and wireless service providers
- Redundant configurations are used to ensure operations during hardware, software or power failures
- Key technology standards including TCP/IP, NIEM/GJXDM, IEEE 1512, ATIS, CAP

Emergency Operations Center (EOC) System – The Montgomery County EOC uses the Previstar Continual Preparedness System (CPS) as their primary resource and information management system. The CPS software includes a number of software modules that allow for implementation of National Incident Management System (NIMS) compliant processes for all hazard planning, response, and recovery. Previstar CPS software is based on a Microsoft platform, SQL Server database, and ESRI-compatible GIS mapping. The software can operate stand-alone on a PC or on web-enabled devices across a local or wide area network.

Third-Party Traffic Flow Data Systems – This represents private companies that provide either raw or processed information directly to the I-270 ICMS. This could be detector data from privately installed detection devices in state highway rights-of-way or privately collected and distributed vehicle probe data. RITIS, for example, currently receives traffic flow data from SpeedInfo, a provider of real-time traffic data using privately installed detector infrastructure on major arterials and evacuation corridors in the District of Columbia. In addition, the I-95 Corridor Coalition is currently sponsoring a traffic monitoring project to provide travel time and speed information on major roadways within the corridor. Travel time and speed information will be acquired from INRIX, a vendor that specializes in the collection of traffic data using probe technology, in which the positions of vehicles in the traffic stream are anonymously tracked.

Information Service Provider Systems – This represents private companies that serve as third-party traveler information service providers for traveler information provided by the I-270 ICMS. The companies typically collect and distribute data by working in conjunction with public agencies. For example, CHART provides freeway system data to Traffic.com through RITIS. Traffic.com repackages the data, together with data from other sources (including their own detectors installed in Maryland highway right-of-way), and either distributes it directly or through additional business relationships with media outlets.

2.3 Major System Conditions

The I-270 ICMS server equipment must exist in a facility designed as a high-availability networking data center with redundant, high-speed connections to all major Internet backbones. The networking data center must able to accommodate standard 19" rack mountable servers, networking equipment, and associated hardware. Redundant power supplies delivering 110 VAC and 240 VAC must exist for all equipment, and all equipment must have both battery and generator failover capabilities. The networking data center must have redundant cooling and humidity control for the equipment which will limit the temperature of the room to within +/– 10 degrees of 70 degrees Fahrenheit with a relative humidity not to exceed 30%.

Redundant configurations of the I-270 ICMS server equipment will be provided such that the overall system architecture includes the necessary levels of redundancy to provide a system designed for a mission critical 24x7 environment with an objective of 99.9% availability. The minimum acceptable availability is 99%, including scheduled downtime. The redundant configuration will be capable of having the primary and backup equipment installed in geographically separate sites. The two sites will be connected through standard Wide Area Network (WAN) telecommunications connections. The initial installation of the system will be at the same site. However, the capability of later separating the backup systems from the primary system will be provided.

2.4 Major System Constraints

A number of system issues (institutional, technical, and operational constraints and assumptions) have been identified in Section 4.9 of the Maryland I-270 ICM Concept of Operations. Major institutional, system, and operational constraints for the I-270 ICMS are summarized in this section. Section 2.6, Assumptions and Dependencies, addresses additional I-270 ICMS issues.

Major Institutional Constraints

- *Agency Retention of Operational Authority / Responsibility* – The I-270 ICMS will be used to enhance the method in which agencies perform their operations functions; however, it must not alter

the lines of legal or operational responsibility for incident management, traffic management, transit management, or other aspects of transportation operations in the corridor. Data collection from and maintenance of field devices will remain the responsibility of the participating agencies. The I-270 ICMS must be operated in manner that maintains existing lines of authority.

- *Long-term Support of Operations and Maintenance* – The Maryland I-270 ICM stakeholders are committed to providing the necessary resources towards the operations and maintenance of their existing systems. Through the I-270 ICM Steering Committee, and in conjunction with the Metropolitan Area Transportation Operations Coordination (MATOC) program, long-term support for the operations and maintenance of the I-270 ICMS must be solidified.

- *Agency IT Institutional Coordination* – The I-270 ICMS will provide data to and extract data from multiple systems at multiple agencies. This will require review of information systems policies with agency IT personnel to determine appropriate interface requirements and logistics. Agency firewalls will need to allow I-270 ICMS information to flow in and out while preventing system incursions. Policies on data privacy and security will also need to be examined, as will the need to restrict potentially sensitive data such as that from CAD systems.

- *Multi-modal Operational Procedure / Policy Development* – Because the I-270 ICMS will emphasize cross-agency and cross-modal coordination, this may require new or revised policies and procedures related to this coordination. Initially, addressing new or changes to policies and procedures will be the responsibility of the ICM Steering Committee but, ultimately, will fall within the purview of the MATOC program.

Major System Technology Constraints

- *Need for Enhanced System Monitoring Capabilities and Field Information Dissemination* – The need for additional system monitoring capabilities and information (e.g., arterial streets, freeways, freeway off-ramps, parking lots, etc. and additional DMS coverage at multi-modal decision points) is a major system constraint. The technical details, such as the distribution, proposed device location, and alternative traffic data collection techniques, will be addressed during the design stages of the I-270 ICM project. The role of purchasing additional ITS standards compliant (e.g., NTCIP) field devices will remain with the individual stakeholder agencies.

- *Building Upon RITIS Framework* – In order to maximize leverage of prior regional data exchange system development, the I-270 ICMS must build upon the existing RITIS infrastructure. It will be essential that data elements exchanged between external agency systems operated by the I-270 ICM stakeholders be defined in the same way. Because the use of RITIS is going to help define interfaces to the various, diverse software packages, the use of ITS standards for the RITIS system will be essential. Independent of developing any shared or central components for the network, providers will need to publish event data in a consistent and known format that can be used by all providers (or at least a format that RITIS can translate). RITIS follows XML, NTCIP, traffic management data dictionary, and other industry standards. RITIS will provide translation back and forth between existing systems and NTCIP standards.

- *Agencies Maintain Device Control and Distribution of Sensitive Information* – The I-270 ICMS will not provide the ability for agencies to jointly control ITS field devices, specifically, control of CCTV camera assets. The I-270 ICMS will include “filters” to avoid releasing sensitive information to non-authorized information outlets. However, the sharing of video images will be part of the I-270 ICMS in that all connected stakeholders will be able to view the images from all agencies along the I-270 Corridor (with pan-tilt-zoom (PTZ) control remaining with the “owning” stakeholder agency).

- *Lack of GIS-Based Information Delivery Capabilities* – Currently, not all participating stakeholder agencies have the ability to, or do not reliably, geo-locate incidents and events. Therefore, a comprehensive corridor map showing real-time status of transportation facilities or devices will require extra information processing to translate textual location descriptions to geographic information system (GIS)-based data. Additionally, agencies without mapping capabilities that want to see I-270 ICMS incidents on a map will have to use the ICMS web interface.

- *Availability of Real-time Modeling and Simulation Software Capability* – The ability to model and simulate multi-modal corridor conditions is a critical component of the I-270 ICMS decision support capability. In is anticipated much will be learned through participation in the development of an ICM analysis, modeling, and simulation package as part of the next phase of the USDOT ICM program. In the meantime, research will continue concurrently on the use of existing corridor modeling and simulation tools.

Major Operational Constraints

- *Development of an I-270 Operations Plan* – Operational issues must be resolved prior to system implementation if the proposed I-270 ICM strategies are to be applied consistently, efficiently, and in a manner that improves overall corridor performance. An I-270 ICM Operations Plan and Manual needs to be developed during the system design phase.

- *Policies on Level of Decision Support for Modal Shifts* – The I-270 ICMS will provide travelers with information to make better modal use decisions. The I-270 ICMS will also provide a level of decision support in the form of, for example, recommended multi-modal trip itineraries based on real-time information. The extent to which recommendations for mode shifts are provided will depend upon policies that must be developed by I-270 ICM stakeholders.

- *Development of Corridor Response Plans* – The I-270 ICMS must support operational response plans for numerous corridor scenarios and events, including location(s) of events, severity and impact, associated strategies (e.g., DMS messages, other traveler information displays, system operational parameters), contact personnel and locations, other resources, and implementation rules. The I-270 ICM Response Plans will be developed during I-270 ICM implementation, and then evaluated and updated throughout the project's life. Each stakeholder agency will have these developed I-270 ICM Response Plans available within their agencies and, based on established and agreed-upon threshold parameters and procedures, will initiate these plans.

2.5 User Characteristics

Table 2, below, provides a detailed summary of the user classes for the I-270 ICMS. Each user class includes characteristics associated with their expected agency/organization, position level, and a brief description of how the respective user class will interact with the I-270 ICMS.

Table 2 – I-270 ICM System User Classes

User Class	Agencies/Organizations	Positions	Interactions with I-270 ICMS
Operations Personnel			
TMC (traffic and transit) operators	• MDOT: MDSHA, MTA-MARC • WMATA • MC DPWT • Select operations centers for agencies not connected to I-270 ICMS	• Traffic operations and maintenance personnel • Transit operations and maintenance personnel • Traffic operator supervisors • Transit operator supervisors	• Monitor roadway and transit facility conditions in the corridor • Assess incidents occurring throughout the corridor to determine if the incident will affect traffic and/or transit operations in their area • Monitor and interpret data from I-270 ICMS for potential response • Based on I-270 ICMS information, notify other staff, supervisors, internal and external departments, and appropriate authorities of adverse conditions requiring a response • Use I-270 ICMS information to determine need to adjust signal operations • Monitor and operate agency systems and input/initiate I-270 ICMS communications • Use I-270 ICMS information to determine need to adjust signal operations • Assess need for rerouting buses; determine best alternative route • Based on I-270 ICMS information, request signal change/preemption • Use I-270 ICMS information to inform drivers and passengers of incidents affecting transit operations • Use I-270 ICMS information to manage I-270 HOV restrictions
Control center and dispatch center managers	• MDOT: SHA, MTA-MARC • WMATA • MC DPWT • Select operations centers for agencies not connected to I-270 ICMS	• Traffic control center manager • Transit control/dispatch center manager	• Monitor systems using I-270 ICMS information (such as freeway management, transit management) • Use I-270 ICMS to coordinate with other agency functions • Use I-270 ICMS to monitor and evaluate multi-modal corridor system performance

User Class	Agencies/Organizations	Positions	Interactions with I-270 ICMS
Service patrols	• MDOT: SHA • MC DPWT	• Patrollers and supervisors	• Monitor events in service area • Evaluate events with potential impact on service area • Provide information about incidents and roadway conditions to TMC operators • Evaluate performance of service patrol activities
Transit vehicle operators	• MDOT: MTA-MARC • WMATA • MC DPWT	• Bus and rail operators	• Receive I-270 ICMS incident information from transit operations center • Inform transit riders of incidents
Management personnel for operations and maintenance	• MDOT- SHA, MTA-MARC • WMATA • MC DPWT	• Operations Managers	• Use I-270 ICMS information for decision making, coordinating resources, and directing staff for incident response • Supervise operations staff who enter or access I-270 ICMS-accessible information • Use I-270 ICMS to coordinate programs such as maintenance, construction, and special events with state and local jurisdictions • Use I-270 ICMS to monitor and evaluate multi-modal corridor system performance • Use I-270 ICMS performance information to review/update operational multimodal operational response policies and/or procedures
Public Safety			
Public safety operators and dispatchers	• 911 centers	• Call takers and dispatcher	• Log call and dispatch information into CAD, to be shared through I-270 ICMS
Emergency Responders			

User Class	Agencies/Organizations	Positions	Interactions with I-270 ICMS
Law enforcement agencies	• MD State Police • Montgomery County Police • WMATA Transit Police • MdTA Police riding MARC trains • Other law enforcement agencies using CapWIN	• Police officers • Barracks commanders • Police dispatchers	• Provide information and updates to I-270 ICMS through CapWIN and CAD interfaces • Monitor incidents • Monitor traffic conditions to provide input for incident response coordination • Monitor events outside their service areas and evaluate the impacts of these events on activities in their area.
Fire departments and emergency medical services	• MC Dept. of Fire and Rescue Services	• Fire dispatchers	• Share CAD data through interface
Tow truck operators	• Towing companies	• Tow truck drivers and dispatchers	• Use CCTV pictures to determine needed equipment • Check desired route for delays prior to dispatching • Review incident information before dispatching
Travelers			
Corridor travelers – private vehicle, commercial vehicle, and transit users			• Receive multimodal (traffic and transit incidents) alerts via I-270 ICMS via PC, cell phone/pager/PDA/e-mail • Information provided to travelers via I-270 ICMS about roadway and transit facility conditions (bus operations, rail operations, parking), events, transit schedules and fares, etc. • I-270 ICMS multimodal trip planning tool will allow travelers to make informed decisions about their trips • I-270 ICMS information provided to travelers via third-party information service providers such as real-time, multi-modal trip updates using in-vehicle navigation devices as well as PDA's and cell phones
Information Service Providers			

User Class	Agencies/Organizations	Positions	Interactions with I-270 ICMS
Traveler information service providers - Public	• MDOT: SHA, MTA • MC DPWT • WMATA	• Control center operators • Information technology staff	• Receive I-270 ICMS traveler information and provide to travelers within operational jurisdiction via agency system traveler information mechanisms (websites, HAR, DMS, etc.)
Traveler information service providers - Private	• Regional 511 System(s) • TrafficLand • Mobility Technologies • Metro Traffic • Etc.	• Private center operations and IT staff	• Information from I-270 ICMS to supplement private traveler information distribution mechanisms • Information from I-270 ICMS to private ISP's for developing business relationships for innovative traveler information distribution services and devices
Media	• Television • Radio	• Traffic reporters	• Receive and use I-270 ICMS traveler information to supplement existing information sources
Public affairs offices	• MDOT: SHA, MTA-MARC • WMATA • MC DPWT	• Public affairs personnel	• Monitor I-270 ICMS for pertinent information and notifications from other agencies • Receive I-270 ICMS alerts
Archived Data Users			
Archived data users	• Universities • Metropolitan Planning Organizations • Transportation operations agencies • Consultants • I-95 Corridor Coalition	• Researchers • Public sector transportation planners and engineers • Operations managers • Consultants	• Assess mobility trends to help understand congestion, safety, growth, etc. • Monitor system performance in accordance with adopted ICMS performance measures • Provide support for decision makers in preparation of transportation plans and programs • Input data for analysis, modeling, and simulation tools • Conduct after-action incident response reviews
Program/System Administration			
Oversight committee	• ICM Steering Committee (near-term) • MATOC Steering Committee (long-term)	• Corridor and regional transportation managers	• Provide overall guidance, strategic management, system enhancement, operations planning, and funding functions for I-270 ICMS

User Class	Agencies/Organizations	Positions	Interactions with I-270 ICMS
System managers	• MDOT: SHA, MTA-MARC • WMATA • MC DPWT	• To be determined – likely to be provided with consultant support	• I-270 ICMS development and implementation oversight
Information Technology			
Developers	• UMD-CATT Laboratory • Others to be determined	• Computer programmers and systems engineers	• Integration / development services for I-270 ICMS related sub-systems and data interfaces
System maintenance personnel	• UMD-CATT Laboratory • UMD-CATT CapWIN • Others to be determined	• Computer programmers and systems engineers	• Manage I-270 ICMS related sub-systems and data archive • Diagnose and fix operational problems • Maintain a record of system maintenance and upgrades • Maintain test system • Fix bugs in test system; implement changes in production system
User support personnel	• To be determined	• Computer programmers and systems engineers	• Update training materials • Train users • Refer unresolved problems to maintenance staff • Maintain log of all user support responses and activities
System Administrators	• To be determined	• To be determined	• Maintain data sources and links • Backup data regularly • Maintain a uniform, consistent interface to data for maintenance personnel • Maintain system and database system security • Maintain user accounts • Maintain log of use statistics • Maintain computer systems, database servers, and web servers • Ensure integrity of system

User Class	Agencies/Organizations	Positions	Interactions with I-270 ICMS
Information Technology Staff	• MDOT: SHA, MTA • MC DPWT • WMATA • Public Safety Agencies • ISP's	• Agency/Organization IT system development and maintenance personnel	• Maintain communications network to ensure data and information flows from agency data system to I-270 ICMS • Develop, repair, and maintain agency software, equipment, databases • Maintain interfaces between I-270 ICMS and agency databases and systems, including system security
Other			
Commercial freight dispatchers	• Freight carriers and delivery companies	• Dispatchers	• Monitor incidents in order to notify drivers of incidents and recommend alternate routes

2.6 Assumptions and Dependencies

The following are key assumptions and dependencies (identified to-date) impacting the development and deployment of the I-270 ICMS:

- Agencies will build capability to provide/receive I-270 ICMS interfaces and data into their respective system development schedules.
- Agency system enhancements and new systems will be developed and implemented, to the largest extent possible, on-schedule and within the timeframe of the desired I-270 ICMS development and implementation.
- An I-270 ICMS Risk Management Plan will be developed to account for the development and implementation risks given that system success is so heavily dependent upon external systems.
- Partnerships with the private sector will be developed to further the innovative collection of transportation data and distribution of traveler information across a wide variety of devices and platforms.
- I-270 stakeholders will agree upon an overall I-270 ICMS System acquisition approach that will maintain flexibility while meeting project schedules in the face of multiple system constraints and dependencies.
- Procedures and protocols for identifying route/modal shifts when spare capacity exists on multiple networks will be developed by corridor stakeholders. These procedures and protocols will also address implementing route/modal shifts when sufficient spare capacity is not available within the corridor.
- Procedures and protocols for implementing demand/capacity management strategies will be developed by corridor stakeholders.
- Common procedures for incident response and reporting will be developed by corridor stakeholders.

- Corridor-wide performance measures and metrics will be agreed upon by I-270 ICMS stakeholders.

- I-270 ICM stakeholders will provide an appropriate level of resources towards marketing and outreach of I-270 ICMS capabilities.

2.7 Operational Scenarios

Sample representative operational scenarios for how the I-270 ICMS will be used to provide ICM capabilities in the corridor are presented in this section. These scenarios identify how the I-270 ICMS will interact and respond to the described events and assumed conditions. It is understood that these sample scenarios are not all-inclusive, but they provide an understanding of the operational context in which the I-270 ICMS is expected to interrelate with agency stakeholders, systems, and travelers.

Operational scenarios include the following:

- Daily operational scenario (e.g., recurring congestion)
- Scheduled event scenario (planned special events or work zone operations)
- Minor traffic incident scenario
- Major traffic incident scenario
- Evacuation scenario

2.7.1 Daily Operational Scenario

The following scenario for recurring congestion is an example that is lived out by I-270 commuters daily.

For many people, the commute starts from north and east of Frederick, Maryland, where a commuter enters the I-270 Corridor from US-15. After entering the I-270 ICM project boundary, the commuter experiences congestion due to high volume. Using information from the I-270 ICMS, the DMS's along the corridor display travel times to various known points along the corridor. Some of the DMS's, specifically those prior to the exits with easy access to Metro stations (Shady Grove, Rockville Center, etc.), additionally show travel time comparisons to indicate how much time it will take to get to the Washington Beltway remaining in the car versus exiting, parking, and taking Metrorail (this information would be turned off once the parking lots are filled). DMS's off I-270 and closer to these Metro stations will also include information about the number and location of open parking spots.

There are known points on the corridor that will slow the commute, sometimes to a complete stop, because of traffic entering the main roadway from the arterial roads. This is especially noticed as traffic from the two-lane collector/distributor system ("local lanes") that brings traffic from Shady Grove Road, Falls Road, and Montrose Road enter onto I-270 ("express lanes").

At each of those locations, the commute slows to stop-and-go or a complete stop.

The last place for congestion before entering the I-495 Capital Beltway is the split where I-270 divides to a southbound path to Virginia, via I-495, and a northbound spur to the I-495 Capital Beltway.

2.7.2 Scheduled Event Scenario

The following scenario outlines the typical "planned event," which would have been broadcasted to the motorists and commuters days in advance via DMS, Highway Advisory Radio / Traveler Advisory Radio (HAR/TAR), Web pages, and other media outlets.

Driving southbound from Frederick on I-270 for the morning commute, there is information on the DMS sign in Frederick County that informs motorists that the express lanes between Shady Grove Road and Gude Drive will be under repair until 9:00 AM. Information from the I-270 ICMS indicates that the typical traffic volume on the roadway at that time-of-day emphasizes the need to merge traffic onto the local lanes and to inform motorists to consider taking alternate routes or transit. Before approaching the I-370 interchange, both the SHA and Montgomery County Highway/Traveler Advisory Radio stations are providing details of the repair work including location, duration, and impact. Additionally, the southbound DMS on I-270 close to Middlebrook Road informs motorists of the location, duration, and impact of the repair. All of these information devices also inform motorists of alternative modes and routes. The I-270 ICMS allows travel time comparisons to be provided that indicate how much time it will take to get to the Washington Beltway if remaining in the car versus exiting, parking, and taking Metrorail. The broadcasted option for an alternate route is to exit on to I-370 East towards MD-355, one of the possible alternative routes (another possible alternate route is going west onto Sam Eig Hwy, via Great Seneca Highway to Darnestown Road back towards I-270; however, based on I-270 ICMS information related to this event, it has been decided to route motorists via MD-355).

Taking the exit from I-370 to MD-355, the traffic is already heavy but is flowing because of the already implemented modification (as suggested to County TMC operators via their I-270 ICMS interface) to the traffic signal timing on both Shady Grove Road and MD-355.

Prior to exiting from I-370 to Shady Grove Road, a new DMS informs motorists of the option to either proceed towards the Shady Grove Road exit or to remain on I-370 to go towards the Shady Grove Metro station. The parking management system that monitors the parking lots at the Metro stations provides information on the total number of open parking spaces available in the parking lots. From there, either Metrorail or Metrobus may be used by commuters to reach their final destinations. Motorists choosing to use the Metro facilities and transit will reach the entrance of the Metro station where the parking management system will provide additional information to speed up locating available spaces within the parking lots. The motorists, after parking their cars, head towards the Metro lines using the regional SmarTrip card, which they will also use to pay for parking upon their return. WMATA, having been informed of the construction event well in advance through their I-270 ICMS interface, has calculated that additional Metrorail vehicles will be needed at the Shady Grove station and increases the number of trains by letting more of the trains that typically turn around at the Grosvenor Station go through to Shady Grove and turn around there.

At each location providing entrance to the Metro system, the parking management system informs the motorists of available parking spaces.

Highway Advisory Radio and local radio stations provide updated information if I-270 is free flowing or congested after the location of the scheduled road repairs. This route can be taken until MD-355 intersects with the I-495 Capital Beltway or, at Rockville, where the vehicles can re-enter I-270 at Jefferson Street and again at Montrose Road.

2.7.3 Minor Traffic Incident Scenario

The possibility of a traffic incident along the I-270 Corridor can happen at any time with the amount of traffic that flows through the corridor. The following scenario defines the actions taken by the

stakeholder agencies using the I-270 ICMS when vehicles are involved in a crash that cannot be moved to the shoulder.

Just as the afternoon rush is about to begin, two vehicles traveling northbound on I-270, just past the I-370 exit, collide and one vehicle hits the barrier wall and comes to an abrupt stop. The driver of the first vehicle is able to maintain control and eventually brings the vehicle to a stop. The shoulder/emergency lane and the right lane are blocked, with debris in the middle lane. Both vehicles are unable to move to the shoulder lane.

The accident is reported by a cellular call to the Montgomery County 911 Center. Since the 911 Center incorporates police and fire dispatch and is co-located with the transportation management center within Montgomery County, responding agencies are notified almost immediately as the 911 information was added to the CAD/AVL System. Transportation managers are simultaneously notified via the CAD/I-270 ICMS interface. Transportation Management Center operators in the County use the CCTV camera nearest the crash location to verify the incident location and description. County CCTV video of the scene is distributed through the I-270 ICMS for access by involved emergency response and traffic management agencies.

Preliminary information is provided directly to travelers via the I-270 ICMS and via Information Service Providers and media outlets (using websites and radio outlets). Warning messages are placed on DMS signs leading to the I-270 Corridor, advising motorists to be alert and that delays are possible. The I-270 ICMS, based on incident location as well as current and archived system conditions, recommends whether alternate route and/or mode information should be provided.

The first arriving officer uses the patrol car to block the right lane ahead of the wrecked vehicles causing the traffic to slow and merge into the open lanes. The officer calls for a wrecker to remove the disabled vehicles. The tow company dispatcher, after receiving the call, views the CCTV video of the scene through the I-270 ICMS web interface, to ensure the proper equipment is dispatched. The emergency medical team administers first aid and monitors the victims for adverse signs of trauma. The Emergency Response Unit (ERU) arrives to set up traffic control upstream of the accident, warning drivers of the problem area by using his flashing light board. Two wreckers arrive at the scene, and each load a vehicle to be removed from the roadway. Each driver is able to ride with the tow trucks to a location of their choosing. The Emergency Medical team leaves the area, followed by the Police. While the response agencies are about to clear the incident scene, the ERU turns off the emergency flasher and leaves the incident area. Since the traffic volume increased steadily during the incident at the beginning of the afternoon rush hour, the traffic takes quite a long time before resuming to normal flow. The information on the traveler information devices, particularly the DMS and HAR/TAR, are adjusted to change from typical information about an incident to a message indicating worse-than-normal traffic due to the accident conditions. Information provided includes I-270 ICMS estimated travel times, based on real-time incident conditions.

During the incident, some vehicles utilize the Collector/Distributor lanes (i.e., Local Lanes) to get around the crash scene. As the local lanes quickly fill to capacity, traffic exits at I-370 and proceeds to detour to either MD-355 or to Great Seneca Highway (MD-119). The operators at the Transportation Management Center in Montgomery County use I-270 ICMS information to verify the traffic flow impacts, and traffic signal cycle lengths are adjusted for the added flow. Those travelers that detoured on to Great Seneca Highway return to I-270 at Quince Orchard Road (MD-117) to find traffic free flowing and are able to resume their original commute. The traffic detouring to MD-355 also returns to I-270 at Montgomery Village Avenue (MD-124) to resume their commute as well.

2.7.4 Major Traffic Incident Scenario

In the event of a major traffic accident involving several vehicles and multiple response agencies in the I-270 Corridor, all partner agencies and additional stakeholders will use the I-270 ICMS to facilitate operational coordination and optimize multi-modal transportation system travel in the corridor.

Due to fog in the early morning hours and several motorists ignoring the posted DMS messages advising them to reduce speed, a multi-vehicle crash involving commercial vehicles occurs along the southbound I-270 Corridor at the Shady Grove Road interchange. One tractor-trailer carrying a hazardous substance overturns, with a second commercial vehicle damaging the middle overpass support. Several points along the dividing traffic barrier between the north- and south-bound lanes are damaged. Almost immediately, a motorist places a cellular call to the 911 Center in Montgomery County; however, the motorist is unable to report the specific details of the incident other than the general location and number of lanes that appear to have been impacted.

Since the 911 Center incorporates police and fire dispatch and is co-located with the Transportation Management Center within Montgomery County, responding agencies are notified almost immediately as the 911 information was added to the CAD/AVL System. Transportation managers are simultaneously notified via the CAD/I-270 ICMS interface. Transportation Management Center operators in the County use the CCTV camera nearest the crash location to verify the incident location and description. Incident information including County CCTV video of the scene is distributed through the I-270 ICMS for access by SHA's CHART System in addition to involved emergency response and traffic management agencies in the corridor (and across the region).

As the first police officer arrives at the scene, she realizes the impact of the crash because of the commercial vehicle carrying the hazardous substance. Using the HAZMAT placard, the officer accesses, via her mobile computer, the Emergency Response Guide (ERG) to determine product information and initial precautions to take. The commercial carrier's dispatch center is notified of the severity of the incident through police dispatch. Fire and EMS responders, based on HAZMAT placards, realize that a hazardous chemical release may be involved which escalates the situation. The beginning of an incident command structure is established. Traffic both north- and south-bound is stopped. The first EMS unit arrives and, observing multiple injuries, immediately calls for medical support and requests dispatch of a medical helicopter. The Maryland Department of Environment is notified by police dispatch and CHART operators of the incident and are dispatched to assist HAZMAT crews with clean up / remediation.

Preliminary information is immediately provided directly to travelers via the I-270 ICMS and via Information Service Providers and media outlets (using websites and radio stations). Warning messages are placed on DMS signs and HAR leading to the I-270 Corridor, advising motorists to be alert and to expect major delays due to road closures and implementation of detour routes. The I-270 ICMS, based on incident location as well as current and archived system conditions, recommends that alternate route and/or mode information be provided and that travelers who have not initiated their trip avoid the corridor altogether.

Travelers who have not left their homes see that the incident is being reported by local television news outlets as well as the County's cable channel. The I-270 ICMS website indicates that major delays are to be expected. While the website incorporates a multi-modal trip planning capability, due to the nature and expected duration of this incident, travelers who have not yet left home are encouraged to postpone or avoid their trip altogether if possible. For those who have no choice, the trip planning feature suggests use of Metro including parking availability at Metro parking facilities (overall expected trip duration is also provided). The website also provides details of the detour routes based on the pre-planned Freeway Incident Traffic Management (FITM) plans.

Travelers en-route will continue to receive updated information via agency-owned fixed assets (DMS, HAR) as noted above. In addition, with the I-270 ICMS, the en-route traveler will have access to updated information via web-enabled mobile devices and in-vehicle navigation devices.[3] Ultimately, the I-270 ICMS will provide the capability for real-time multi-modal decision support that includes detailed multi-modal navigational guidance.

Transportation Emergency Response Units and Emergency Traffic Patrols arrive to assist with traffic control for closures and set up the FITM detour routes and temporary signing. The Metrorail and Metrobus systems, in conjunction with the MARC Train system, prepare for increased ridership based on preplanned Standard Operating Procedures (SOP's). The Emergency Response Units are equipped with mobile computing and the Capital Wireless Information Net (CapWIN) system application. These units, together with Maryland State Police units on scene, join the incident and provide additional details from the scene. This additional information is fed back into the I-270 ICMS which, in turn, updates existing transportation management systems in the corridor (CHART, Montgomery County ATMS, WMATA) as well as region wide transportation centers (VDOT Northern Virginia Smart Traffic Center and the DC Transportation Management Center) and emergency management centers (Maryland, DC, and Virginia Emergency Management Agencies). CHART communicates with TRANSCOM which, in turn, provides incident information up and down the east coast in conjunction with the I-95 Corridor Coalition. Mobile phone and digital camera images (still and video) from the scene are uploaded into the CapWIN system application and added to the incident as an I-270 ICMS resource (note: these images are restricted to operational agencies for distribution). Scene information and area wide impacts are also captured by the County's traffic plane using video images transmitted from the plane to the County ATMS and into the I-270 ICMS for access by emergency response and traffic management agencies.

As the incident unfolds, there are three major areas of concern: (1) life and health safety of those involved in the crash; (2) the commercial vehicle containing the hazardous materials; and (3) the structural damage to the overpass and barrier wall.

The I-270 ICMS facilitates the operational response towards addressing these areas of concern by:

- Enhancing the provision of continuously updated scene information (situational awareness) which quickly and efficiently identifies and communicates the safest landing zone for the MEDIVAC helicopter.
- Providing the mechanism to exchange real-time information as to the nature of the hazardous materials, the potential impact zone, the identified evacuation zone (if necessary), and the ongoing status of HAZMAT operations.
- Providing access to immediate detailed scene imagery of structural damage to the overpass which can be shared with County, State, and even Federal structural experts for decisions on whether to close the overpass as well as temporary structural fixes.
- Providing access to and the exchange mechanism for status of FITM detour implementation as well as multi-modal response plans.
- Providing a one-stop shop for continuous monitoring of multi-modal transportation system conditions (freeway, arterials, Metrorail, commuter rail, and county/WMATA buses).
- Based on incident conditions, providing recommended freeway and arterial DMS and HAR messages as well as implementation of new traffic signal timing plans.
- Providing access to and the exchange mechanism for distribution of fixed CCTV video assets as well as mobile assets regardless of owning agency (note: control will NOT be shared).
- Providing access to continuous multi-modal traveler information, whether pre-trip or en-route, including trip planning decision support tools.

[3] These types of services will likely be implemented in conjunction with a private Information Service Provider.

2.7.5 Evacuation Scenario

A Category 4 Hurricane is approaching the Chesapeake Bay area. It is predicted that the eye will pass directly over the Washington, D.C. area. The governing officials within the entire metropolitan area have issued an evacuation order for the surrounding areas. Regional emergency management officials have notified the transportation agencies of a pending evacuation order for the region, including the I-270 Corridor.

Based on modeling and analyses of such an emergency scenario (performed on a regional, statewide, and multi-state basis), it is well understood that the evacuation order will significantly impact all modes of transportation within the I-270 Corridor; however, the freeway facility will be the primary route for the evacuation. Rail service to outlying stations combined with bus service from the stations to designated shelters (outside the zone of predicted storm surge) will also need to be provided for those residents who do not own cars.

Evacuation routes, designated shelters, and related emergency procedures have been identified in regional evacuation plans (e.g., those developed by Maryland's Regional Operations Coordination Committee). In accordance with established plans, the State Joint Operations Center operated by the Maryland Emergency Management Agency and the Emergency Operations Center (EOC) for Montgomery County are activated for managing the evacuation for routes throughout the Maryland suburbs including north through the I-270 Corridor.

The I-270 ICMS facilitates the operational response towards addressing the evacuation by:

- Providing the mechanism for data exchange both prior to and during the hurricane response.
- Providing access to pre-planned multi-modal response plans.
- Providing suggested coordinated DMS/HAR messages to travelers on freeways, arterials, and transit systems in the corridor.
- Providing a one-stop shop for continuous monitoring of multi-modal transportation system conditions (freeway, arterials, Metrorail, commuter rail, and county/WMATA buses).
- Providing access to and the exchange mechanism for distribution of fixed CCTV video assets as well as mobile assets regardless of owning agency (note: control will NOT be shared).
- Providing access to continuous multi-modal traveler information, whether pre-trip or en-route, including trip planning decision support tools.

It should be noted that this plan focuses only on an evacuation scenario. The I-270 ICMS could incorporate additional plans that have been developed for coordinating transportation clean-up and clearance activities (e.g., prioritize and perform emergency repairs), and for re-entry into the evacuated areas.

3. System Capabilities, Conditions, and Constraints

3.1 Physical

This section delineates the physical capabilities, conditions, and constraints placed upon the I-270 ICM System.

Note that ITS field equipment (e.g., CCTV cameras, dynamic message signs, traffic signals) are not discussed directly in this section, as this equipment is owned, maintained, and operated by individual corridor stakeholder agencies. This equipment and associated control systems are treated as external systems in the overall I-270 ICMS context, as shown in Figure 2, Maryland I-270 ICMS Component Diagram, on page 17.

3.1.1 Construction and Environmental Conditions

Construction and environmental conditions pertain to the computer hardware, peripherals, and communications components of the I-270 ICM System. A number of detailed physical characteristics will be addressed during the design of the system, including:

- Sufficient electrical capacity to support all identified equipment, along with spare capacity to accommodate future expansion needs. This also includes backup support to address power failure scenarios, such as the implementation of uninterruptible power supplies (UPS) and gas generators.
- Temperature control ensuring that the system hardware operates within specified tolerances so as not to overheat or become inoperable due to very low temperatures.
- Adequate lighting to operate and maintain the system
- Clean air quality to provide reasonable operating conditions for personnel and equipment
- Sufficient physical space to ensure equipment does not overheat and to accommodate future system expansion.
- Enclosures (e.g., equipment cabinets) to provide security, protect equipment, and organize related hardware components with access to switches, system panels, peripherals, cabling, etc. to simplify maintenance efforts.
- Markings and labeling for each system component with ID numbers and descriptions as necessary. This is also important for system cabling to minimize cause confusion when maintaining, modifying, or replacing equipment. Equipment identification and description information will be entered and maintained in a database for inventory control.

Physical restrictions to the server/equipment room(s) will also be implemented so that only authorized personnel will be permitted access to this critical system.

3.1.2 Durability

The durability of the physical system components is critical to ensure proper system operation over a long period of time. As such, a number of “safeguards” will be employed to maximize the longevity of the system. This includes:

- Extended warranties and service contracts will be procured to ensure that (1) any issues are dealt with as quickly as possible, and (2) any unplanned system downtime is minimized.

- Redundant equipment (e.g., application/database and communications servers, Redundant Array of Independent Disks (RAID) devices) will be procured and configured to automatically take over operations in the event of a primary system component failure. Properly configured spare equipment will also be on hand if a switchover is needed. This spare equipment can also be utilized for development and testing of system enhancements and system training purposes.

- Plans and designs will be developed to ensure that replacement system hardware (servers, workstations, monitors, peripherals, etc.) is procured every 3-5 years to take advantage of new advances in technology to improve system performance, functionality, expandability, and maintainability.

- Hardware and peripheral selection will be from vendors with sufficient market share to ensure adequate ongoing support with readily available upgrade and maintenance paths.

Section 3.1.1, above, also addresses various conditions to ensure a conducive environment for the operational equipment.

3.1.3 Adaptability

The I-270 ICM System will be designed to address the likelihood for system expansion in a variety of areas, such as performance, geographic implementation areas and associated roadways, number of stakeholders and interfaced systems, and number of users. For example, the system will be designed for potential expansion to the entire Washington Metropolitan area covering additional freeway, arterial, and transit networks. Likewise, possible upgrade paths will be examined as options that can be exercised as additional growth needs become apparent.

The design of the system will include an analysis of the initial planned system size along with anticipated growth over different periods of time. This will allow the system designers to specify additional capacity at the outset of the system to support expansion needs. Areas of expansion to be addressed include:

- Physical space for central system equipment
- Server capacity – Number of servers, processors, memory, disk space
- Workstations – Number of workstations for system administration, maintenance, and development
- COTS software licensing – Database management system (DBMS), Geographic Information System (GIS), reporting engine, etc.
- Communications capacity – Network bandwidth
- System functionality – For example, additional decision support capabilities, data analysis/reporting functions, etc.

System designers will also address possible re-allocation and/or contraction of the ICM System. For example, corridor stakeholders may determine that travelers would be better served if the system was focused on a smaller section of the I-270 corridor. In this situation, the system resources may need to be re-allocated and re-configured to support a smaller, yet potentially more concentrated, geographic area.

3.2 System Performance Characteristics

A wide variety of critical system performance conditions have been identified resulting in the creation of several specific performance requirements, such as:

- Data Exchanges:
  - Disseminating data to travelers within 180 seconds of receipt from source systems.
  - Disseminating data to external systems for dissemination to travelers within 180 seconds of receipt from source systems.
  - Publishing real-time corridor transportation data to stakeholder agency systems within 180 seconds of receipt from the source systems.
  - Processing a minimum of 50 concurrent data exchange interfaces.

- ITS Device Control:
  - Requesting modification of messages on I-270 DMS within 120 seconds upon identification of changing traffic conditions within the corridor. Similar for requests for HAR/TAR messages and traffic signal timing plans.

- User Interface:
  - ICMS agency web site storage for up to 10 million user accounts. Similar for ICMS public web site and ICMS administration web site.
  - ICMS agency web site processing for up to 10 million concurrent users. Similar for ICMS public web site and ICMS administration web site.

Corridor-level performance measures will also be established to determine the effectiveness of the I-270 ICM strategies and operations in comparison to corridor goals and objectives. Performance measures will be available to authorized users through a number of data analysis and reporting capabilities. Sample performance measures include the following:

- Travel time comparisons under varying conditions
- Incident response and clearance times
- Number of data exchanges between stakeholders for incident management coordination and traveler information sharing
- ICMS public web site usage
- Measures of consistency between traveler information disseminated through various means and agencies during similar events.

System endurance capabilities will also be measured during real-life operations and environmental conditions and compared with established goals. This will include assessments of system components in terms of usage versus capacity. Typical system components to be evaluated are system processors, memory, disk space, and network bandwidth. Overall system up time is also a widely used performance measure. Given that the I-270 ICMS is considered a mission-critical system, a goal of close to 100% system up time has been established.

3.3 System Security

System security can be addressed in terms of physical security as well as software/data security. Physical security is associated with protecting the physical assets of the ICM system. This includes items such as hierarchical, authentication-based access to the physical facility housing the ICMS servers and other hardware, as well as system communications hubs.

Software/data security can be addressed through a number of safeguards, such as data encryption, firewalls, tiered access protection, and attack detection software. Capabilities will be developed to address the following specific security needs:

- Prevent dissemination of sensitive and inappropriate corridor transportation information to non-authorized recipients.
- Protect against unauthorized access to sensitive information in the ICMS database.
- Protect against unauthorized access to underlying data exchanged with stakeholder agency systems.
- System backup and restore capabilities, including off-site data/software storage as necessary.
- Send automatic alerts to System Administrators when a system failure occurs.
- Protect against unauthorized access through the following ICMS user interfaces:
    - ICMS Agency web site
    - ICMS Public web site
    - ICMS Administration web site

As an example, User ID and Password prompts will be implemented for each of the ICMS user interfaces to authenticate user access. Users will be given varying levels of permission depending on their needs. In the case of the ICMS Agency web site, permission levels will include (from lowest to highest):

- Read-only (e.g., report generation, view data)
- Transportation data updates (e.g., event updates)
- Agency-specific system administration/configuration access
- Overall ICMS system administration/configuration access

A limited number of System Administrators will be responsible for managing user accounts and permissions for respective users.

3.4 Information Management

The benefits of the resulting I-270 ICM System will be directly tied to the data that is collected, stored, integrated, and disseminated by the system. As such, the system's information management components are critical and must be carefully designed to satisfy a diverse set of requirements. Information management components will reside in several envisioned sub-systems as follows:

- Data Collection – Data will be collected from several corridor stakeholder agency systems supporting freeway, arterial, and transit networks. A list of planned data types is shown in Table 3, ICM System Data Types, on page 55. A robust, industry standard relational database management system (DBMS) will be used to store all collected transportation data. Data access security will be implemented through various means as discussed in Section 3.3, System Security, above.

- Data Fusion/Integration – All collected data will be verified for accuracy through a series of error detection, error correction, and reasonability checks. Verified data will be organized, correlated, and processed for subsequent analysis and dissemination. All collected data will remain online for a period of at least 365 days. As mentioned previously, analysis will be conducted during the design phase to properly size the system databases based on current requirements and potential future expansion needs.

- Data Dissemination – The system will manage and organize data for dissemination to (1) corridor stakeholder systems for operational use and decision support purposes through publish/subscribe mechanisms and web-based user interfaces, (2) information service provider systems for ultimate dissemination to the public, and (3) the traveling public through "push" and "pull" technologies (e-

mail/fax/pager-based notification subscriptions, web sites, 511/IVR (Interactive Voice Response), etc.).

- Data Archiving and Data Analysis – Data will also be archived for offline use, but readily available for performance measurements and data analysis needs to compare actual performance against specific quantitative corridor goals and objectives. Data analyses can be performed on an ad-hoc request basis as needed or through automatic, periodic, scheduled reporting capabilities. In addition, data backup and restoration capabilities will be provided to satisfy data storage, redundancy, and security needs.

In addition to the above ICMS sub-systems, proper configuration management will be maintained throughout the project system development lifecycle. This starts with the development and implementation of a version control repository for system requirements that will be traced throughout the design, development, testing, and implementation phases of the project. All software developed for the system will be maintained in a configuration management repository for system builds and version histories. Likewise, all system documentation (e.g., design, test procedures, manuals) will be stored under configuration control.

3.5 System Operations

This section addresses operational aspects of the I-270 ICM System, including human factors and system maintenance and reliability strategies.

3.5.1 System Human Factors

Given the importance of the I-270 ICM System and the number and diversity of potential stakeholders utilizing the system, human factors are an important consideration in establishing the requirements and design of the user interface for the system.

An overview of the planned web-based system user interfaces is provided in Section 4.4, User Interfaces, on page 66. Likewise, detailed user interface requirements are listed in the User Interface section within Table 8, I-270 ICM System Requirements, starting on page 125.

A number of human factors will be addressed in designing the web sites for each of the stakeholder user types, including:

- Functional organization
- System responsiveness (tied to system hardware and performance requirements)
- Adherence to industry standards (e.g., text attributes such as fonts and colors)
- Consistency (e.g., navigation, wording)
- Availability of help/user guides
- Screen resolution needs
- Support for multiple web browsers
- Compliance with Section 508 standards for accessibility

Usability testing will be conducted throughout the design and development phases of the project to ensure the resulting system meets the needs of its users. For example, web site mockups and prototypes will be given to representative users for review and feedback.

3.5.2 System Maintainability and Reliability

System maintainability and reliability play critical roles in mission-critical systems such as the I-270 ICMS. The system will run in a 24x7 environment with at least 99% availability. This equates to a maximum of 87.6 hours of downtime over a one-year period, for system maintenance (e.g., system upgrades, data backup/restore) and recovery from system failures. A number of strategies will be employed to minimize system downtime, including:

- Implementation of a high-availability networking data center for the system hardware, including:
    - Redundant application, database, and communications servers
    - Redundant, high-speed connections to all major Internet backbones
    - Redundant power supplies
    - Redundant cooling and humidity control
    - System component labeling with ID numbers and descriptions as necessary. Equipment identification and description information will be entered and maintained in a database for inventory control.

- Procurement of replacement system hardware every 3-5 years.

- Selection of hardware and peripherals from vendors with sufficient market share to ensure adequate ongoing support with readily available upgrade and maintenance paths. Hardware warranty services with Service Level Agreements (SLA's) for specified response and resolution times will be implemented.

- Development of a secure web-based System Administration user interface for system configuration and maintenance purposes.

- Onboard System Administrators to:
    - Diagnose and fix operational problems
    - Maintain data sources and communications network
    - Backup data regularly
    - Maintain a uniform, consistent interface to data for maintenance personnel
    - Maintain system and database system security
    - Maintain user accounts
    - Maintain computer systems, database servers, and web servers
    - Ensure integrity of system

- Ongoing utilization of system development personnel to fix bugs in the system (using a similarly configured test system) and implement changes in the production system.

- Development of system capabilities to automatically alert System Administrators when a system failure occurs (within one minute of failure detection).

Additional system maintenance and reliability parameters will be defined during system design.

3.5.3 System Modes and States

The I-270 ICMS will allow for operation in the following three primary modes and associated states.

1. On-Line Mode: The I-270 ICMS will be considered in on-line operational mode under the following major state conditions:
    a. All sub-systems are operational

b. All freeway, arterial, bus, and rail system interfaces are operational
c. Decision Support Data, Multi-Network Data, and Traveler Information interfaces are operational

2. Degraded Mode: The I-270 ICMS will be considered in degraded mode under the following major state conditions:
    a. Failure of any one or more sub-systems
    b. Failure of any one or more interfaces:
        i. Freeway Data
        ii. Arterial Data
        iii. Bus Data
        iv. Rail Data
        v. Decision Support Data
        vi. Multi-Network Data
        vii. Traveler Information

    While the system may continue to operate in degraded mode, it must be clear to system users as to the sub-systems and/or interfaces that are inoperable.

3. Training Mode: The I-270 ICMS will include a training mode that allows for user interaction without impacting any real-time data exchanges.

The system will be capable of controlling mode and state transitions by an authorized System Administrator. Additional modes, sub-modes, and states will be developed during system design. In no case should any ICMS mode or state impact the stand-alone operation of any external system.

3.6 Policy and Regulation

Given the number of stakeholder agencies within the corridor, the I-270 ICMS will emphasize cross-agency and cross-modal coordination that may require new or revised policies and procedures related to coordinated transportation operations. Initially, addressing new or changes to policies and procedures will be the responsibility of the I-270 ICM Steering Committee but, ultimately, will fall within the purview of the Metropolitan Area Transportation Operations Coordination (MATOC) program.

Agency IT institutional coordination will be conducted to determine data exchange logistics and examine compatibility of planned data interfaces between systems. Agency firewalls will need to allow I-270 ICMS information to flow in and out while preventing system incursions. Policies on data privacy and security will also need to be examined, as will the need to restrict potentially sensitive data such as that from CAD systems.

I-270 ICM stakeholders will develop policies for coordinated modal shifts utilizing system decision support tools in the form of, for example, recommended multi-modal trip itineraries based on real-time information.

Additional I-270 ICMS policies and procedures will include:

- Coordinated traffic management and incident management within the corridor.
- Determining authority for decision-making pertaining to transportation-related issues based on location, type of incident, etc.
- Implementing demand/capacity management strategies in the corridor.
- Incident response and reporting in the corridor.
- Video distribution/censoring policy.

- Operations and Maintenance Plan for the corridor.
- Standardized DMS message displays for similar incidents within the corridor.

3.7 System Life-Cycle Sustainment

The effectiveness of the I-270 ICM System will be evaluated using a series of metrics, based on collected data, to determine performance trends and compare actual performance with pre-defined corridor goals and objectives. Performance measures will be available to authorized users through various web-based data analysis and reporting capabilities. System reports can be generated on an ad-hoc request basis or through an automatic, scheduled reporting capability.

Sample performance measures include the following:

- Travel time index for a trip, i.e., ratio of travel times in the peak period or other corridor condition to a target or acceptable travel time (e.g., freeflow/on-schedule conditions)
- Buffer index for a trip, i.e., amount of extra "buffer" time needed to be on-time 95% of the time
- Average delay for a specified trip, segregated by incident and event types
- Incident response times
- Incident clearance times
- Time required to channel a potential evacuation
- Number of data exchanges between stakeholders for incident management, sharing traveler information display information, and sharing information about parking space availability
- Number of "cross-network" messages displayed on all DMS within the corridor within a specified period of time
- Number of corridor-related ICMS public web site hits within a specified period of time
- Number of corridor-related 511/IVR calls within a specified period of time.
- Average parking availability by facility and time of day
- Comparisons of traveler information disseminated by different agencies for the same or similar incidents or events
- Uniformity of messages across DMS within the corridor

The I-270 ICMS will also include capabilities to create, modify, and present corridor traveler surveys, and record and report results as additional measures of effectiveness.

4. System Interfaces

This section summarizes the requirements for I-270 ICM interfaces to existing and future systems and components. Detailed system interface requirements can be found primarily in the Data Collection, Traveler Information Dissemination, Data Exchanges with Other Systems, and User Interface sections within Table 8, I-270 ICM System Requirements, starting on page 74.

Information pertaining to ICM system interfaces is organized as follows:

- System Data Types
- System Data Exchanges
- System Data Exchange Methods, Standards, and Frequencies
- User Interfaces

4.1 System Data Types

In order to define the requirements for the I-270 ICMS data interfaces, it is important to first identify the types of data to be collected and stored in the ICM system database(s). A compiled set of data types is shown in Table 3, below, and is organized into the following categories:

- Event Data
- Work Zone Data
- Surveillance Data
- Transit-Specific Data
- Travel Options Data
- Parking Data

The columns in Table 3 are as follows:

- Data Type – A description of the data type and underlying data elements, if applicable.

- Associated Network/Travel Mode – The network(s) (i.e., Freeway, Arterial, Transit) that each data type is associated with.

- Input – The types of data that are input into the system through incoming data exchanges from other systems or via direct data entry. Each incoming data exchange is generally from an individual agency-specific travel mode/network.

- Output – The types of data that are output from the system for use by stakeholder agencies, travelers, or third-party entities. Specific data outputs can represent multiple travel modes/networks (e.g., event response plans, travel times between designated points) through the integration of a variety of input data.

- Disseminate to Stakeholder Agencies – The types of data that are available to corridor agency users.

- Disseminate to Travelers – The types of data that may be provided to travelers through various means (e.g., DMS, 511, etc.).

Table 3 – I-270 ICM System Data Types

Data Type	Associated Network/Travel Mode			Input	Output	Disseminate to Stakeholder Agencies	Disseminate to Travelers
	Freeway	Arterial	Transit				
Event Data (Includes Incidents)							
Event Type: • Accident • Transit Disruption/Schedule Change • Disabled Vehicle • Debris • Signal System Failure • Fire	✓	✓	✓	✓	✓	✓	✓
Event Location: • Latitude/Longitude Coordinates • Primary Road • Intersecting Road • Mile-Marker or Log-Mile	✓	✓	✓	✓	✓	✓	✓ (except for Lat./Long. Coordinates, Mile-Marker or Log-Mile)
Event Start Date and Time	✓	✓	✓	✓	✓	✓	✓
Event Severity Levels	✓	✓	✓	✓	✓	✓	✓
Individual Lane Status (Open or Closed, including timestamps): • Shoulders • Normal Lanes • Ramps • Collector Distributors • Turning Lanes	✓	✓	✓	✓	✓	✓	✓
Event Notifications (including timestamps): • Other Operations Centers • Police, Fire, and Rescue • Hazardous Materials • Media • Public	✓	✓	✓	✓	✓	✓	✓

Data Type	Associated Network/Travel Mode			Input	Output	Disseminate to Stakeholder Agencies	Disseminate to Travelers
	Freeway	Arterial	Transit				
Deployment Status (including timestamps for on-scene arrival and departure): • Medical Services • Safety Service Patrols • Police, Fire, and Rescue • Hazardous Materials Crews • Towing and Recovery	✓	✓	✓	✓	✓	✓	✓
Event Messages on Highway Advisory Radio	✓	✓	✓	✓	✓	✓	✓
Event Messages on Dynamic Message Signs	✓	✓	✓	✓	✓	✓	✓
Status of Cleanup Effort: • Expected Duration • Expected Lane Openings • Expected Return to Free Flow	✓	✓	✓	✓	✓	✓	✓
Event Detours or Rerouting Alternatives	✓	✓	✓	✓	✓	✓	✓
Event Detection Source: • CCTV Camera • Police CAD • Service Patrols • Motorist • Media	✓	✓	✓	✓	✓	✓	
Event Response Plans (including definitions and implementation timestamps): • Predetermined Signal Timings • Predetermined Lane Reconfigurations • Predetermined Detours	✓	✓	✓	✓	✓	✓	
Traffic Operations Logs and Communications	✓	✓	✓	✓	✓	✓	

Data Type	Associated Network/Travel Mode			Input	Output	Disseminate to Stakeholder Agencies	Disseminate to Travelers
	Freeway	Arterial	Transit				
Event Shelters for Hurricanes or Other Natural Disasters Requiring Evacuations	✓	✓	✓	✓	✓	✓	✓
Event Staging Areas for Large Scale Events	✓	✓	✓	✓	✓	✓	
Event Point of Contact: • Name • Phone Number • Agency • Role	✓	✓	✓	✓	✓	✓	✓
Event End Date and Time	✓	✓	✓	✓	✓	✓	✓
Event – Equipment: • Availability • Location	✓	✓		✓	✓	✓	
Work Zone Data							
Work Zone Type: • Milling/Paving • Mobile Operations • Mowing • Signal Maintenance • Track Maintenance	✓	✓	✓	✓	✓	✓	✓
Work Zone Location (Starting and Ending) • Latitude/Longitude Coordinates • Primary Road • Intersecting Road • Mile-Marker or Log-Mile • Rail Station(s) • Rail Line(s)	✓	✓	✓	✓	✓	✓	✓ (except for Lat./Long. Coordinates, Mile-Marker or Log-Mile)

Data Type	Associated Network/Travel Mode			Input	Output	Disseminate to Stakeholder Agencies	Disseminate to Travelers
	Freeway	Arterial	Transit				
Work Zone Schedule: • Proposed Start Time • Actual Start Time • Proposed End Time • Actual End Time	✓	✓	✓	✓	✓	✓	✓
Individual Lane Status (Open or Closed, including timestamps): • Shoulders • Normal Lanes • Ramps • Collector Distributors • Turning Lanes	✓	✓		✓	✓	✓	✓
Work Zone Lane Impacts (Open or Closed) for: • Shoulders • Normal Lanes • Ramps • Collector Distributors • Turning Lanes	✓	✓		✓	✓	✓	✓
Rail Status (Open or Closed, including timestamps): • Rail Lines • Rail Stations • Rail Tracks			✓	✓	✓	✓	✓
Rail Impacts (Open or Closed) for: • Rail Lines • Rail Stations • Rail Tracks			✓	✓	✓	✓	✓
Work Zone Notifications (including timestamps): • Other Operations Centers • Media • Public	✓	✓	✓	✓	✓	✓	✓

Data Type	Associated Network/Travel Mode			Input	Output	Disseminate to Stakeholder Agencies	Disseminate to Travelers
	Freeway	Arterial	Transit				
Work Zone Point of Contact: • Name • Phone Number • Agency • Role	✓	✓	✓	✓	✓	✓	
Work Zone Messages on Highway Advisory Radio	✓	✓		✓	✓	✓	✓
Work Zone Messages on Dynamic Message Signs	✓	✓		✓	✓	✓	✓
Work Zone Response Plans: • Detour routes • Signal Timings	✓	✓	✓	✓	✓	✓	
Work Zone – Equipment: • Availability • Location	✓	✓	✓	✓	✓	✓	
Work Zone Permit Numbers	✓	✓	✓	✓	✓	✓	
Surveillance Data							
Freeway Video – Agency-Accessible	✓			✓	✓	✓	
Freeway Video – Traveler-Accessible	✓			✓	✓		✓
Arterial Video – Agency-Accessible		✓		✓	✓	✓	
Arterial Video – Traveler-Accessible		✓		✓	✓		✓
Transit Video – Agency-Accessible			✓	✓	✓	✓	
Transit Video – Traveler-Accessible			✓	✓	✓		✓
Freeway Point Detection: • Volume • Speed • Occupancy • Classification (length)	✓			✓	✓	✓	✓

Data Type	Associated Network/Travel Mode			Input	Output	Disseminate to Stakeholder Agencies	Disseminate to Travelers
	Freeway	Arterial	Transit				
Arterial Point Detection: • Volume • Speed • Occupancy • Classification (length)		✓		✓	✓	✓	✓
Roadway Weather Information Systems Data: • Air Temperature • Pavement Temperature • Wind Speed	✓	✓	✓	✓	✓	✓	✓
National Weather Service Data: • Radar • Cloud Cover • Severe Weather Alerts • Forecasts	✓	✓	✓	✓	✓	✓	✓
Intersection Approach Volumes (Downstream)		✓		✓	✓	✓	
Link Travel Times	✓	✓	✓	✓	✓	✓	✓
Road/Transit Weather Data	✓	✓	✓	✓	✓	✓	✓
ITS Device Identification and Location – CCTV, DMS, Traffic Signals, Traffic Flow Detectors, HAR/TAR, Parking Sensors, Highway-Rail Intersection (HRI) Equipment	✓	✓	✓	✓	✓	✓	
ITS Device Messages – DMS, HAR/TAR	✓	✓	✓	✓	✓	✓	✓
ITS Device Status	✓	✓	✓	✓	✓	✓	
ITS Device Quality/Reliability	✓	✓	✓	✓	✓	✓	
Transportation Network Demand	✓	✓	✓	✓	✓	✓	
Transportation Network Capacity	✓	✓	✓	✓	✓	✓	

Data Type	Associated Network/Travel Mode			Input	Output	Disseminate to Stakeholder Agencies	Disseminate to Travelers
	Freeway	Arterial	Transit				
Current Service Patrol Vehicle Locations (AVL)	✓	✓		✓	✓	✓	
Current Emergency Response Vehicle Locations (AVL)	✓	✓	✓	✓	✓	✓	
Tolling Data (Future)	✓			✓	✓	✓	
Transit-Specific Data							
Current Bus Location (AVL)			✓	✓	✓	✓	✓
Estimated Next Bus Arrival Time			✓	✓	✓	✓	✓
Bus Schedules			✓	✓	✓	✓	✓
Bus Schedule Adherence Data			✓	✓	✓	✓	✓
Bus Schedule Changes (Ad-Hoc)			✓	✓	✓	✓	✓
Bus Capacity Changes (Ad-Hoc)			✓	✓	✓	✓	✓
Bus Routes			✓	✓	✓	✓	✓
Bus Transfer Options			✓	✓	✓	✓	✓
Current Train Location			✓	✓	✓	✓	✓
Estimated Next Train Arrival Time			✓	✓	✓	✓	✓
Train Schedules			✓	✓	✓	✓	✓
Train Schedule Adherence Data			✓	✓	✓	✓	✓
Train Schedule Changes (Ad-Hoc)			✓	✓	✓	✓	✓
Train Capacity Changes (Ad-Hoc)			✓	✓	✓	✓	✓
Train Routes			✓	✓	✓	✓	✓
Train Transfer Options			✓	✓	✓	✓	✓
CAD/AVL Data			✓	✓	✓	✓	
Transit Delays			✓	✓	✓	✓	✓
Transit Fares			✓	✓	✓	✓	✓
Current and Historical Ridership Data			✓	✓	✓	✓	
Elevator/Escalator Status			✓	✓	✓	✓	✓

Data Type	Associated Network/Travel Mode			Input	Output	Disseminate to Stakeholder Agencies	Disseminate to Travelers
	Freeway	Arterial	Transit				
Travel Options Data							
Multi-Modal Connection Information	✓	✓	✓		✓	✓	✓
Alternate Strategies/Modes (with Travel Times)	✓	✓	✓	✓	✓	✓	✓
Traffic Detour Routes	✓	✓		✓	✓	✓	✓
Travel Times Between Designated Points	✓	✓	✓	✓	✓	✓	✓
Travel Time Reliability (Comparison to Historical Data)	✓	✓	✓	✓	✓	✓	✓
Parking Data							
Parking Locations			✓	✓	✓	✓	✓
Current Vehicle Volumes at Parking Locations			✓	✓	✓	✓	✓
Total Vehicle Capacity at Parking Locations			✓	✓	✓	✓	✓
Parking Availability at Parking Locations			✓		✓	✓	✓
Locations of Available Parking Spaces (Within Lots)			✓	✓	✓	✓	✓
Parking Fees			✓	✓	✓	✓	✓
Bus Routes Served			✓	✓	✓	✓	✓
Other Data							
System Configuration Parameters	✓	✓	✓				
User Account Data	✓	✓	✓	✓			
Corridor Map Data	✓	✓	✓	✓	✓	✓	
System Communications Network Status	✓	✓	✓	✓	✓	✓	
System Performance Goals	✓	✓	✓	✓	✓	✓	

4.2 System Data Exchanges

Section 2.2.2, ICMS External Systems, on page 25, provides a description of the external systems that will interface with the I-270 ICM System. These systems are shown in Table 4, below, along with the categories of data to be sent to and received from the I-270 ICMS. Most of the referenced systems currently exist; systems that do not exist are noted as "future" in the table.

The data categories are referenced in Table 3, above, with two exceptions. The "Decision Support Data" exchange from the ICMS represents a combination of multiple data types including traffic management response actions, requests for ITS device commands, and data from other corridor networks, such as incidents, work zones, and surveillance data. Likewise, the "Multi-Network Data" exchange from the ICMS refers to data from other networks that originated from various corridor systems.

These data exchanges are depicted graphically in Figure 2, Maryland I-270 ICMS Component Diagram, on page 17.

Table 4 – I-270 ICM System Data Exchanges with External Systems

External System	Data Exchanges Sent To I-270 ICMS	Data Exchanges Received From I-270 ICMS
MD CHART Freeway System	• Freeway Event Data • Freeway Work Zone Data • Freeway Surveillance Data • Freeway Travel Options Data	• Decision Support Data
Montgomery County ATMS / Traffic Signal Control System	• Arterial Event Data • Arterial Work Zone Data • Arterial Surveillance Data • Freeway Surveillance Data • Arterial Travel Options Data	• Decision Support Data
Montgomery County Ride On Bus CAD/AVL System	• Transit Event Data • Transit Surveillance Data • Bus Data • Transit Travel Options Data	• Decision Support Data
WMATA Metrorail Rail Operations Control System	• Transit Event Data • Transit Surveillance Data • Rail Data • Transit Travel Options Data	• Decision Support Data
WMATA Metrobus CAD/AVL System	• Transit Event Data • Transit Surveillance Data • Bus Data • Transit Travel Options Data	• Decision Support Data
MARC Commuter Rail CAD/AVL System	• Transit Event Data • Transit Surveillance Data • Rail Data • Transit Travel Options Data	• Decision Support Data
WMATA Metrorail Parking Management System (prototype)	• Transit Parking Data	• N/A

External System	Data Exchanges Sent To I-270 ICMS	Data Exchanges Received From I-270 ICMS
MARC Commuter Rail Parking Management System (future)	• Transit Parking Data	• N/A
Montgomery County Public Safety CAD/911 System	• Transportation Event Data	• N/A
MD State Police CAD/RMS System (future)	• Transportation Event Data	• N/A
Capital Wireless Information Net System	• Transportation Event Data	• Multi-Network Event Data • Multi-Network Work Zone Data • Multi-Network Surveillance Data
Emergency Operations Center Systems	• Transportation Event Data	• Multi-Network Event Data • Multi-Network Work Zone Data • Multi-Network Surveillance Data
Third-Party Traffic Flow Data Systems	• Traffic Flow Data	• N/A
Information Service Provider Systems	• N/A	• Multi-Network Traveler Information Data (Events, Work Zones, Surveillance, Transit, Travel Options, Parking)

4.3 System Data Exchange Methods, Standards, and Frequencies

In terms of major system interfaces, all data sent to or collected from the I-270 ICMS will be available via similar methods and standards; however, the data elements will vary depending on the user, use case, and external systems that are connected. The I-270 ICMS will utilize established ITS standards for data content within the corridor, including:

- ITE TMDD Version 3 – Definitions data, such as link definitions and field device information (traffic signals, DMS, etc.)
- SAE ATIS J2354 – Traveler information data
- IEEE 1512 – Incident data
- TCIP Version 3 – Transit data

In addition, the ASTM WK7604 standard will be utilized for data archived in the ICMS.

Regional naming and classification standards will also be established for corridor events and incidents to ensure interoperability and consistent data exchange across stakeholder agency systems.

Error detection, error correction, and reasonability checks will be implemented for all data received from external stakeholder systems as discussed in the document, *Monitoring Urban Freeways in 2003: Current*

Conditions and Trends from Archived Operations Data, Publication FHWA-HOP-05-018, Federal Highway Administration, December 2004.

A corridor data communications network will be established with sufficient capacity and speed to support real-time data exchanges between the I-270 ICMS and stakeholder systems. The I-270 ICMS will be connected to the network, and each stakeholder agency will be responsible for connecting their system(s) to the network. Center-to-center data communications will be based on the NTCIP 2306 standard which defines the use of the industry standard XML (eXtensible Markup Language).

Data will be transmitted via either of two methods:

- HTTPS XML polling, or
- Subscription-based Java Messaging Service (JMS).

The first method allows polling various I-270 ICMS data sources via HTTPS for an XML document with specific data elements. The second method is a publish/subscribe system using JMS. I-270 ICMS data consumers will be given a queue location to which they can connect. On each connection, the I-270 ICMS will send the consumer a complete list of all requested data. From that point on, the consumer will only receive messages as information changes. Data will be sent asynchronously to the clients as it is received to minimize the lag inherent in a synchronous or polling-based system. Additionally, each queue will have a set of filters specified by I-270 ICMS System Administrators to determine the type of data a consumer receives. For example, incident data from the MD CHART Freeway System queue will be set up such that this external system does not receive data from the I-270 ICMS that originates from the MD CHART Freeway System (resulting in the transmission of redundant data).

All data exchanges and alarm notifications will be logged for audit purposes. In addition, all data exchanged with corridor stakeholder systems will be encrypted for security purposes.

The I-270 ICMS will publish all data to stakeholder agency subscribers within 180 seconds of receipt from the source system(s). Data collection will occur at common frequency intervals (to be determined during design) from all stakeholder systems, with the ability to change the intervals as the need arises.

The I-270 ICMS will disseminate data directly to travelers via internal ICMS traveler information services (e.g., e-mail/fax/pager-based subscription services, corridor web site/trip planner) within 180 seconds of receipt from source systems. The I-270 ICMS will provide traveler information to external Advanced Traveler Information System (ATIS) providers, including media outlets, within 180 seconds of receipt from source systems.

For each stakeholder system interfacing with the I-270 ICMS, a separate Interface Control Document (ICD) will be developed to document the parameters of all data exchanges between the systems, such as data types, data definitions, data formats and standards, encryption/decryption, exchange frequencies, and communications methods.

4.4 User Interfaces

The I-270 ICMS will include a variety of user interfaces for stakeholder agency users, travelers, and ICM system administration staff, as listed below. Each user interface will be web-based to provide flexible access without the need for installing client software. Appropriate security safeguards, such as encryption, firewalls, tiered access protection, and attack detection software, will be employed to prevent unauthorized access to each site.

- ICMS Agency User Interface – This web site will be accessible only to authorized stakeholder agency users. It will include functionality to create/modify agency subscriptions for real-time corridor transportation data, create/modify agency contact data, perform data analysis and reporting, and view tabular and map-based displays of corridor transportation data, such as incidents and recommended response plans and actions, work zones, and surveillance video. This interface is particularly useful for corridor agencies that do not have an automated system to exchange data with the ICMS.

- Public User Interface – This web site will allow the traveling public to create/modify information dissemination subscriptions (e.g., e-mail/fax/pager), and view tabular and map-based displays of corridor transportation data. Note that sensitive data, such as security-related data and limited access video, will not be accessible through this user interface so as not to disrupt transportation management operations or alarm the public unnecessarily. Mechanisms will be developed to define sensitive and inappropriate information and prevent dissemination of this type of data to non-authorized recipients.

- ICMS Administration User Interface – This web site will provide capabilities for ICM System Administrators to manage user accounts and permissions on all ICMS web sites, monitor the performance of the system, and modify system configuration parameters. Only authorized system administration staff will have access to this web site.

5. Detailed System Requirements

5.1 System Requirements Organization

The I-270 ICM System Requirements are organized into several high-level categories in order to group similar requirements together. These categories are shown in Table 5, below. This table also shows, for each group, the associated ICMS sub-systems as depicted in Figure 2, Maryland I-270 ICMS Component Diagram, on page 17.

Table 5 – I-270 ICM System Requirements Groupings

Requirement Group	Requirement Numbering	ICM Sub-System(s)
Data Collection	100 – 299	• Data Collection • Data Fusion/Integration
Traveler Information Dissemination	300 – 499	• Traveler Information Dissemination / Internal Information Service Provider
Data Exchanges with Other Systems	900 – 1099	• Data Fusion/Integration • Data Dissemination
ITS Device Control and Monitoring	1100 – 1299	• Decision Support
Parking Management System	1300 – 1499	• Traveler Information Dissemination
Decision Support System	1500 – 1699	• Decision Support
Data Analysis and Performance Measurement	1700 – 1899	• Data Analysis and Performance Measurement • Data Archiving
Policies, Procedures, and Standards	1900 – 2099	• All Sub-Systems
System Security and Information Technology	2100 – 2299	• Data Collection • Data Dissemination • User Interface
User Interface	2300 – 2499	• User Interface

The I-270 ICM System Requirements are provided in Section 5.3 in a tabular format with the following columns:

- ID – A unique identifier for each requirement. Requirement ID's are in the form X-NNN-MMM, where X is a single letter identifying the type of requirement as explained in Table 6, I-270 ICM System Requirements Categories, below. NNN and MMM are numbers assigned to the requirement. X-NNN represents a high-level requirement; X-NNN-MMM represents a detailed requirement associated with the high-level requirement X-NNN. Additional groups of numbering suffixes (e.g., X-NNN-MMM-PPP) indicate further levels of detailed requirements.

- Requirement – A concise description of the requirement.

- Need – An identifier referring to a need used to create the requirement. Needs were primarily derived from the revised I-270 ICMS Concept of Operations (ConOps) document, dated June 18, 2007. Table 7, I-270 ICM System Needs, in Section 5.2, provides a listing of needs and associated identifiers. Note that external requirements (those requirements prefixed with "X" in the ID column) have "N/A" for this column, as ICMS needs will not be satisfied by external systems.

- Source – The source/originator of the requirement. In most cases, this refers to a specific section and page number within the revised I-270 ICMS Concept of Operations document, dated June 18, 2007. For detailed requirements, this may also refer to the associated high-level requirement.

- Allocation – A two-letter abbreviation representing the functional category of the requirement as defined in Table 6, I-270 ICM System Requirements Categories, below. Some requirements pertain to multiple categories. Note that external requirements have "N/A" for this column, as ICMS-specific functionality will not be addressed by external systems.

- Comment – Additional information clarifying the requirement and related issues. In most cases, this includes pertinent text from the I-270 ICMS Concept of Operations document.

- Criticality – A one-letter abbreviation representing the relative priority of the requirement as defined in Table 6, I-270 ICM System Requirements Categories, below.

Table 6 – I-270 ICM System Requirements Categories

Abbreviation	Category	Category Description
Requirements ID Categories		
C	Design Constraints	Requirements imposed on the system due to industry standards, regulations, etc.
D	Data Requirements	Requirements that define the data in the system, such as data elements and data structures
F	Functional Requirements	Requirements that define what the system will do
I	Interface Requirements	Requirements that define the system interfaces with other systems, including the inputs and outputs
O	Other Requirements	Requirements that are not categorized elsewhere. This may include non-testable requirements, such as documentation and training.
P	Performance Requirements	Requirements that define the performance of the system, such as speed, capacity, and duration
Q	Quality Requirements	Requirements that define quality attributes of the system, including reliability, accuracy, security, and maintainability
X	External Requirements	External requirements that are the responsibility of other system owners
Requirements Allocation Categories		
DC	Data Content	Requirements that define the types of data and associated attributes in the system
DE	Data Exchange	Requirements that define data exchanges between the system and other systems

Abbreviation	Category	Category Description
DQ	Data Quality	Requirements that define the quality attributes of the data in the system including accuracy, reliability, and consistency
DS	Decision Support	Requirements that support decision-making for system users, such as response planning and standard procedures/protocols
PM	Performance Measures	Requirements that define system capabilities to measure and evaluate the performance of the system
SD	Surveillance and Detection	Requirements that define the system's surveillance and detection capabilities, such as monitoring roadway sensors and controlling CCTV cameras
SS	System Security	Requirements that define the security of the system and underlying data
TI	Traveler Information Dissemination	Requirements that define methods for disseminating system data to travelers
TM	Traffic Management	Requirements that define the system's traffic management capabilities, such as traffic signal control and transportation modeling
UI	User Interface	Requirements that define how users interact with the system
Requirements Criticality Categories		
H	High	Essential, critical requirements that are needed in order to achieve the system's primary goals and objectives
M	Medium	Desired requirements that will improve the usability and effectiveness of the system
L	Low	Nice-to-have features that provide marginal system benefits
D	Deferred/Future	Questionable requirements deferred for a potential future version of the system as necessary

5.2 System Needs

Table 7, below, lists the needs that were used to create the I-270 ICM System Requirements. Most of these needs were extracted from the revised I-270 ICMS Concept of Operations (ConOps) document, dated June 18, 2007. A unique identifier, description, and source are provided for each need. This unique identifier is referenced for each requirement in Table 8, I-270 ICM System Requirements, in Section 5.3.

Table 7 – I-270 ICM System Needs

ID	Description	Source
1	Need to expand corridor-wide information sharing to help disseminate reliable and real-time traveler information to commuters.	ConOps § 1.4, p. 8
2	Need tools and procedures to assist stakeholder agencies with operational decision-making for improved transportation management within the corridor.	ConOps § 1.4, Table 1-2, p. 9
3	Need for traffic signals to be able to respond to changing conditions on affected arterials and adjacent roadways, including I-270, to maintain optimal traffic flow.	ConOps § 1.4, Table 1-2, p. 9
4	Need on-demand access to information comparing travel times by automobile and transit in real-time to help travelers make better informed travel decisions.	ConOps § 1.4, Table 1-2, p. 9
5	Need to provide travelers access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route, to enable travelers to make better informed travel decisions.	ConOps § 1.4, Table 1-2, p. 10
6	Need to exchange real-time information on road and transit conditions with the corridor's managing partners and stakeholders to improve transportation management efficiency and traveler information dissemination.	ConOps § 1.5, p. 10
7	Need to establish connections with key corridor stakeholders to automate data exchanges between the I-270 ICMS and external systems.	ConOps § 1.6, Table 1-4, p. 12
8	Need to provide real-time, corridor-based traveler information to the media and other ATIS providers via standards-based and standard data distribution interfaces to facilitate improved access to current transportation information.	ConOps § 1.6, Table 1-4, p. 12
9	Need to provide pre-trip and en-route real-time corridor traveler information to travelers for access to up-to-date transportation information.	ConOps § 1.6, Table 1-4, p. 12
10	Need to share notification-based information (e.g., incident alerts) that is accessible pre-trip and en-route to provide travelers with real-time access to information impacting the transportation network.	ConOps § 3.5, p. 38
11	Need to collect transit, traffic, and other transportation data of regional interest from stakeholders in the corridor for use in enhancing regional traveler information and transportation management functions performed by member agencies.	ConOps § 3.5, p. 40, ConOps § 3.7, p. 47
12	Need to fuse collected transportation data into regional information to enhance regional traveler information and transportation management functions performed by member agencies.	ConOps § 3.5, p. 40
13	Need documented policies and procedures for coordinated traffic/transit management and incident management within the corridor to improve safety and overall transportation flow.	ConOps § 4.5, Table 4-7, p. 66
14	Need ICMS backup and restore capabilities to minimize system downtime.	ConOps § 4.5, Table 4-7, p. 68

ID	Description	Source
15	Need up-to-date corridor response plans to better plan for, and respond to, recurring and non-recurring congestion and to enable the corridor to function more efficiently and react more effectively to changing traffic and transit conditions.	ConOps § 4.7, pp. 78-79
16	Need to provide alarm notifications for incidents, etc. to stakeholder systems to improve transportation management operations.	ConOps § 4.7, p. 79
17	Need to define common data collection frequency intervals among all stakeholders for data standardization and timeliness purposes.	ConOps § 4.9, Table 4-12, p. 82
18	Need a Communications System with sufficient capacity and speed to support real-time data exchanges with stakeholder systems.	ConOps § 4.9, Table 4-12, p. 82
19	Need to use common definitions for all data elements exchanged between the different software central systems operated by the I-270 ICM stakeholders so that there is a clear, unambiguous understanding between the interfaced centers as to the meaning of these data.	ConOps § 4.9, p. 83
20	Need to utilize applicable ITS standards and other pertinent standards to achieve consistency among corridor stakeholder systems and improve overall corridor operations and maintenance efforts.	ConOps § 4.9, p. 83
21	Need to avoid releasing sensitive information to non-authorized information outlets so as not to disrupt transportation management operations or alarm the public unnecessarily.	ConOps § 4.9, p. 84
22	Need a documented Operations and Maintenance Plan to ensure that ICM strategies are applied consistently, efficiently, and in a manner that improves overall corridor performance.	ConOps § 4.9, p. 84
23	Need to provide travel conditions at decision points to provide motorists with decision-making information, particularly travel times using one or another travel mode choice.	ConOps § 4.9, p. 84
24	Need corridor-level performance measures to determine the effectiveness of the I-270 ICM strategies and operations in comparison to corridor goals and objectives.	ConOps § 4.11, p. 87
25	Need to archive data for data mining and performance measuring purposes.	ConOps § 4.11, p. 88
26	Need standard operating procedures to improve communications and coordination and shorten response times.	ConOps § 4.11, p. 88
27	Need to coordinate with corridor stakeholder agencies in utilizing appropriate traveler information devices (DMS, HAR, 511) for broadcasting/displaying appropriate corridor transportation messages.	ConOps § 5.2, Table 5-2, p. 96
28	Need to provide travelers with reliable information in getting from one location to another location within the corridor.	ConOps § 1.4, Table 1-2, p. 10
29	Need to log all data exchanges and alarm notifications for audit and evaluation purposes.	I-270 ICMS Project Team

ID	Description	Source
30	Need to provide suggested modifications to messages on traveler information field devices (e.g., DMS, HAR) to owning agencies to ensure accurate corridor-wide information is provided to motorists.	I-270 ICMS Project Team
31	Need reporting/query tools for data analysis and research purposes.	RITIS ConOps § 2.6, pp. 31-32
32	Need to exchange data with corridor stakeholder agency systems in a secure manner.	RITIS ConOps § 2.7, p. 32
33	Need to operate in a 24x7 environment, as corridor transportation management needs to operate continuously.	I-270 ICMS Project Team
34	Need to automatically notify the System Administrator when a System failure occurs to minimize system downtime.	I-270 ICMS Project Team
35	Need a secure agency user interface available only to corridor stakeholder agency users for transportation management purposes.	RITIS ConOps § 2.4.1, p. 28
36	Need an easily accessible public user interface for traveler information purposes.	RITIS ConOps § 2.4.2, p. 28
37	Need a secure System Administration user interface for system configuration and maintenance purposes.	RITIS ConOps Appendix A, Table A-1, p. 43

5.3 System Requirements Table

Table 8 – I-270 ICM System Requirements

ID	Requirement	Need	Source	Allocation	Comment	Criticality
5.3.1 Data Collection (Requirements 100-299)						
D-100	The I-270 ICMS shall include a database to store all collected transportation data.	11	ConOps – Throughout	DC	Related ConOps Examples: • Gather pertinent data and archive in RITIS. • Each agency's system will have an interface to RITIS, which will allow the automatic input of relevant data. • RITIS will collect data of regional interest and fuse the data into regional information… Note: The I-270 ICMS will use the existing RITIS database as the foundation for the ICMS database.	H
D-100-010	The I-270 ICMS database shall include the types of corridor transportation data listed in Table 3.	11	ConOps – Throughout	DC	Data types listed throughout ConOps. Examples: • An Archive Management Center that collects transit, traffic, and other data from all stakeholders in the corridor. • Operations data collected by RITIS, including incident data, response times, clearance times, volumes, speeds, etc. • Use AVL data to furnish real-time transit information to travelers, including bus location, next bus/train arrival time, bus/train schedules, etc.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
D-100-020	The I-270 ICMS shall retain all data collected online for a period of at least 365 days.	11	D-100	DC	Related ConOps Examples: • Archive corridor transportation, traffic, transit, and incident response data for performance measurement. • It will also archive data for use in transportation-related studies and performance evaluations.	H
F-110	The I-270 ICMS shall collect the data listed in Table 3 from corridor stakeholder agency systems.	11	ConOps – Throughout	DC, DE	Related ConOps Examples: • RITIS will collect data of regional interest and fuse the data into regional information that can be used to enhance regional traveler information and transportation management functions performed by member agencies. • An Archive Management Center that collects transit, traffic, and other data from all stakeholders in the corridor. • Operations data collected by RITIS, including incident data, response times, clearance times, volumes, speeds, etc.	H
F-110-010	The I-270 ICMS shall collect the corridor freeway data listed in Table 3 from the MD CHART system.	11	ConOps § 3.5, p. 39, and others	DC, DE	ConOps Example: SHA has detectors on the I-270 corridor used to feed into CHART.	H
F-110-020	The I-270 ICMS shall collect the corridor arterial data listed in Table 3 from the Montgomery County ATMS.	11	ConOps § 1.6, Table 1-4, p. 13 (under Optimize Traffic Signals on Arterials), and others	DC, DE	ConOps Example: Evaluate performance of the Traffic Signal System and arterial operations through the collection and processing of current information on systems performance.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-110-030	The I-270 ICMS shall collect the corridor arterial data listed in Table 3 from the Montgomery County Traffic Signal system.	11	ConOps § 1.6, Table 1-4, p. 13 (under Optimize Traffic Signals on Arterials), and others	DC, DE	ConOps Example: Evaluate performance of the Traffic Signal System and arterial operations through the collection and processing of current information on systems performance.	H
F-110-040	The I-270 ICMS shall collect the corridor transit data listed in Table 3 from Montgomery County's Ride On Bus CAD/AVL system.	11	ConOps § 4.6, Table 4-11, p. 78 (under Ride On Network), and others	DC, DE	ConOps Example: (Ride On) Interface with RITIS for providing and extracting real-time information (2008).	H
F-110-050	The I-270 ICMS shall collect the corridor transit data listed in Table 3 from WMATA's Metrorail Rail Operations Control System (ROCS).	11	ConOps § 4.6, Table 4-11, p. 78 (under Metrorail Network), and others	DC, DE	ConOps Example: (Metrorail) Interface with RITIS for providing and extracting real-time information (2008).	H
F-110-060	The I-270 ICMS shall collect the corridor transit data listed in Table 3 from WMATA's Metrobus CAD/AVL system.	11	ConOps § 4.6, Table 4-11, p. 78 (under Metrobus Network), and others	DC, DE	ConOps Example: (Metrobus) Interface with RITIS for providing and extracting real-time information (2008).	H
F-110-070	The I-270 ICMS shall collect the corridor transit data listed in Table 3 from MTA's MARC Commuter Rail CAD/AVL system.	11	ConOps § 4.6, Table 4-11, p. 78 (under MARC Commuter Rail Network), and others	DC, DE	ConOps Example: (MARC) Interface with RITIS for providing and extracting real-time information (2008).	H
F-110-080	The I-270 ICMS shall collect traffic flow data from third-party traffic flow data systems within the corridor.	11	I-270 ICMS Project Team	DC, DE		M
Q-110-090	The I-270 ICMS shall perform error detection, error correction, and reasonability checks on all data collected.	1, 11	ConOps – Throughout	DQ	Many "reliability" needs throughout ConOps. Example: • There is a need to expand corridor-wide information sharing to help disseminate reliable and real-time traveler information to the commuters.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
Q-110-090-010	The I-270 ICMS shall perform data quality checks in accordance with FHWA's Mobility Monitoring Program as documented in *Monitoring Urban Freeways in 2003: Current Conditions and Trends from Archived Operations Data*, Publication FHWA-HOP-05-018, Federal Highway Administration, December 2004.	1, 11	I-270 ICMS Project Team	DQ		H
F-110-100	The I-270 ICMS shall organize the collected data into regional traveler information.	12, 11	ConOps § 3.5, p. 39	DC, TI	ConOps Text: RITIS will collect data of regional interest and fuse the data into regional information that can be used to enhance regional traveler information and transportation management functions performed by member agencies.	H
F-110-110	The I-270 ICMS shall organize the collected data into regional information for transportation management.	12, 11	ConOps § 3.5, p. 39	DC, DS, TM	ConOps Text: RITIS will collect data of regional interest and fuse the data into regional information that can be used to enhance regional traveler information and transportation management functions performed by member agencies.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
5.3.2 Traveler Information Dissemination (Requirements 300-499)						
F-300	The I-270 ICMS shall disseminate designated data to travelers specified in Table 3 where a check mark is shown in the "Disseminate to Travelers" column.	5	ConOps – Throughout	TI	ConOps Examples: • Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route. • Travelers need travel conditions information in sufficient detail that they can make "smart" decisions about staying the course, selecting alternate routes, shifting travel modes, skipping or postponing travel, etc. • Travelers need information about alternative routes/modes when conditions so dictate.	H
F-300-010	The I-270 ICMS shall disseminate designated data to travelers via a publicly accessible web site.	9, 5	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	TI	ConOps Text: Provide real-time corridor traveler information, including transit, to travelers via the Web, 511, mobile devices, and in-vehicle devices.	H
F-300-020	The I-270 ICMS shall disseminate designated data to travelers via mobile device notification subscriptions.	10, 5	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	TI	ConOps Text: Provide real-time corridor traveler information, including transit, to travelers via the Web, 511, mobile devices, and in-vehicle devices.	M
F-300-030	The I-270 ICMS shall disseminate designated data to travelers via e-mail notification subscriptions.	10, 5	ConOps § 3.5, p. 38	TI	ConOps Text: Enhanced Data Dissemination – Sharing information with the public through notification services (fax, pager, email, Web-based Real Simple Syndication (RSS), WAP/PDA access, etc.).	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-300-040	The I-270 ICMS shall disseminate designated data to travelers via fax notification subscriptions.	10, 5	ConOps § 3.5, p. 38	TI	ConOps Text: Enhanced Data Dissemination – Sharing information with the public through notification services (fax, pager, email, Web-based Real Simple Syndication (RSS), WAP/PDA access, etc.).	D
F-300-050	The I-270 ICMS shall disseminate designated data to travelers via pager notification subscriptions.	10, 5	ConOps § 3.5, p. 38	TI	ConOps Text: Enhanced Data Dissemination – Sharing information with the public through notification services (fax, pager, email, Web-based Real Simple Syndication (RSS), WAP/PDA access, etc.).	L
F-300-060	The I-270 ICMS shall manage traveler information notification subscriptions.	10, 5	RITIS ConOps § 2.3.3, pp. 26-27	TI	ConOps Text: Alerts, which can be set up on the RITIS web site, will be sent to agency field staff and travelers who request the information.	M
F-300-060-010	The I-270 ICMS shall manage traveler mobile device notification subscriptions.	10, 5	RITIS ConOps § 2.3.3, pp. 26-27	TI	ConOps Text: Alerts, which can be set up on the RITIS web site, will be sent to agency field staff and travelers who request the information.	M
F-300-060-020	The I-270 ICMS shall manage traveler e-mail notification subscriptions.	10, 5	RITIS ConOps § 2.3.3, pp. 26-27	TI	ConOps Text: Alerts, which can be set up on the RITIS web site, will be sent to agency field staff and travelers who request the information.	M
F-300-060-030	The I-270 ICMS shall manage traveler fax notification subscriptions.	10, 5	RITIS ConOps § 2.3.3, pp. 26-27	TI	ConOps Text: Alerts, which can be set up on the RITIS web site, will be sent to agency field staff and travelers who request the information.	D
F-300-060-040	The I-270 ICMS shall manage traveler pager notification subscriptions.	10, 5	RITIS ConOps § 2.3.3, pp. 26-27	TI	ConOps Text: Alerts, which can be set up on the RITIS web site, will be sent to agency field staff and travelers who request the information.	L

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-300-060-050	The I-270 ICMS shall create information notification subscriptions for travelers.	10, 5	RITIS ConOps § 2.3.3, pp. 26-27	TI	ConOps Text: Alerts, which can be set up on the RITIS web site, will be sent to agency field staff and travelers who request the information.	M
F-300-060-060	The I-270 ICMS shall modify information notification subscriptions for travelers.	10, 5	RITIS ConOps § 2.3.3, pp. 26-27	TI	ConOps Text: Alerts, which can be set up on the RITIS web site, will be sent to agency field staff and travelers who request the information.	M
F-300-060-070	The I-270 ICMS shall delete information notification subscriptions for travelers.	10, 5	RITIS ConOps § 2.3.3, pp. 26-27	TI	ConOps Text: Alerts, which can be set up on the RITIS web site, will be sent to agency field staff and travelers who request the information.	M
P-300	The I-270 ICMS shall disseminate designated data to travelers within 180 seconds of receipt from the source system(s).	9, 5	ConOps § 1.5, pp. 10-11	TI	ConOps Examples: • Key technology systems and decision support tools within the corridor are interoperable and real-time information on road and traffic conditions is commonly exchanged among the corridor's managing partners and stakeholders. • Enhance the exchange of accurate, timely information among partners.	H
Q-300	Each corridor data element disseminated to travelers by the I-270 ICMS over a designated period of time shall be at least 80% accurate.	5	ConOps § 3.8, Table 3-10, p. 48 (under Traveler Information)	TI, DQ	ConOps Text: Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route.	H
F-310	The I-270 ICMS shall disseminate designated data to external systems for dissemination to travelers as specified in Table 3 where a check mark is shown in the "Disseminate to Travelers" column.	8	ConOps § 1.7, p. 14	TI	ConOps Text: RITIS will link to existing (and potentially new) venues for disseminating information to the general public.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-310-010	The I-270 ICMS shall disseminate designated data to the corridor's 511/IVR system as specified in Table 3 where a check mark is shown in the "Disseminate to Travelers" column.	9, 8	ConOps § 1.6, Table 1-4, p.12 (under Prototype and Deploy Enhanced RITIS)	TI	ConOps Text: Provide real-time corridor traveler information, including transit, to travelers via the Web, 511, mobile devices, and in-vehicle devices.	M
F-310-020	The I-270 ICMS shall disseminate designated data to media outlets as specified in Table 3 where a check mark is shown in the "Disseminate to Travelers" column.	8	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	TI	ConOps Text: Provide real-time, corridor-based traveler information to media and other ATIS providers via the Web and direct data feeds.	H
F-310-030	The I-270 ICMS shall include a standard data feed containing designated data as specified in Table 3 where a check mark is shown in the "Disseminate to Travelers" column that can be disseminated to third-party ATIS providers.	8	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	TI	ConOps Text: Provide real-time, corridor-based traveler information to media and other ATIS providers via the Web and direct data feeds.	H
F-310-040	The I-270 ICMS shall disseminate designated data to corridor transportation agency systems for dissemination to travelers as specified in Table 3 where a check mark is shown in the "Disseminate to Travelers" column.	27, 8	ConOps § 1.7, p. 14	TI	ConOps Text: RITIS will link to existing (and potentially new) venues for disseminating information to the general public.	H
F-310-040-010	The I-270 ICMS shall disseminate designated data to corridor transportation agency systems for dissemination to en-route travelers via DMS as specified in Table 3 where a check mark is shown in the "Disseminate to Travelers" column.	27, 8	ConOps § 4.5, Table 4-7, p. 68 (under Traveler Information)	TI	ConOps Text: DMS on Freeway and Arterials	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-310-040-020	The I-270 ICMS shall provide recommendations to corridor transportation agency systems in selecting specific DMS to display designated data.	27, 8	ConOps – Throughout	TI	Related ConOps Examples: • For example, the information on a DMS (e.g., travel time estimates, parking availability data, information on conditions ahead, etc.) could typically be strictly informational. • Driving southbound from Frederick on I-270 for the morning commute, there is information on the DMS sign in Frederick County that informs motorists that the express lanes between Shady Grove Road and Gude Drive will be under repair until 9 AM. • Place messages on appropriate DMS signs	H
F-310-040-030	The I-270 ICMS shall disseminate designated data to corridor transportation agency systems for dissemination to en-route travelers via HAR/TAR as specified in Table 3 where a check mark is shown in the “Disseminate to Travelers” column.	27, 8	ConOps § 5.2, p. 95	TI	ConOps Text: The following scenario outlines the typical ”planned event,” which would have been broadcasted to the motorists and commuters days in advance via DMS, HAR/TAR, Web pages, and other media outlets.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-310-040-040	The I-270 ICMS shall provide recommendations to corridor transportation agency systems in selecting specific HAR/TAR to display designated data.	27, 8	ICMS Stakeholder Meeting – 9/20/07	TI	Related ConOps Examples: • The following scenario outlines the typical ”planned event,” which would have been broadcasted to the motorists and commuters days in advance via DMS, HAR/TAR, Web pages, and other media outlets. • The information on the traveler information devices, particularly the DMS and HAR/TAR, are adjusted to change from typical information about an incident to a message indicating worse-than-normal traffic due to the accident conditions.	H
P-310	The I-270 ICMS shall disseminate designated data to external systems for dissemination to travelers within 180 seconds of receipt from the source system(s).	6, 8	ConOps § 1.5, pp. 10-11	TI	ConOps Examples: • Key technology systems and decision support tools within the corridor are interoperable and real-time information on road and traffic conditions is commonly exchanged among the corridor’s managing partners and stakeholders. • Enhance the exchange of accurate, timely information among partners.	H
Q-310	Each corridor data element transferred to external systems by the I-270 ICMS for dissemination to travelers over a designated period of time shall be at least 80% accurate.	5, 8	ConOps § 3.8, Table 3-10, p. 48 (under Traveler Information)	TI, DQ	ConOps Text: Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-320	The I-270 ICMS shall disseminate travel conditions for different travel modes at decision points in the corridor to travelers.	23	ConOps § 4.9, p. 84	TI	ConOps Text: One of the proposed approaches will be the provision of travel conditions at decision points to provide motorists with the decision-making information, particularly travel times using one or another travel mode choice.	H
F-320-010	The I-270 ICMS shall disseminate comparisons of current travel times to known points within the corridor for multiple travel modes and routes to travelers.	4, 23	ConOps § 4.11, p. 90	TI	ConOps Text: Displays of travel time comparisons can be provided on other routes. Note: Related to Requirement F-1700-050-030.	M
F-320-020	The I-270 ICMS shall calculate transit travel times based on user selected origin and destination.	4, 23	ConOps § 4.11, Table 4-14, p. 91	DC, TI	ConOps Text: For travel time comparison purposes and travel decision support, the "true" travel times will be calculated for each alternative travel mode. An average parking time for driving to Park-n-Ride lots and for bus/rail mode transfers and wait times will be added, along with the potential impact of any incidents.	M
F-320-020-010	The calculated transit travel times shall include the following aggregated data elements: a) Time to drive to and park at Park-n-Ride lots, b) Time for bus/rail mode transfers, c) Wait times for next bus/train, d) En-route travel time, e) Estimated delay due to planned and unplanned events.	4, 23	ConOps § 4.11, Table 4-14, p. 91	DC, TI	ConOps Text: For travel time comparison purposes and travel decision support, the "true" travel times will be calculated for each alternative travel mode. An average parking time for driving to Park-n-Ride lots and for bus/rail mode transfers and wait times will be added, along with the potential impact of any incidents.	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-320-030	The I-270 ICMS shall calculate roadway travel times based on user selected origin and destination.	4, 23	ConOps § 4.11, Table 4-14, p. 91	DC, TI	ConOps Text: For travel time comparison purposes and travel decision support, the "true" travel times will be calculated for each alternative travel mode. An average parking time for driving to Park-n-Ride lots and for bus/rail mode transfers and wait times will be added, along with the potential impact of any incidents.	H
F-330	The I-270 ICMS shall include a multi-modal trip planner.	28	ConOps § 1.4, Table 1-2, p. 10 (under Traveler Information)	TI	ConOps Text: Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route.	M
F-330-010	The I-270 ICMS multi-modal trip planner shall be accessible to travelers via the I-270 ICMS public web site.	28	ConOps § 1.4, Table 1-2, p. 10 (under Traveler Information)	TI	ConOps Text: Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route. Note: See requirement F-2310 for additional requirements for the ICMS public web site.	M
F-330-020	The I-270 ICMS multi-modal trip planner shall be accessible to travelers via mobile devices.	28	ConOps § 1.4, Table 1-2, p. 10 (under Traveler Information)	TI	ConOps Text: Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route.	M
F-330-030	The I-270 ICMS multi-modal trip planner shall be accessible to travelers via the corridor's 511/IVR system.	28	ConOps § 1.4, Table 1-2, p. 10 (under Traveler Information)	TI	ConOps Text: Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route.	M
F-330-040	The I-270 ICMS multi-modal trip planner shall provide directions, distances, and travel times between known points within the corridor using one or more travel modes for which data is available.	28	ConOps § 1.4, Table 1-2, p. 10 (under Traveler Information)	TI, DE	ConOps Text: Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route.	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-330-040-010	The I-270 ICMS multi-modal trip planner shall provide travel recommendations to the user based on available current transportation data in the corridor.	28	ConOps § 1.4, Table 1-2, p. 10 (under Traveler Information)	TI, DE	ConOps Text: Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route.	M
F-330-050	The I-270 ICMS multi-modal trip planner shall save a created trip.	28	ConOps § 1.4, Table 1-2, p. 10 (under Traveler Information)	TI	ConOps Text: Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route.	M
F-330-060	The I-270 ICMS multi-modal trip planner shall retrieve a previously saved trip.	28	ConOps § 1.4, Table 1-2, p. 10 (under Traveler Information)	TI	ConOps Text: Travelers need access to accurate, reliable, and multi-modal travel information, both pre-trip and en-route.	M
X-340	Corridor transportation agencies will disseminate designated corridor freeway data to travelers via their respective agency web sites.	N/A	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	N/A	ConOps Text: Provide real-time corridor traveler information, including transit, to travelers via the Web, 511, mobile devices, and in-vehicle devices.	H
X-340-010	The following corridor transportation agencies will disseminate designated corridor freeway data to travelers via their respective agency web sites: • MD CHART • Montgomery County DPWT	N/A	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	N/A	ConOps Text: Provide real-time corridor traveler information, including transit, to travelers via the Web, 511, mobile devices, and in-vehicle devices.	H
X-340-020	The following corridor transportation agencies will disseminate designated corridor arterial data to travelers via their respective agency web sites: • Montgomery County DPWT	N/A	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	N/A	ConOps Text: Provide real-time corridor traveler information, including transit, to travelers via the Web, 511, mobile devices, and in-vehicle devices.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-340-030	The following corridor transportation agencies will disseminate designated corridor transit data to travelers via their respective agency web sites: • WMATA • Montgomery County DPWT • MTA	N/A	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	N/A	ConOps Text: Provide real-time corridor traveler information, including transit, to travelers via the Web, 511, mobile devices, and in-vehicle devices.	H
5.3.3 Data Exchanges with Other Systems (Requirements 900-1099)						
I-900	The I-270 ICMS shall automatically exchange current corridor transportation data with corridor stakeholder systems.	6	ConOps § 1.5, p. 10	DE	ConOps Text: Key technology systems and decision support tools within the corridor are interoperable and real-time information on road and traffic conditions is commonly exchanged among the corridor's managing partners and stakeholders.	H
I-900-010	The I-270 ICMS shall include a web-based agency user interface for corridor stakeholder agency systems to subscribe to current corridor transportation data.	7, 6	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	DE	ConOps Text: Establish publish/subscribe connections with key corridor stakeholders. Note: Related to Requirement F-2300-080.	H
I-900-010-010	The I-270 ICMS shall provide a list of transportation data available to each stakeholder agency within the corridor.	7, 6	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	DE	ConOps Text: Establish publish/subscribe connections with key corridor stakeholders.	H
I-900-010-020	Subscribing agencies shall be able to select specific transportation data available within the I-270 ICMS to fulfill data subscriptions.	7, 6	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	DE	ConOps Text: Establish publish/subscribe connections with key corridor stakeholders.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
I-900-020	The I-270 ICMS shall publish current corridor transportation data per stakeholder agency system subscriptions and associated Interface Control Documents (ICD's).	7, 6	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	DE	ConOps Text: Establish publish/subscribe connections with key corridor stakeholders. Note: ICD's to be developed.	H
I-900-030	The I-270 ICMS shall exchange current corridor transportation data with the MD CHART system as defined in the I-270 ICMS / MD CHART System Interface Control Document.	7, 6	ConOps § 1.8, Table 1-5, p. 14 (under Freeway Network)	DE	ConOps Text: Interface with RITIS for providing and extracting real-time information (2007). Note: Existing ICD to be expanded.	H
I-900-040	The I-270 ICMS shall exchange current corridor transportation data with the Montgomery County ATMS as defined in the I-270 ICMS / Montgomery County ATMS Interface Control Document.	7, 6	ConOps § 1.8, Table 1-5, p.15 (under Arterial Network)	DE	ConOps Text: Interface with RITIS for providing and extracting real-time information (2008). Note: ICD to be developed.	H
I-900-050	The I-270 ICMS shall exchange current corridor transportation data with the Montgomery County Traffic Signal system as defined in the I-270 ICMS / Montgomery County Traffic Signal System Interface Control Document.	7, 6	ConOps § 1.8, Table 1-5, p.15 (under Arterial Network)	DE	ConOps Text: Interface with RITIS for providing and extracting real-time information (2008). Note: ICD to be developed.	H
I-900-060	The I-270 ICMS shall exchange current corridor transportation data with the Montgomery County Ride On Bus system as defined in the I-270 ICMS / Montgomery County Ride On Bus CAD/AVL System Interface Control Document.	7, 6	ConOps § 1.8, Table 1-5, p. 15 (under Ride On Network)	DE	ConOps Text: Interface with RITIS for providing and extracting real-time information (2008). Note: ICD to be developed.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
I-900-070	The I-270 ICMS shall exchange current corridor transportation data with the WMATA Metrorail system as defined in the I-270 ICMS / WMATA Metrorail Rail Operations Control System Interface Control Document.	7, 6	ConOps § 1.8, Table 1-5, p.15 (under Metrorail Network)	DE	ConOps Text: Interface with RITIS for providing and extracting real-time information (2008). Note: Existing ICD to be expanded.	H
I-900-080	The I-270 ICMS shall exchange current corridor transportation data with the WMATA Metrobus system as defined in the I-270 ICMS / WMATA Metrobus CAD/AVL System Interface Control Document.	7, 6	ConOps § 1.8, Table 1-5, p.15 (under Metrobus Network)	DE	ConOps Text: Interface with RITIS for providing and extracting real-time information (2008). Note: ICD to be developed.	H
I-900-090	The I-270 ICMS shall exchange current corridor transportation data with the MARC Commuter Rail system as defined in the I-270 ICMS / MARC Commuter Rail CAD/AVL System Interface Control Document.	7, 6	ConOps § 1.8, Table 1-5, p. 15 (under MARC Commuter Rail Network)	DE	ConOps Text: Interface with RITIS for providing and extracting real-time information (2008). Note: ICD to be developed.	L
I-900-100	The I-270 ICMS shall exchange current corridor transportation data with the WMATA Metrorail Parking Management System as defined in the I-270 ICMS / WMATA Metrorail Parking Management System Interface Control Document.	7, 6	ConOps § 5.3.2, Table 5-4, p. 101 (under Role and Responsibilities)	DE	ConOps Text: (RITIS) Provide transit parking information to other agencies for display on selected DMS. Note: ICD to be developed.	M
I-900-110	The I-270 ICMS shall exchange current corridor transportation data with the MARC Commuter Rail Parking Management System as defined in the I-270 ICMS / MARC Commuter Rail Parking Management System Interface Control Document.	7, 6	ConOps § 5.3.2, Table 5-4, p. 101 (under Role and Responsibilities)	DE	ConOps Text: (RITIS) Provide transit parking information to other agencies for display on selected DMS. Note: ICD to be developed.	L

ID	Requirement	Need	Source	Allocation	Comment	Criticality
I-900-120	The I-270 ICMS shall exchange current corridor transportation data with the Montgomery County Police CAD/911 System as defined in the I-270 ICMS / Montgomery County Police CAD/911 System Interface Control Document.	7, 6	ConOps § 5.3.2, p. 100	DE	ConOps Text: The 911 operator immediately enters the information into the CAD system which automatically notifies the Police and Fire dispatches co-located within the facility. Note: ICD to be developed.	M
I-900-130	The I-270 ICMS shall exchange current corridor transportation data with the MD State Police CAD/911 System as defined in the I-270 ICMS / MD State Police CAD/911 System Interface Control Document.	7, 6	ConOps § 5.3.2, p. 103	DE	ConOps Text: State Police – Provide incident management local to the scene. Note: ICD to be developed.	L
I-900-140	The I-270 ICMS shall exchange current corridor transportation data and incident/event data with CapWIN as defined in the I-270 ICMS / CapWIN Interface Control Document.	7, 6	ConOps § 3.5, p. 40	DE	ConOps Text: Installation of CapWIN mobile data terminals in the Service Patrol vehicles. Expected completion date of 2008. Note: ICD to be developed.	H
I-900-150	The I-270 ICMS shall exchange current corridor transportation data with the Montgomery County Emergency Operations Center system, if activated, as defined in the I-270 ICMS / Montgomery County Emergency Operations Center System Interface Control Document.	7, 6	ConOps § 5.4, p. 104	DE	ConOps Text: In accordance with the hurricane plan, the Emergency Operations Center (EOC) for Montgomery County is activated for managing the evacuation for routes north through the I-270 Corridor. Note: ICD to be developed.	M
I-900-160	The I-270 ICMS shall exchange current corridor transportation data with third-party traffic flow data systems as defined in the I-270 ICMS / Third-Party Traffic Flow Data System Interface Control Document.	7, 6	I-270 ICMS Project Team	DE	Note: ICD to be developed.	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
I-900-170	The I-270 ICMS shall disseminate automated current alarm notifications for corridor incidents to stakeholder agencies.	16, 6	ConOps § 4.7, p. 79	DE	ConOps Text: RITIS will provide data-collection, data archiving, and data-exchange capabilities, including automated alarm notifications for incidents, etc.	H
I-900-180	The I-270 ICMS shall collect corridor transportation data from stakeholder systems based on common frequency intervals (e.g., once per minute).	17, 6	ConOps § 4.9, Table 4-12, p. 82	DE	ConOps Text: Creation of a common data collection frequency among all stakeholders.	L
I-900-180-010	The frequency intervals (e.g., once per minute) in collecting corridor transportation data from stakeholder systems shall be changeable.	17, 6	ConOps § 4.11, p. 90	DE	ConOps Text: Some of the data identified above will be harder to collect because they require gathering and merging data from different stakeholders, which means coordinating and potentially adjusting collection period starting times and collection frequencies.	M
D-900	The I-270 ICMS shall implement common definitions for all data elements exchanged between corridor stakeholder systems.	19, 6	ConOps § 4.9, p. 83	DE, DQ, DC	ConOps Text: It will be essential that all data elements exchanged between the different software central systems operated by the I-270 ICM stakeholders be defined in exactly the same way; that there be perfect understanding between the interfaced centers as to the meaning of these data — both status and control information.	H
F-900	The I-270 ICMS shall log all data exchanges and alarm notifications.	29, 6	RITIS ConOps § 2.6, p. 30	DE	ConOps Text: RITIS will provide a comprehensive data archive and retrieval service, including online access to data catalogues and other information. The RITIS archive will record data attributes, sources, and date and time of publication.	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
P-900	The I-270 ICMS shall publish current corridor transportation data to all stakeholder agency systems within 180 seconds of receipt from the source system(s).	7, 6	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	DE	ConOps Text: Establish publish/subscribe connections with key corridor stakeholders.	M
P-910	The I-270 ICMS shall process a minimum of 50 concurrent data exchange interfaces.	18	I-270 ICMS Project Team	DE		H
X-920	A data communications network will exist to process I-270 ICMS data exchanges with stakeholder agency systems.	N/A	ConOps § 4.9, Table 4-12, p. 82	N/A	ConOps Text: Sizing and managing a Communications System among stakeholders.	H
I-930	The I-270 ICMS shall include a redundant network connection to the corridor data communications network for data exchanges with stakeholder agency systems.	18, 33	ConOps § 4.9, Table 4-12, p. 82	DE	ConOps Text: Sizing and managing a Communications System among stakeholders.	H
X-940	Each stakeholder agency that will exchange data with the I-270 ICMS will establish a connection to the corridor data communications network.	N/A	ConOps § 4.9, Table 4-12, p. 82	DE	ConOps Text: Sizing and managing a Communications System among stakeholders.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
5.3.4 ITS Device Control and Monitoring (Requirements 1100-1299)						
X-1100	Stakeholder agency systems will retain sole control of freeway ITS devices within the corridor.	N/A	ConOps – Throughout	N/A	ConOps Examples: • Additional DMS on I-270. • Additional detectors along I-270 to collect volumes, speeds, and travel time. • Additional CCTV along I-270. • Consequently, the total integration of all systems and the rendering of control of field devices and other assets to a new transportation management facility is not envisioned for this project.	H
X-1100-010	The MD CHART system will control DMS on I-270 to display traveler information to motorists.	N/A	ConOps § 1.8, Table 1-5, p. 14 (under Freeway Network)	N/A	ConOps Text: Additional DMS on I-270.	H
X-1100-020	The MD CHART system will control HAR/TAR on I-270 to disseminate traveler information to motorists.	N/A	ConOps § 5.3.1, p. 98	N/A	ConOps Text: The information on the traveler information devices, particularly the DMS and HAR/TAR, are adjusted to change from typical information about an incident to a message indicating worse-than-normal traffic due to the accident conditions.	H
X-1100-030	The MD CHART system will monitor vehicle detectors on I-270 to collect vehicle volumes, speeds, and travel times.	N/A	ConOps § 1.8, Table 1-5, p. 14 (under Freeway Network)	N/A	ConOps Text: Additional detectors along I-270 to collect volumes, speeds, and travel time.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1100-030-010	The MD CHART system will be able to adjust the frequency of collecting I-270 vehicle detector data.	N/A	ConOps – Throughout	N/A	ConOps Examples: • Expanded detection and verification capabilities are needed across all transportation networks. • Improve rapid response to changing traffic, incident, and weather conditions. • Agencies need to detect and verify incidents quickly and efficiently.	M
X-1100-030-020	The MD CHART system will collect I-270 vehicle detector data at least every 60 seconds.	N/A	ConOps – Throughout	N/A	ConOps Examples: • Expanded detection and verification capabilities are needed across all transportation networks. • Improve rapid response to changing traffic, incident, and weather conditions. • Agencies need to detect and verify incidents quickly and efficiently.	H
X-1100-040	The MD CHART system will monitor roadway weather sensors on I-270.	N/A	ConOps – Throughout	N/A	ConOps Example: • Improve rapid response to changing traffic, incident, and weather conditions.	H
X-1100-040-010	The MD CHART system will be able to adjust the frequency of collecting I-270 roadway weather sensor data.	N/A	ConOps – Throughout	N/A	ConOps Example: • Improve rapid response to changing traffic, incident, and weather conditions.	M
X-1100-040-020	The MD CHART system will collect I-270 roadway weather sensor data at least every five minutes.	N/A	ConOps – Throughout	N/A	ConOps Example: • Improve rapid response to changing traffic, incident, and weather conditions.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1100-050	The MD CHART system and Montgomery County ATMS will control CCTV cameras on I-270 to verify roadway incidents and other events.	N/A	ConOps § 1.8, Table 1-5, p. 14	N/A	ConOps Text: Additional CCTV along I-270.	H
X-1100-060	The MD CHART system and Montgomery County ATMS will monitor freeway ITS devices within the corridor for faults or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	H
X-1100-070	The MD CHART system and Montgomery County ATMS will generate an alarm when an associated freeway ITS device within the corridor fails or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	H
X-1110	Stakeholder agency systems will retain sole control of arterial ITS devices within the corridor.	N/A	ConOps – Throughout	N/A	ConOps Examples: • Additional DMS on arterials. • Additional detectors along arterials to collect volumes, speeds, and travel time. • Additional CCTV along arterials. • Consequently, the total integration of all systems and the rendering of control of field devices and other assets to a new transportation management facility is not envisioned for this project.	H
X-1110-010	The Montgomery County ATMS will control DMS on corridor arterials to display traveler information to motorists.	N/A	ConOps § 1.8, Table 1-5, p. 15 (under Arterial) Network)	N/A	ConOps Text: Additional DMS on arterials (2010).	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1110-020	The Montgomery County ATMS will control HAR/TAR on corridor arterials to disseminate traveler information to motorists.	N/A	ConOps § 5.3.1, p. 98	N/A	ConOps Text: The information on the traveler information devices, particularly the DMS and HAR/TAR, are adjusted to change from typical information about an incident to a message indicating worse-than-normal traffic due to the accident conditions.	H
X-1110-030	The Montgomery County ATMS will monitor vehicle detectors on corridor arterials to collect vehicle volumes, speeds, and travel times.	N/A	ConOps § 1.8, Table 1-5, p. 15 (under Arterial) Network)	N/A	ConOps Text: Additional detectors along arterials to collect volumes, speeds, and travel time (2010).	H
X-1110-030-010	The Montgomery County ATMS will be able to adjust the frequency of collecting arterial vehicle detector data.	N/A	ConOps – Throughout	N/A	ConOps Examples: • Traffic signals on arterials along the corridor need to be able to respond instantly to changing traffic conditions. • Expanded detection and verification capabilities are needed across all transportation networks. • Improve rapid response to changing traffic, incident, and weather conditions. • Agencies need to detect and verify incidents quickly and efficiently.	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1110-030-020	The Montgomery County ATMS will collect arterial vehicle detector data at least every 60 seconds.	N/A	ConOps – Throughout	N/A	ConOps Examples: • Traffic signals on arterials along the corridor need to be able to respond instantly to changing traffic conditions. • Expanded detection and verification capabilities are needed across all transportation networks. • Improve rapid response to changing traffic, incident, and weather conditions. • Agencies need to detect and verify incidents quickly and efficiently.	H
X-1110-040	The Montgomery County ATMS will control CCTV cameras on corridor arterials to verify roadway incidents and other events.	N/A	ConOps § 1.8, Table 1-5, p. 15 (under Arterial Network)	N/A	ConOps Text: Additional CCTV along arterials (2010).	H
X-1110-050	The Montgomery County ATMS will monitor arterial ITS devices within the corridor for faults or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	H
X-1110-060	The Montgomery County ATMS will generate an alarm when an arterial ITS device within the corridor fails or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1120	The Montgomery County Traffic Signal system will control/monitor traffic signals on corridor arterials.	N/A	ConOps § 3.8, Table 3-10, p. 47 (under Traffic Signals) ConOps § 1.6, Table 1-4, p. 13 (under Optimize Traffic Signals on Arterials)	N/A	ConOps Text: • Traffic signals on arterials along the corridor need to be able to respond instantly to changing traffic conditions. • Enable automated traffic-responsive and traffic-adaptive operation of signals.	H
X-1120-010	The Montgomery County Traffic Signal system will automatically modify traffic signal timings on corridor arterials.	N/A	ConOps § 3.8, Table 3-10, p. 47 (under Traffic Signals) ConOps § 1.6, Table 1-4, p. 13 (under Optimize Traffic Signals on Arterials)	N/A	ConOps Text: • Traffic signals on arterials along the corridor need to be able to respond instantly to changing traffic conditions. • Enable automated traffic-responsive and traffic-adaptive operation of signals.	M
X-1120-020	The Montgomery County Traffic Signal system will generate adaptive signal timing plans that improve vehicle throughput under normal conditions.	N/A	ConOps § 4.3.2, p. 58	N/A	ConOps Text: Traffic Signal Optimization Outputs – Enhanced, adaptive signal timing plans that improve vehicle throughput, both under normal conditions and during incidents.	H
X-1120-030	The I-270 Montgomery County Traffic Signal system will generate adaptive signal timing plans that improve vehicle throughput during incidents.	N/A	ConOps § 4.3.2, p. 58	N/A	ConOps Text: Traffic Signal System Outputs – Enhanced, adaptive signal timing plans that improve vehicle throughput, both under normal conditions and during incidents.	H
X-1120-040	The I-270 Montgomery County Traffic Signal system will store pre-planned timing plans for special events, emergencies, and regional/corridor-based scenarios.	N/A	ConOps § 3.8, Table 3-10, p. 47 (under Traffic Signals)	N/A	Traffic signals on arterials along the corridor need to be able to respond instantly to changing traffic conditions.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1120-050	Authorized users of the Montgomery County Traffic Signal system will be able to select pre-planned timing plans for special events, emergencies, and regional/corridor-based scenarios.	N/A	ConOps § 3.8, Table 3-10, p. 47 (under Traffic Signals)	N/A	Traffic signals on arterials along the corridor need to be able to respond instantly to changing traffic conditions.	H
X-1120-060	The Montgomery County Traffic Signal system will provide traffic signal prioritization on corridor arterials.	N/A	ConOps § 1.6, Table 1-4, p. 13 (under Optimize Traffic Signals on Arterials)	N/A	ConOps Text: Include enhanced capabilities such as potentially providing priority to Ride On and Metrobus.	M
X-1120-060-010	The Montgomery County Traffic Signal system will provide traffic signal prioritization for Montgomery County Ride On buses.	N/A	ConOps § 1.6, Table 1-4, p. 13 (under Optimize Traffic Signals on Arterials)	N/A	ConOps Text: Include enhanced capabilities such as potentially providing priority to Ride On and Metrobus.	M
X-1120-060-020	The Montgomery County Traffic Signal system will provide traffic signal prioritization for WMATA Metrobuses.	N/A	ConOps § 1.6, Table 1-4, p. 13 (under Optimize Traffic Signals on Arterials)	N/A	ConOps Text: Include enhanced capabilities such as potentially providing priority to Ride On and Metrobus.	M
X-1120-060-030	The Montgomery County Traffic Signal system will provide traffic signal prioritization for emergency vehicles.	N/A	ConOps § 3.8, Table 3-10, p. 47 (under Traffic Signals)	N/A	ConOps Text: Traffic signal prioritization for emergency vehicles is desirable.	M
X-1120-070	The Montgomery County Traffic Signal System will provide traffic signal pre-emption for traffic signals adjacent to highway-rail intersection (HRI) equipment located in the field.	N/A	Traffic Signal System Modernization (TSSM) ConOps § 3.3, p. 22	N/A	ConOps Text: HRI Management – remotely control highway-rail intersection (HRI) equipment located in the field.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1120-080	The Montgomery County Traffic Signal system will monitor traffic signal devices within the corridor for faults or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	H
X-1120-090	The Montgomery County Traffic Signal system will generate an alarm when a traffic signal device within the corridor fails or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	H
X-1130	Stakeholder agency systems will retain sole control of transit ITS devices within the corridor.	N/A	ConOps – Throughout	N/A	ConOps Example: • The sharing of video images will be part of the RITIS system in that all connected stakeholders will be able to view the images from all agencies along the I-270 Corridor; however, the control of PTZ commands will remain with the "owning" stakeholder agency. • Consequently, the total integration of all systems and the rendering of control of field devices and other assets to a new transportation management facility is not envisioned for this project.	H
X-1130-010	Transit stakeholder agency systems will monitor transit ITS devices within the corridor for faults or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	H
X-1130-020	Transit stakeholder agency systems will generate an alarm when a transit ITS device within the corridor fails or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1140	Stakeholder agency systems will provide automated incident detection within the corridor.	N/A	ConOps § 3.8, Table 3-10, p. 47 (under Incident and Emergency Management)	N/A	ConOps Text: Agencies need to detect and verify incidents quickly and efficiently.	M
X-1140-010	Stakeholder agency freeway management systems will provide automated incident detection over all corridor freeways.	N/A	ConOps § 4.9, p. 81	N/A	ConOps Text: There are "gaps" in the integrated approach to incident management.	M
X-1140-020	Stakeholder agency arterial management systems will provide automated incident detection over all corridor arterials.	N/A	ConOps § 4.9, p. 81	N/A	ConOps Text: There are "gaps" in the integrated approach to incident management.	M
X-1140-030	Stakeholder agency transit management systems will provide automated incident detection over corridor transit routes.	N/A	ConOps § 4.9, p. 81	N/A	ConOps Text: There are "gaps" in the integrated approach to incident management.	M
X-1150	Stakeholder agency management systems will provide automated congestion detection within the corridor.	N/A	ConOps § 5.3.1, p. 98 ConOps § 4.9, p. 84	N/A	ConOps Text: As the local lanes quickly fill to capacity (due to detouring traffic), the operators at the traffic center in Montgomery County verify the traffic flow and monitor the signal optimization patterns. The cycle lengths are adjusted for the added capacity. ConOps Text: Another approach includes the continuous provision of a congestion map, which already exists within the CHART software, but which will need to be expanded to include the primary arterials in the I-270 Corridor.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1150-010	Stakeholder agency arterial management systems will provide automated congestion detection over all corridor arterials.	N/A	ConOps § 5.3.1, p. 98	N/A	ConOps Text: As the local lanes quickly fill to capacity (due to detouring traffic), the operators at the traffic center in Montgomery County verify the traffic flow and monitor the signal optimization patterns. The cycle lengths are adjusted for the added capacity.	H
X-1150-020	Stakeholder agency freeway management systems will provide automated congestion detection over all corridor freeways.	N/A	ConOps § 4.9, p. 84	N/A	ConOps Text: Another approach includes the continuous provision of a congestion map, which already exists within the CHART software, but which will need to be expanded to include the primary arterials in the I-270 Corridor.	H
F-1160	The I-270 ICMS shall automatically request modification of messages on I-270 DMS based on changing traffic conditions within the corridor.	30	ConOps § 1.8, Table 1-5, p. 14 (under Freeway Network)	TI	ConOps Text: Additional DMS on I-270.	H
P-1160	The I-270 ICMS shall automatically request modification of messages on I-270 DMS within 120 seconds upon identification of changing traffic conditions within the corridor.	30	ConOps § 1.8, Table 1-5, p. 14 (under Freeway Network)	TI	ConOps Text: Additional DMS on I-270.	H
F-1170	The I-270 ICMS shall automatically request modification of messages on arterial DMS based on changing traffic conditions within the corridor.	30	ConOps § 1.8, Table 1-5, p. 15 (under Arterial) Network)	TI	ConOps Text: Additional DMS on arterials (2010).	H
P-1170	The I-270 ICMS shall automatically request modification of messages on arterial DMS within 120 seconds upon identification of changing traffic conditions within the corridor.	30	ConOps § 1.8, Table 1-5, p. 15 (under Arterial) Network)	TI	ConOps Text: Additional DMS on arterials (2010).	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-1180	The I-270 ICMS shall automatically request modification of messages on transit DMS based on changing traffic conditions within the corridor.	30	ConOps – Throughout	TI	ConOps Examples: • Platform DMS • 10 DMS signs in selected bus shelters	H
P-1180	The I-270 ICMS shall automatically request modification of messages on transit DMS within 120 seconds upon identification of changing traffic conditions within the corridor.	30	ConOps – Throughout	TI	ConOps Examples: • Platform DMS • 10 DMS signs in selected bus shelters	H
F-1190	The I-270 ICMS shall automatically request modification of messages on I-270 HAR/TAR based on changing traffic conditions within the corridor.	30	ConOps § 5.3.1, p. 98	TI	ConOps Text: The information on the traveler information devices, particularly the DMS and HAR/TAR, are adjusted to change from typical information about an incident to a message indicating worse-than-normal traffic due to the accident conditions.	H
P-1190	The I-270 ICMS shall automatically request modification of messages on I-270 HAR/TAR within 120 seconds upon identification of changing traffic conditions within the corridor.	30	ConOps § 5.3.1, p. 98	TI	ConOps Text: The information on the traveler information devices, particularly the DMS and HAR/TAR, are adjusted to change from typical information about an incident to a message indicating worse-than-normal traffic due to the accident conditions.	H
F-1200	The I-270 ICMS shall automatically request modification of messages on arterial HAR/TAR based on changing traffic conditions within the corridor.	30	ConOps § 5.3.1, p. 98	TI	ConOps Text: The information on the traveler information devices, particularly the DMS and HAR/TAR, are adjusted to change from typical information about an incident to a message indicating worse-than-normal traffic due to the accident conditions.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
P-1200	The I-270 ICMS shall automatically request modification of messages on arterial HAR/TAR within 120 seconds upon identification of changing traffic conditions within the corridor.	30	ConOps § 5.3.1, p. 98	TI	ConOps Text: The information on the traveler information devices, particularly the DMS and HAR/TAR, are adjusted to change from typical information about an incident to a message indicating worse-than-normal traffic due to the accident conditions.	H
F-1210	The I-270 ICMS shall automatically request modification of traffic signal timings based on changing traffic conditions within the corridor.	3	ConOps § 3.8, Table 3-10, p. 47 (under Traffic Signals)	TM, SD	ConOps Text: Traffic signals on arterials along the corridor need to be able to respond instantly to changing traffic conditions.	H
P-1210	The I-270 ICMS shall automatically request modification of traffic signal timings within 120 seconds upon identification of changing traffic conditions within the corridor.	3	ConOps § 3.8, Table 3-10, p. 47 (under Traffic Signals)	TM, SD	ConOps Text: Traffic signals on arterials along the corridor need to be able to respond instantly to changing traffic conditions.	H
5.3.5 Parking Management System (Requirements 1300-1499)						
X-1300	The MARC Parking Management system will monitor current parking availability for MARC parking lots within the corridor.	N/A	ConOps § 1.8, Table 1-5, p. 15 (under MARC Commuter Rail Network)	N/A	ConOps Text: Parking management software (2009). Surveillance of park-n-ride lots at the stations for real-time monitoring of parking availability (2009).	L
X-1300-010	The MARC Parking Management system will electronically monitor vehicle volumes at MARC parking lots in the corridor.	N/A	ConOps § 4.3.4, p. 59	N/A	ConOps Text: Parking Availability Inputs – Parking sensor volume data.	L
X-1300-020	The MARC Parking Management system will track vehicle capacity at MARC parking lots in the corridor.	N/A	ConOps § 4.3.4, p. 59	N/A	ConOps Text: Parking Availability Inputs – Total parking lot capacity data.	L

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1300-030	The MARC Parking Management system will calculate the rate of fill at MARC parking lots in the corridor.	N/A	ConOps § 4.3.4, p. 59	N/A	ConOps Text: Parking Availability Inputs – Algorithm for calculating rate of fill.	L
X-1300-040	The MARC Parking Management system will control DMS in MARC parking lots to display current parking availability information.	N/A	ConOps § 1.8, Table 1-5, p. 15 (under MARC Commuter Rail Network)	N/A	ConOps Text: DMS for parking information dissemination (2008).	L
X-1300-050	The MARC Parking Management system will monitor associated ITS devices for faults or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	L
X-1300-060	The MARC Parking Management system will generate an alarm when an associated ITS device fails or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	L
X-1310	The Metrorail Parking Management system will monitor current parking availability for Metrorail parking lots within the corridor.	N/A	ConOps § 1.8, Table 1-5, p. 15 (under Metrorail Network)	N/A	ConOps Examples: • Parking management software (2009). • Surveillance of park-n-ride lots at the stations for real-time monitoring of parking availability (2009).	M
X-1310-010	The Metrorail Parking Management system will electronically monitor vehicle volumes at Metrorail parking lots in the corridor.	N/A	ConOps § 4.3.4, p. 59	N/A	ConOps Text: Parking Availability Inputs – Parking sensor volume data.	M
X-1310-020	The Metrorail Parking Management system will track vehicle capacity at Metrorail parking lots in the corridor.	N/A	ConOps § 4.3.4, p. 59	N/A	ConOps Text: Parking Availability Inputs – Total parking lot capacity data.	M
X-1310-030	The Metrorail Parking Management system will calculate the rate of fill at Metrorail parking lots in the corridor.	N/A	ConOps § 4.3.4, p. 59	N/A	Parking Availability Inputs – Algorithm for calculating rate of fill.	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1310-040	The Metrorail Parking Management system will control DMS in Metrorail parking lots to display current parking availability information.	N/A	ConOps § 1.8, Table 1-5, p. 15 (under Metrorail Network)	N/A	ConOps Text: DMS for parking information dissemination (2009).	M
X-1310-050	The Metrorail Parking Management system will monitor associated ITS devices for faults or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	M
X-1310-060	The Metrorail Parking Management system will generate an alarm when an associated ITS device fails or malfunctions.	N/A	ConOps § 3.1, p. 19	N/A	ConOps Text: Various ITS devices are crucial to operations, and are located in and around the I-270/Montgomery County Corridor.	M
5.3.6 Decision Support System (Requirements 1500-1699)						
F-1500	The I-270 ICMS shall include a Decision Support system.	2	ConOps § 1.5, p. 10	DS	ConOps Text: Key technology systems and decision support tools within the corridor are interoperable and real-time information on road and traffic conditions is commonly exchanged among the corridor's managing partners and stakeholders.	H
F-1500-030	The I-270 ICMS shall maintain coordinated traffic management plans for evacuation routes through the corridor.	15, 2	ConOps § 5.4, p. 103	DS, TM	ConOps Text: In accordance with the hurricane plan, the Emergency Operations Center (EOC) for Montgomery County is activated for managing the evacuation for routes north through the I-270 Corridor.	H
F-1500-040	The I-270 ICMS Decision Support system shall store response plans for at least 25,000 corridor scenarios and events.	15, 2	ConOps § 4.9, Table 4-12, p. 82 (under Technology Issues)	DS	ConOps Text: Real-time decision support (i.e., software-based response plan development/selection management tools).	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-1500-040-010	The I-270 ICMS Decision Support system shall manage response plans.	15, 2	ConOps § 4.9, Table 4-12, p. 82 (under Technology Issues)	DS	ConOps Text: Real-time decision support (i.e., software-based response plan development/selection management tools).	M
F-1500-040-010-010	The I-270 ICMS Decision Support system shall create new response plans.	15, 2	ConOps § 4.9, Table 4-12, p. 82 (under Technology Issues)	DS	ConOps Text: Real-time decision support (i.e., software-based response plan development/selection management tools).	M
F-1500-040-010-020	The I-270 ICMS Decision Support system shall modify and rename existing response plans.	15, 2	ConOps § 4.9, Table 4-12, p. 82 (under Technology Issues)	DS	ConOps Text: Real-time decision support (i.e., software-based response plan development/selection management tools).	M
F-1500-040-010-030	The I-270 ICMS Decision Support system shall delete existing response plans.	15, 2	ConOps § 4.9, Table 4-12, p. 82 (under Technology Issues)	DS	ConOps Text: Real-time decision support (i.e., software-based response plan development/selection management tools).	M
F-1500-040-010-040	The I-270 ICMS Decision Support system shall categorize/group existing response plans.	15, 2	ConOps § 4.9, Table 4-12, p. 82 (under Technology Issues)	DS	ConOps Text: Real-time decision support (i.e., software-based response plan development/selection management tools).	M
F-1500-040-010-050	The I-270 ICMS Decision Support system shall recommend the implementation of existing response plans based on the transportation conditions in the corridor.	15, 2	ConOps § 4.9, Table 4-12, p. 82 (under Technology Issues)	DS	ConOps Text: Real-time decision support (i.e., software-based response plan development/selection management tools).	M
F-1510	The I-270 ICMS shall recommend detour routes based on corridor traffic conditions.	15	ConOps § 5.3.2, p. 100	DS, TM, DE	ConOps Text: Traffic Detour routes are put into place with notifications sent to the corridor agencies.	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
I-1510	The I-270 ICMS shall provide detour route recommendations to stakeholder agency systems.	15	ConOps § 5.3.2, p. 100	DE	ConOps Text: Traffic Detour routes are put into place with notifications sent to the corridor agencies.	H
X-1540	The MD CHART system will include updated Freeway Incident Traffic Management (FITM) plans for the I-270 corridor.	N/A	ConOps § 3.5, p. 38	N/A	ConOps Text: Update of the SHA Freeway Incident Traffic Management (FITM) Plans for the I-270 Corridor.	H
X-1540-010	The MD CHART I-270 corridor FITM plans will be updated to include inputs from Montgomery County DPWT and Maryland State Police to improve the management of heavy backups and delays during major closures on interstates within and adjacent to the corridor.	N/A	ConOps § 3.5, p. 38	N/A	ConOps Text: FITM plans along I-270 are being updated with input from Montgomery County DPWT and Maryland State Police. The purpose of this update is to improve the management of heavy backups and delays during major closures on interstates.	H
X-1540-020	The MD CHART I-270 corridor FITM plans will be updated to reflect Montgomery County's traffic signal system and current travel patterns in order to efficiently route traffic around incidents within the corridor.	N/A	ConOps § 3.5, p. 38	N/A	ConOps Text: Montgomery County's traffic operations team will take account of traffic signal system capabilities and current travel patterns in order to efficiently route traffic around incidents.	M
X-1540-030	The MD CHART I-270 corridor FITM plans will be updated to reflect Montgomery County's automated signal timing plans so they can be easily activated upon request by MDSHA CHART and/or Maryland State Police.	N/A	ConOps § 3.5, p. 38	N/A	ConOps Text: Eventually, the FITM plans will be based on automated signal timing plans so they can be easily activated upon request by MDSHA CHART and/or Maryland State Police.	H
X-1560	The Montgomery County Traffic Signal System will generate current time-space diagrams.	N/A	ConOps § 1.8, Table 1-5, p. 15 (under Arterial Network) TSSM ConOps § 3.2, Table 3-2, p. 21	N/A	ConOps Text: Decision-support software as part of the signal system upgrade (mid-2009).	L

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1570	The Montgomery County Traffic Signal System will display split monitors.	N/A	ConOps § 1.8, Table 1-5, p. 15 (under Arterial Network) TSSM ConOps § 3.2, Table 3-2, p. 21	N/A	ConOps Text: Decision-support software as part of the signal system upgrade (mid-2009).	L
5.3.7 Data Analysis and Performance Measurements (Requirements 1700-1899)						
O-1700	The I-270 ICMS shall include defined parameters and documented procedures for assessing system performance.	24	ConOps § 1.6, Table 1-4, p. 13 (under Measure Operations Performance)	PM	ConOps Text: Identify parameters and procedures for assessing performance from CHART and RITIS.	H
F-1700	The I-270 ICMS shall analyze collected data (as defined in Table 3, ICM System Data Types) to determine system performance measurements.	24	ConOps § 1.6, Table 1-4, p. 13 (under Measure Operations Performance)	PM	ConOps Text: Analyze data to assess performance.	H
F-1700-010	The I-270 ICMS shall archive corridor transportation data for performance measurements and analyses purposes.	25, 24	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	PM	Archive corridor transportation, traffic, transit, and incident response data for performance measurement.	H
F-1700-020	The I-270 ICMS shall retrieve archived corridor transportation data for performance measurements and analysis purposes.	25, 24	ConOps § 1.8, Table 1-5, p. 14 (under Freeway Network)	PM	ConOps Text: Interface with RITIS for extracting archived data for performance analysis and evaluation (2008).	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-1700-040	The I-270 ICMS shall format the results of system performance analyses for dissemination to stakeholders.	31, 24	ConOps § 1.6, Table 1-4, p. 13 (under Measure Operations Performance)	PM	ConOps Text: Disseminate performance findings to stakeholders.	H
F-1700-050	The I-270 ICMS shall calculate performance measurements using data collected as shown in Table 3, I-270 ICM System Data Types.	24	ConOps § 4.11, p. 88	PM, DC	ConOps Text: Therefore, obtained data from the stakeholders will be fed into RITIS from where it can be used in the modeling of the corridor and for subsequent analysis, including determination of performance trends and updating of decision-support parameters.	H
F-1700-050-010	The I-270 ICMS shall calculate performance measurements based on collected data to determine performance trends.	24	ConOps § 4.11, p. 88	PM, DC	ConOps Text: Therefore, obtained data from the stakeholders will be fed into RITIS from where it can be used in the modeling of the corridor and for subsequent analysis, including determination of performance trends and updating of decision-support parameters.	H
F-1700-050-020	The I-270 ICMS shall calculate performance measurements based on collected data to update decision-support parameters.	24	ConOps § 4.11, p. 88	PM, DC	ConOps Text: Therefore, obtained data from the stakeholders will be fed into RITIS from where it can be used in the modeling of the corridor and for subsequent analysis, including determination of performance trends and updating of decision-support parameters.	H
F-1700-050-030	The I-270 ICMS shall calculate the average travel time between two designated locations within the corridor under normal conditions.	24	ConOps § 4.11, Table 4-13, p. 87 (under Optimize Mobility, Reliability, and Safety)	PM	ConOps Text: Average Travel Time under normal conditions. Note: Designated locations can be freeway, arterial, or transit.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-1700-050-040	The I-270 ICMS shall calculate a travel time index for a specified trip between two designated locations within the corridor).	24	ConOps § 4.11, Table 4-13, p. 87 (under Optimize Mobility, Reliability, and Safety)	PM	ConOps Text: Travel Time Index – a ratio of travel times in the peak period or other corridor condition to a target or acceptable travel time (typically free-flow/on-schedule conditions are used). The travel time index indicates how much longer a trip will take during a peak time. Note: Designated locations can be freeway, arterial, or transit.	H
F-1700-050-050	The I-270 ICMS shall calculate the buffer index for a specified trip between two designated locations within the corridor.	24	ConOps § 4.11, Table 4-13, p. 87 (under Optimize Mobility, Reliability, and Safety)	PM	ConOps Text: Buffer Index – this measure expresses the amount of extra "buffer" time needed to be on-time 95 percent of the time (late one day per month). Travelers could multiply their average trip time by the buffer index, and then add that buffer time to their trip to ensure they will be on-time 95 percent of all trips. An advantage of expressing the reliability (or lack thereof) in this way is that a percent value is distance and time neutral. Note: Designated locations can be freeway, arterial, or transit.	H
F-1700-050-060	The I-270 ICMS shall calculate the average delay for a specified trip, segregated by incident and event types (e.g., minor and major roadway incident, minor and major transit incident, weather, special event) for the corridor and each network.	24	ConOps § 4.11, Table 4-13, p. 87 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Average Delay Per Trip – segregated by incident and event types (e.g., minor and major roadway incident, minor and major transit incident, weather, special event) for the corridor and each network	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-1700-050-080	The I-270 ICMS shall calculate incident response times for specified incidents.	24	ConOps § 4.11, Table 4-13, p. 87 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Incident Response Time (time between incident detection and emergency responder arrival at incident site).	H
F-1700-050-090	The I-270 ICMS shall calculate incident clearance times for specified incidents.	24	ConOps § 4.11, Table 4-13, p. 87 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Incident Clearance Time (time between emergency responder arrival at incident site and incident clearance time)	H
F-1700-050-100	The I-270 ICMS shall calculate incident response/clearance times for single-stakeholder incidents.	24	ConOps § 4.11, Table 4-13, p. 87 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Response/Clearance Times for Incidents (involving a single stakeholder). Note: See requirements F-1700-050-080 and F-1700-050-090 for definitions of incident response and clearance times, respectively.	H
F-1700-050-110	The I-270 ICMS shall calculate incident response/clearance times for multiple-stakeholder incidents.	24	ConOps § 4.11, Table 4-13, p. 87 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Response/Clearance Times for Major Incidents (involving multiple stakeholders). Note: See requirements F-1700-050-080 and F-1700-050-090 for definitions of incident response and clearance times, respectively.	H
F-1700-050-120	The I-270 ICMS shall calculate the time required to channel a potential Evacuation.	24	ConOps § 4.11, Table 4-13, p. 87 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Time Required to Channel a Potential Evacuation.	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-1700-050-130	The I-270 ICMS shall calculate the number of data exchanges between stakeholders in order to detect/verify incidents, including weather-related incidents.	24	ConOps § 4.11, Table 4-13, p. 87 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Number of data exchanges between stakeholders in order to detect, manage, and clear incidents, including weather-related incidents.	M
F-1700-050-133	The I-270 ICMS shall calculate the number of data exchanges between stakeholders in order to manage incidents, including weather-related incidents.	24	ConOps § 4.11, Table 4-13, p. 87 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Number of data exchanges between stakeholders in order to detect, manage, and clear incidents, including weather-related incidents.	M
F-1700-050-136	The I-270 ICMS shall calculate the number of data exchanges between stakeholders in order to clear incidents, including weather-related incidents.	24	ConOps § 4.11, Table 4-13, p. 87 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Number of data exchanges between stakeholders in order to detect, manage, and clear incidents, including weather-related incidents.	M
F-1700-050-140	The I-270 ICMS shall calculate the number of data exchanges between stakeholders in order to share traveler information display information (both DMS and HAR).	24	ConOps § 4.11, Table 4-13, p. 88 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Number of data exchanges between stakeholders in order to share traveler information display information (both DMS and HAR).	M
F-1700-050-150	The I-270 ICMS shall calculate the number of data exchanges between stakeholders in order to share information about parking space availability.	24	ConOps § 4.11, Table 4-13, p. 88 (under Strengthen Corridor-Level Decision Support)	PM	ConOps Text: Number of data exchanges between stakeholders in order to share information about parking space availability.	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-1700-050-160	The I-270 ICMS shall calculate the number of "cross-network" messages displayed on all DMS within the corridor within a specified period of time.	24	ConOps § 4.11, Table 4-13, p. 88 (under Enhance Reliable, Real-Time Information to Customers)	PM	ConOps Text: Number of "cross-network" messages displayed on all DMS's.	M
F-1700-050-170	The I-270 ICMS shall calculate the number of corridor-related ICMS public web site hits within a specified period of time.	24	ConOps § 4.11, Table 4-13, p. 88 (under Enhance Reliable, Real-Time Information to Customers)	PM	ConOps Text: Corridor-related ATIS Web site hits/511 calls.	M
F-1700-050-180	The I-270 ICMS shall calculate the number of corridor-related 511 calls within a specified period of time.	24	ConOps § 4.11, Table 4-13, p. 88 (under Enhance Reliable, Real-Time Information to Customers)	PM	ConOps Text: Corridor-related ATIS Web site hits/511 calls.	L
F-1700-050-190	The I-270 ICMS shall create corridor traveler surveys.	24	ConOps § 4.11, Table 4-13, p. 88 (under Promote Multi-Modalism)	PM	ConOps Text: Number of Corridor Customers switching travel modes based on available pre-trip and en-route information (estimation, determined via survey)	L
F-1700-050-193	The I-270 ICMS shall modify existing corridor traveler surveys.	24	ConOps § 4.11, Table 4-13, p. 88 (under Promote Multi-Modalism)	PM	ConOps Text: Number of Corridor Customers switching travel modes based on available pre-trip and en-route information (estimation, determined via survey)	L

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-1700-050-196	The I-270 ICMS shall delete existing corridor traveler surveys.	24	ConOps § 4.11, Table 4-13, p. 88 (under Promote Multi-Modalism)	PM	ConOps Text: Number of Corridor Customers switching travel modes based on available pre-trip and en-route information (estimation, determined via survey)	L
F-1700-050-200	The I-270 ICMS shall collect/record traveler survey information through the I-270 ICMS public web site.	24	ConOps § 4.11, Table 4-13, p. 88 (under Promote Multi-Modalism)	PM	ConOps Text: Number of Corridor Customers switching travel modes based on available pre-trip and en-route information (estimation, determined via survey) Note: See requirement F-2310 for additional requirements for the ICMS public web site.	L
F-1700-050-210	The I-270 ICMS shall generate reports on recorded traveler survey information.	31, 24	ConOps § 4.11, Table 4-13, p. 88 (under Promote Multi-Modalism)	PM	ConOps Text: Number of Corridor Customers switching travel modes based on available pre-trip and en-route information (estimation, determined via survey)	L
F-1700-050-220	The I-270 ICMS shall calculate the average parking availability by facility and time of day.	24	ConOps § 4.11, Table 4-13, p. 88 (under Promote Multi-Modalism)	PM	ConOps Text: Average Parking Availability Per Facility Per Time-of-Day	M
X-1700-050-230	The Montgomery County Traffic Signal system will calculate a demand failure ratio.	N/A	TSSM ConOps § 3.5, Table 3-4, p. 24	N/A	ConOps Text: (Demand failure ratio is defined as) A ratio of the number of times the traffic signal system fails to clear all demand at an intersection to the total number of times the system serves the intersection.	M

ID	Requirement	Need	Source	Allocation	Comment	Criticality
X-1700-050-240	The Montgomery County Traffic Signal system will calculate the time to recognize a significant change in traffic flow, and implement the appropriate signal timing.	N/A	TSSM ConOps § 3.5, Table 3-4, p. 24	N/A	ConOps Text: Time to recognize a significant change in traffic flow, and implement the appropriate timing.	M
F-1700-060	The I-270 ICMS shall compare corridor-level performance metrics against specific quantitative performance goals.	24	ConOps § 4.11, p. 86	PM	ConOps Text: Beside maintaining the existing performance measures, which are needed for agency-internal processes, the I-270 ICM stakeholders have identified initial performance measures that will be used to determine the effectiveness of the proposed I-270 ICM framework, strategies, and operations as compared to the stated corridor goals and objectives.	H
F-1700-070	The I-270 ICMS shall compare traveler information disseminated by different agencies for the same or similar incidents or events.	24	ConOps § 4.11, p. 88	PM, DQ	ConOps Text: Establish mechanisms to ensure uniformity of traveler information dissemination.	M
F-1700-070-010	The I-270 ICMS shall assess the uniformity of messages across DMS within the corridor.	24	ConOps § 4.11, Table 4-13, p. 88 (under Enhance Reliable, Real-Time Information to Customers)	PM	ConOps Text: Uniformity of messages across DMS's within the corridor.	M
F-1710	The I-270 ICMS shall generate reports for authorized stakeholder agency users.	31	ConOps § 1.7, p. 14	PM	ConOps Text: RITIS will support the generation of performance measures reports.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-1710-010	The I-270 ICMS shall generate pre-defined reports on collected corridor data based on a user request.	31	RITIS ConOps § 2.6, p. 31	PM	ConOps Text: RITIS will provide an archived data graphical interface for data querying and mining for researchers, decision-makers, and others. This function will output raw data or aggregates of the raw data, at the user-requested temporal and spatial levels of aggregation.	H
F-1710-020	The I-270 ICMS shall generate scheduled pre-defined reports on collected corridor data at a specified day/time and frequency.	31	I-270 ICMS Project Team	PM		M
F-1710-030	The I-270 ICMS shall provide options for sorting data in reports.	31	I-270 ICMS Project Team	PM		H
F-1710-040	The I-270 ICMS shall provide options for filtering data in reports.	31	I-270 ICMS Project Team	PM		H
F-1710-050	The I-270 ICMS shall generate reports on archived data in the I-270 ICMS database.	31	RITIS ConOps § 2.6, p. 31	PM	ConOps Text: RITIS will provide an archived data graphical interface for data querying and mining for researchers, decision-makers, and others. This function will output raw data or aggregates of the raw data, at the user-requested temporal and spatial levels of aggregation.	H
F-1710-060	The I-270 ICMS shall generate reports on corridor-wide data.	31	I-270 ICMS Project Team	PM		H
F-1710-070	The I-270 ICMS shall generate reports on agency-specific data.	31	I-270 ICMS Project Team	PM		H
F-1710-080	The I-270 ICMS shall display report outputs on the screen.	31	I-270 ICMS Project Team	PM		H
F-1710-090	The I-270 ICMS shall print report outputs.	31	I-270 ICMS Project Team	PM		H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-1710-100	The I-270 ICMS shall save report outputs in electronic format.	31	I-270 ICMS Project Team	PM		H
F-1710-110	The I-270 ICMS shall generate system administration reports to monitor the status and health of the ICMS.	31	I-270 ICMS Project Team	PM		H
F-1710-120	The I-270 ICMS shall define ad-hoc reports on collected corridor data.	31	RITIS ConOps § 2.6, p. 31	PM	ConOps Text: RITIS will allow ad-hoc and predetermined statistical reports to form region-wide or agency-specific summaries.	M
F-1710-130	The I-270 ICMS shall generate ad-hoc reports based on a user request.	31	RITIS ConOps § 2.6, p. 31	PM	ConOps Text: RITIS will allow ad-hoc and predetermined statistical reports to form region-wide or agency-specific summaries.	M
F-1710-140	The I-270 ICMS shall query for specific data and extract the data from the ICMS database for subsequent analysis.	31	RITIS ConOps § 2.6, p. 31	PM	ConOps Text: The RITIS archived toolset will allow users to perform a variety of canned and ad hoc queries and will return data to the user in a variety of media and formats such as *.txt files and Excel spreadsheets.	M
5.3.8 Policies, Procedures, and Standards (Requirements 1900-2099)						
O-1900	The I-270 ICMS shall include documented policies and procedures for coordinated traffic management and incident management within the corridor.	13	ConOps – Throughout	TM, DS	See detailed requirements below.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
O-1900-010	The I-270 ICMS shall include documented procedures for determining authority for decision-making pertaining to transportation-related issues based on location, type of incident, etc.	13	ConOps § 4.9, p. 81	DS	ConOps Text: An institutional framework allowing the close coordination between agencies will have to be put in place. This institutional framework will need to span all stakeholders and cover all available transportation modes. This will also need to address the determination of authority for decision-making pertaining to transportation-related issues based on location, type of incident, etc.	L
O-1900-020	The I-270 ICMS shall include documented procedures and protocols for identifying route/modal shifts when spare capacity exists on multiple transportation networks in the corridor.	13	ConOps § 4.9, Table 4-12, p. 82 (under Operational Issues)	TM, DS	ConOps Text: Procedures and protocols for identifying route/modal shifts when spare capacity exists on multiple networks	H
O-1900-030	The I-270 ICMS shall include documented procedures and protocols for implementing route/modal shifts when sufficient spare capacity is not available within the corridor.	13	ConOps § 4.9, Table 4-12, p. 82 (under Operational Issues)	TM, DS	ConOps Text: Policies for implementing route/modal shifts when sufficient spare capacity is not available within the corridor	H
O-1900-040	The I-270 ICMS shall include documented policies for implementing demand/capacity management strategies in the corridor.	13	ConOps § 4.9, Table 4-12, p. 82 (under Operational Issues)	TM, DS	ConOps Text: Policies for implementing demand/capacity management strategies	H
O-1900-050	The I-270 ICMS shall include documented common policies for incident response and reporting in the corridor.	13	ConOps § 4.9, Table 4-12, p. 82 (under Operational Issues)	TM, DS	ConOps Text: Common policies for incident response & reporting	H
O-1900-060	The I-270 ICMS shall include a documented video distribution/censoring policy.	13	ConOps § 4.9, Table 4-12, p. 82 (under Operational Issues)	DE	ConOps Text: Video distribution/censoring policy	L

ID	Requirement	Need	Source	Allocation	Comment	Criticality
O-1910	The I-270 ICMS shall include a documented Operations and Maintenance Plan for the corridor.	22	ConOps § 4.9, p. 84	DS	ConOps Text: The I-270 ICM stakeholders are aware that an *Operations Plan and Manual* needs to be developed during the system design phase. At a minimum, this Operations Plan will address those issues presented in bold type in Table 4-12. This plan will also serve as the basis for the *I-270 ICM Operations and Maintenance Plan* as described in the ICM Implementation Guidance.	H
O-1910-010	The I-270 ICMS Operations and Maintenance Plan shall be electronically accessible to all corridor stakeholder agencies.	22	ConOps § 4.9, p. 84	DS	ConOps Text: The I-270 ICM stakeholders are aware that an *Operations Plan and Manual* needs to be developed during the system design phase. At a minimum, this Operations Plan will address those issues presented in bold type in Table 4-12. This plan will also serve as the basis for the *I-270 ICM Operations and Maintenance Plan* as described in the ICM Implementation Guidance.	H
O-1910-020	The I-270 ICMS shall include documented standard operating procedures for communications and coordination among corridor stakeholder agencies.	26, 22	ConOps § 4.11, p. 88	DS	ConOps Text: Establish standard operating procedures (SOPs) that among other things enable individuals to use horizontal communications between staff of different agencies to shorten response times.	H
O-1910-020-010	The I-270 ICMS shall include documented standard operating procedures for HazMat response coordination between corridor stakeholder agencies.	26, 22	ConOps § 5.3.2, p. 100	DS	ConOps Text: Hazardous chemical release may be involved (so) the Hot Zone is established according to the National Incident Management System. Traffic both north- and south-bound is stopped.	H
C-1920	The I-270 ICMS shall implement the latest version of applicable standards.	20	ConOps – Throughout	DC, DE, DQ, TI	See detailed requirements below.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
C-1920-010	The I-270 ICMS shall disseminate traveler information in a consistent manner across transportation networks in the corridor.	20	ConOps § 4.9, Table 4-12, p. 82 (under Operational Issues)	TI	ConOps Text: Disseminating traveler information in a consistent manner across networks	H
C-1920-020	The I-270 ICMS shall utilize established ITS standards for both data content and communications protocols (data exchange) within the corridor.	20	ConOps § 4.9, p. 83	DC, DE, DQ	ConOps Text: Use of ITS standards for the RITIS system will be essential.	H
C-1920-020-010	The I-270 ICMS shall utilize the following standards for center-to-center data communications: • NTCIP 2306	20	ConOps § 4.9, p. 83	DC, DE, DQ	ConOps Text: Use of ITS standards for the RITIS system will be essential. NTCIP 2306 – Support of certain options defined within this standard for the I-270 ICM will need to be determined.	H
C-1920-020-020	The I-270 ICMS shall utilize the following standards for transit data: • TCIP Version 3	20	ConOps § 4.9, p. 83	DC, DE, DQ	ConOps Text: Use of ITS standards for the RITIS system will be essential. TCIP Version 3 – The precise functions/features to be supported within the I-270 ICM from this standard will need to be determined.	H
C-1920-020-030	The I-270 ICMS shall utilize the following standards for incident and event data: • IEEE 1512 for Incident Data • TMDD Version 3 for Definitions Data – link definitions, field device information (signals, DMS, etc.)	20	ConOps § 4.9, p. 83	DC, DE, DQ	ConOps Text: Use of ITS standards for the RITIS system will be essential. IEEE 1512 for Incident Data – The precise functions/features to be supported within the I-270 ICM from this standard will need to be determined. TMDD Version 3 for Definitions Data – The precise functions/features to be supported within the I-270 ICM from this standard will need to be determined.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
C-1920-020-040	The I-270 ICMS shall utilize the following standards for traveler information data: • SAE ATIS J2354	20	ConOps § 4.9, p. 83	DC, DE, DQ	ConOps Text: Use of ITS standards for the RITIS system will be essential. SAE ATIS J2354 – The precise functions/features to be supported within the I-270 ICM from this standard will need to be determined.	H
C-1920-020-050	The I-270 ICMS shall utilize the following standards for data archived in the ICMS: • ASTM WK7604	20	ConOps § 4.9, p. 83	DC, DE, DQ	ConOps Text: Use of ITS standards for the RITIS system will be essential. ASTM WK7604 – This ADMS standard is still under development. Note also that the precise functions/features to be supported within the I-270 ICM from this standard will need to be determined.	H
C-1920-030	The I-270 ICMS shall utilize naming and classification standards for corridor incidents and events.	20	ConOps § 4.9, p. 83	DQ, DC	ConOps Text: The I-270 ICM project will need to develop regional incident naming and classification standards.	H
X-1920-040	Participating stakeholder agencies will implement standards for DMS message displays among corridor stakeholder systems.	N/A	ConOps § 4.9, Table 4-12, p. 82 (under Technology Issues)	N/A	ConOps Text: Development of a unified approach to message displays on DMS.	H
C-1920-050	The I-270 ICMS electronic documentation shall be compliant with current Section 508 standards for accessibility.	20	I-270 ICMS Project Team	UI		H
5.3.9 System Security and Information Technology (Requirements 2100-2299)						
Q-2100	The I-270 ICMS shall prevent dissemination of sensitive and inappropriate corridor transportation information to non-authorized recipients.	21	ConOps § 4.9, p. 84	SS, DE	ConOps Text: RITIS will include “filters” to avoid releasing sensitive information to non-authorized information outlets.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
Q-2100-010	The I-270 ICMS shall protect against unauthorized access to sensitive information in the ICMS database.	21	ConOps § 1.8, Table 1-5, p. 15 (under Metrobus Network)	SS	ConOps Text: Interface to CAD, including protection/security of sensitive information (2009).	H
Q-2100-020	The I-270 ICMS shall include documented procedures for defining sensitive and inappropriate information.	21	ConOps § 4.9, p. 84	SS, DE	ConOps Text: RITIS will include "filters" to avoid releasing sensitive information to non-authorized information outlets.	H
Q-2110	The I-270 ICMS shall encrypt data exchanged with corridor stakeholder agency systems for security purposes.	32	RITIS ConOps § 2.7, p. 32	SS, DE	ConOps Text: The use of state-of-the-art security solutions, including encryption, firewalls, tiered access protection, and attack detection software, will be essential to a successful deployment of RITIS. Security will be provided for access to the operational and public web sites and applied to data transmissions into and out of RITIS.	H
Q-2120	The I-270 ICMS shall backup and restore system data.	14	ConOps § 4.5, Table 4-7, p. 68 (under Other Operational/ Performance Assets)	SS	ConOps Text: System Back-Up/Disaster Recovery	H
Q-2130	The I-270 ICMS shall function in a 24x7 environment, with a minimum of 99% availability.	33	ConOps § 4.5, Table 4-7, p. 68 (under Other Operational/ Performance Assets)	SS	ConOps Text: System Back-Up/Disaster Recovery	H
Q-2130-010	The I-270 ICMS networking data center shall include redundant power supplies to power all central computer hardware and peripherals.	33	I-270 ICMS Project Team	SS		H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
Q-2130-020	The I-270 ICMS networking data center shall include redundant temperature and humidity controls for proper operation and maintenance of all central computer hardware and peripherals.	33	I-270 ICMS Project Team	SS		H
Q-2130-030	The I-270 ICMS networking data center shall include lighting controls for proper operation and maintenance of all central computer hardware and peripherals.	33	I-270 ICMS Project Team	SS		H
Q-2130-040	The I-270 ICMS networking data center shall be physically sized for proper operation and maintenance of all central computer hardware and peripherals.	33	I-270 ICMS Project Team	SS		H
Q-2130-050	The I-270 ICMS central servers and networking equipment shall be housed within equipment cabinets.	33	I-270 ICMS Project Team	SS		H
Q-2130-060	The I-270 ICMS central computer hardware and peripherals shall be labeled with identification information.	33	I-270 ICMS Project Team	SS		H
Q-2130-070	The I-270 ICMS shall include a hardware inventory control system to track all central computer hardware and peripherals.	33	I-270 ICMS Project Team	SS		H
Q-2130-080	The I-270 ICMS shall include redundant application/database/communications servers.	33	I-270 ICMS Project Team	SS	Note: Types of servers to be determined.	H
Q-2130-090	The I-270 ICMS central computer hardware shall be replaced at least every five (5) years.	33	I-270 ICMS Project Team	SS		H
Q-2130-100	Physical access to the I-270 ICMS networking data center shall be limited to authorized personnel.	33	I-270 ICMS Project Team	SS		H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
Q-2130-110	The I-270 ICMS shall monitor central hardware usage in comparison to hardware capacity.	33	I-270 ICMS Project Team	PM, SS	Note: Hardware includes system processors, memory, disk space, and network bandwidth.	H
Q-2140	The I-270 ICMS shall send an alert to one or more System Administrators when a system failure occurs.	34	I-270 ICMS Project Team	PM, SS		H
P-2140	The I-270 ICMS shall send an alert to the System Administrator(s) within one minute of detecting the system failure.	34	I-270 ICMS Project Team	PM, SS		H
5.3.10 User Interface (Requirements 2300-2499)						
F-2300	The I-270 ICMS shall include a secure web-based agency user interface ("ICMS agency web site") available only to corridor stakeholder agency users.	35	RITIS ConOps § 2.7, p. 32	UI	ConOps Text: The operational and ADUS web sites will require a username and password for access. The operational side of RITIS will be limited to secure access by public agencies. RITIS will register, authenticate, and authorize users and services.	H
Q-2300-010	The I-270 ICMS shall protect against unauthorized access to the ICMS agency web site through the use of User ID and Password prompts for authenticating user access.	35	RITIS ConOps § 2.7, p. 32	UI, SS	ConOps Text: The operational and ADUS web sites will require a username and password for access. The operational side of RITIS will be limited to secure access by public agencies. RITIS will register, authenticate, and authorize users and services.	H
Q-2300-020	The I-270 ICMS shall register stakeholder agency users for access to the ICMS agency web site.	35	RITIS ConOps § 2.7, p. 32	UI, SS	ConOps Text: The operational and ADUS web sites will require a username and password for access. The operational side of RITIS will be limited to secure access by public agencies. RITIS will register, authenticate, and authorize users and services.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
Q-2300-030	The I-270 ICMS system shall include the following types of user accounts for the ICMS agency web site: a) Read-only (e.g., report generation, view data) b) Transportation data updates (e.g., event updates) c) Agency-specific system administration/configuration access d) Overall ICMS system administration/configuration access	35	I-270 ICMS Project Team	UI, SS		H
Q-2300-040	Each agency's System Administrator shall manage user accounts and permissions for respective agency users through the I-270 ICMS agency web site.	35	RITIS ConOps § 2.7, p. 32	UI, SS	ConOps Text: RITIS will include the ability for an agency selected administrator to manage user accounts and permissions.	H
Q-2300-050	I-270 ICMS agency web site users shall be given access to specific functions based on their type of user account.	35	RITIS ConOps § 2.7, p. 32	UI, SS	ConOps Text: Participating agencies should be able to control and monitor access to information by specific individuals and groups of users. RITIS will include the ability for an agency selected administrator to manage user accounts and permissions.	H
P-2300-060	The I-270 ICMS agency web site shall provide user information storage for up to 10 million user accounts.	35	I-270 ICMS Project Team	UI		M
P-2300-070	The I-270 ICMS agency web site shall process up to 10 million concurrent users.	35	I-270 ICMS Project Team	UI		H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-2300-080	The I-270 ICMS agency web site shall create/modify agency subscriptions for current corridor transportation data.	35	ConOps § 1.6, Table 1-4, p. 12 (under Prototype and Deploy Enhanced RITIS)	UI, DE	ConOps Text: Establish publish/subscribe connections with key corridor stakeholders. Note: Related to Requirement I-900-010.	H
F-2300-090	The I-270 ICMS agency web site shall create/modify agency contact data.	35	ConOps § 4.9, Table 4-12, p. 81 (under Operational Issues)	UI	ConOps Text: Up-to-date data base of contact personnel and locations	H
F-2300-100	The I-270 ICMS agency web site shall include an interactive map displaying corridor transportation network information.	35	ConOps § 4.9, p. 84	UI, SD, DE	ConOps Text: Another approach includes the continuous provision of a congestion map, which already exists within the CHART software, but which will need to be expanded to include the primary arterials in the I-270 Corridor.	H
F-2300-110	The I-270 ICMS agency web site shall display corridor transportation network information in a tabular format.	35	I-270 ICMS Project Team	UI, SD, DE		H
F-2300-120	The I-270 ICMS agency web site shall provide selectable criteria for filtering subsets of corridor transportation network information for display.	35	RITIS ConOps § 2.4, p. 28	UI, SD, DE	ConOps Text: Web site users will be able to filter and sort data according to their needs.	H
F-2300-130	The I-270 ICMS agency web site shall provide selectable criteria for sorting corridor transportation network information for display.	35	RITIS ConOps § 2.4, p. 28	UI, SD, DE	ConOps Text: Web site users will be able to filter and sort data according to their needs.	H
F-2300-140	The I-270 ICMS agency web site shall monitor incidents from all modal transportation systems operating in the corridor.	35	RITIS ConOps § 2.4, Table 6, p. 28	UI, SD, DE	See Table 6 in RITIS ConOps document.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-2300-150	The I-270 ICMS agency web site shall monitor police CAD incidents that impact modal transportation systems operating in the corridor.	35	RITIS ConOps § 2.4, Table 6, p. 28	UI, SD, DE	See Table 6 in RITIS ConOps document.	H
F-2300-160	The I-270 ICMS agency web site shall access information on planned and current closures and events within the corridor.	35	RITIS ConOps § 2.4, Table 6, p. 28	UI, SD, DE	See Table 6 in RITIS ConOps document.	H
F-2300-170	The I-270 ICMS agency web site shall access all agency CCTV video and camera assets regardless of mode.	35	RITIS ConOps § 2.4, Table 6, p. 28	UI, SD, DE	See Table 6 in RITIS ConOps document.	H
F-2300-180	The I-270 ICMS agency web site shall display National Weather Service radar and alerts.	35	RITIS ConOps § 2.4, Table 6, p. 28	UI, SD, DE	See Table 6 in RITIS ConOps document.	M
F-2300-190	The I-270 ICMS agency web site shall provide access to corridor stakeholder agency AVL information including buses, service patrol vehicles, and emergency response vehicles.	35	RITIS ConOps § 2.3.1, Table 5, p. 23	UI, SD, DE	See Table 5 in RITIS ConOps document.	M
F-2300-200	The I-270 ICMS agency web site shall provide access to a graphically-based incident timeline that shows current incident response resources, transportation management device status, and operator response actions.	35	RITIS ConOps § 2.6, p. 31	UI, SD, DE	ConOps Text: 3D traffic data graphing allows users to query the RITIS incident databases to graph incident statistics, derive performance measures, and create timelines of individual incidents.	H
F-2300-210	The I-270 ICMS agency web site shall provide access to recommended response plans.	35	I-270 ICMS Project Team	UI, SD		H
F-2300-220	The I-270 ICMS agency web site shall select and implement response plan actions.	35	I-270 ICMS Project Team	UI, SD, DE		H
F-2300-230	The I-270 ICMS agency web site shall provide access to ICMS data analysis and reporting.	35	I-270 ICMS Project Team	UI, PM	Note: See Requirements 1700-1899 for further information on performance measures and reporting capabilities.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-2300-240	The I-270 ICMS agency web site shall display and print data exchange and alarm notification transaction logs.	35	I-270 ICMS Project Team	UI, DE	Note: Related to Requirement F-900.	M
F-2300-250	The I-270 ICMS shall log user transactions performed through the ICMS agency web site.	35	I-270 ICMS Project Team	UI, SS		H
F-2300-250-010	The I-270 ICMS agency web site shall display and print user transaction logs.	35	I-270 ICMS Project Team	UI, SS		H
O-2300-260	The I-270 ICMS shall include user documentation on use of the ICMS agency web site.	35	I-270 ICMS Project Team	UI		M
O-2300-260-010	The I-270 ICMS agency web site user documentation shall be electronically accessible through the ICMS agency web site.	35	I-270 ICMS Project Team	UI		M
F-2300-270	The I-270 ICMS shall include a “training mode” that allows for user interaction without impacting any current data exchanges.	35	I-270 ICMS Project Team	UI		H
O-2300-280	I-270 ICMS agency web site training shall be provided for corridor stakeholder agency users.	35	I-270 ICMS Project Team	UI		H
C-2300-290	The I-270 ICMS agency web site shall be compliant with current Section 508 standards for accessibility.	35	I-270 ICMS Project Team	UI		H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-2310	The I-270 ICMS shall include a web-based public user interface ("ICMS public web site").	36	RITIS ConOps § 2.4, p. 27	UI, TI	ConOps Text: The web sites will also provide traveler information to the public and traveler information service providers and facilitate the use of archived data. Note: See requirement F-1700-050-200 for conducting traveler surveys through ICMS public web site. See requirement F-330-010 for multi-modal trip planner to be accessed through ICMS public web site.	H
Q-2310-010	The I-270 ICMS public web site shall require users to register for information dissemination subscriptions for a mobile device/e-mail/fax/pager.	36	RITIS ConOps § 2.4.2, p. 28	UI, TI, SS	ConOps Text: This web site will also be able to push user-defined traveler information to an assortment of remote devices such as cell phones, PDAs, and pagers.	H
Q-2310-020	The I-270 ICMS public web site shall require the user to enter a valid User ID and Password in order to manage information dissemination subscriptions.	36	I-270 ICMS Project Team	UI, TI, SS		H
P-2310-030	The I-270 ICMS public web site shall provide user information storage for up to 10 million concurrent users.	36	I-270 ICMS Project Team	UI, TI		M
P-2310-040	The I-270 ICMS public web site shall process up to 10 million user accounts.	36	I-270 ICMS Project Team	UI, TI	Note: User accounts may only be needed for users who desire information dissemination subscriptions.	H
F-2310-050	The I-270 ICMS public web site shall include an interactive map displaying corridor transportation network information.	36	ConOps § 4.9, p. 84	UI, TI	ConOps Text: Another approach includes the continuous provision of a congestion map, which already exists within the CHART software, but which will need to be expanded to include the primary arterials in the I-270 Corridor.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
F-2310-060	The I-270 ICMS public web site shall display corridor transportation network information in a tabular format.	36	I-270 ICMS Project Team	UI, TI		H
F-2310-070	The I-270 ICMS public web site shall provide selectable criteria for filtering subsets of corridor transportation network information for display.	36	RITIS ConOps § 2.4.2, p. 28	UI, TI	ConOps Text: Web site users will be able to filter and sort data according to their needs.	H
F-2310-080	The I-270 ICMS public web site shall provide selectable criteria for sorting corridor transportation network information for display.	36	RITIS ConOps § 2.4.2, p. 28	UI, TI	ConOps Text: Web site users will be able to filter and sort data according to their needs.	H
C-2310-090	The I-270 ICMS public web site shall be compliant with current Section 508 standards for accessibility.	36	I-270 ICMS Project Team	UI, TI		H
F-2320	The I-270 ICMS shall include a secure web-based System Administration user interface (“ICMS Administration web site”) available only to ICMS System Administration staff.	37	I-270 ICMS Project Team	UI		H
Q-2320-010	The I-270 ICMS shall protect against unauthorized access to the ICMS Administration web site through the use of User ID and Password prompts for authenticating user access.	37	RITIS ConOps § 2.7, p. 32	UI, SS	ConOps Text: The operational and ADUS web sites will require a username and password for access.	H
Q-2320-020	System Administration staff shall manage user accounts and permissions for users on the Administration web site, agency web site, and public web site through the I-270 ICMS Administration web site.	37	RITIS ConOps Appendix A, Table A-1, p. 43	UI, SS	See Table A-1 in RITIS ConOps document.	H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
Q-2320-030	I-270 ICMS Administration web site users shall be given access to specific functions based on their type of user account.	37	I-270 ICMS Project Team	UI, SS		H
P-2320-040	The I-270 ICMS Administration web site shall provide user information storage for up to 10 million user accounts.	37	I-270 ICMS Project Team	UI		M
P-2320-050	The I-270 ICMS Administration web site shall process up to 10 million concurrent users.	37	I-270 ICMS Project Team	UI		H
F-2320-060	The I-270 ICMS Administration web site shall display system performance information for System Administration staff to monitor the performance of the system.	37	RITIS ConOps § 2.8, p. 32	UI, PM	ConOps Text: Standards and requirements will be developed that identify and define performance parameters for system speed, accuracy, dependability, availability, robustness of connection establishment, information transfer, and connection disengagement. There will also be measures for information accuracy, timeliness, usefulness, and reliability. Measurement techniques will be defined for these performance parameters.	H
F-2320-070	The I-270 ICMS shall include a user interface for System Administration staff to modify system configuration parameters.	37	I-270 ICMS Project Team	SS		H
O-2320-080	The I-270 ICMS shall include electronic system documentation on administration of the ICMS.	37	I-270 ICMS Project Team	UI		H
O-2320-090	I-270 ICMS Administration training shall be provided for System Administration staff.	37	I-270 ICMS Project Team	UI		H

ID	Requirement	Need	Source	Allocation	Comment	Criticality
C-2320-100	The I-270 ICMS Administration web site shall be compliant with current Section 508 standards for accessibility.	37	I-270 ICMS Project Team	UI		H