TRAFFIC ENGINEERING & HIGHWAY SAFETY BULLETIN 15-01
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Transportation Management Centers

Definitions and Overview

National Cooperative Highway Research Program (NCHRP) “Synthesis 270: Transportation Management Center Functions” defines a transportation management center (TMC) as “**a central facility that controls, monitors, and manages the surface street, highway, transit, and bridge/tunnel control systems within its coverage area. To accomplish these tasks, the TMC aims to manage the operation of the transportation system by communicating travel condition information, making necessary modifications to traffic and transit control systems, and directing response activities.**”

DETERMINING THE NEED FOR A TMC

Existing guidance is very limited for establishing when, and to what magnitude of size and functionality, a TMC should be considered at military installations. If an installation is interested in implementing a TMC, a study should be performed by qualified personnel to determine the need based on the potential contributing factors listed below and the cost effectiveness of the implementation. The potential benefits derived from the TMC should be evaluated against the following costs and resource needs, which can vary widely depending on the size and functionality of the TMC. For example, the cost of retrofitting an existing space to provide TMC functionality can range from approximately $50,000 to $500,000 depending on the need for any modifications to existing walls, door frames, etc. Generally, costs for a small stand-alone TMC begin at approximately $1,000,000. Each of these costs includes design, construction, furniture, and control room equipment but does not include power, communications, or field equipment expenses.

Need-based considerations

- Population (number of personnel/residents) on the installation
- Number of gates, variance of operational hours, and frequency of gate closures
- Number of traffic signals on the installation
- Existing field equipment and systems present on the installation to integrate and control
- Frequency of special events
- Security need for Force Protection to have more control over infrastructure and systems
- Significant traffic congestion or crash history within or adjacent to the installation
- Presence of or need for a TMC in an adjacent or surrounding community/region

Cost-based considerations

- Facility requirements—costs to retrofit existing space or build standalone facility
- Control room equipment requirements—costs to equip control room with furniture, servers, video panels, etc.
- Field equipment requirements—costs to install or upgrade existing traffic signal, intelligent transportation systems (ITS), and communications infrastructure
- Operations and maintenance requirements—staff resources and costs to power, maintain, and periodically upgrade equipment and systems
- Staffing requirements—personnel resources to potentially include technicians/maintenance staff, TMC operators, and/or traffic engineers

If a study concludes that a TMC is not needed, or may not be feasible or cost effective, there could still be TMC elements or functions that would be advantageous to implement such as individual ITS technologies or systems, or levels of communication and coordination with other divisions or external agencies. However, it is still critical that a study be prepared by qualified personnel to support any level of ITS or TMC implementation.

In This Issue

Definitions and Overview, continued

According to the Federal Highway Administration's (FHWA) *TMC Concepts of Operation Implementation Guide*, the TMC is the hub or nerve center of a transportation management system. It is where information about the transportation network is collected, processed, and fused with other operational and control data to produce information. The information is then used by system operators to monitor the operations of the transportation system and to initiate control strategies to effect changes in operation. It also is where agencies can coordinate their responses to transportation situations and conditions such as incidents or roadway closures. Furthermore, the TMC is the focal point for communicating transportation related information to the media and the motoring public.

ITS technologies are often critical to the function and operation of the TMC. ITS is the integration and application of management strategies and technology to improve the safety and efficiency of the surface transportation system (i.e., cars, trucks, buses, transit, railroads). ITS uses advanced sensors, traveler information distribution devices, computers and networks, and communication infrastructure to achieve more efficient use of the transportation network.

Generally, a typical TMC consists of a central operations room, data room, maintenance room, and hardware components such as television screens, map displays, and computer workstations. A larger-scale TMC will house all these functions within its own facility or a joint facility with an Emergency Operations Center. A smaller-scale TMC can house most or all these functions in a single room that is either dedicated to TMC duties or integrated into the existing operations of the space.

Types of TMCs

There are three major types of TMCs: Freeway Management Centers, Transit Management Centers, and Traffic Signal System Centers. These need not be physically separate TMCs, but each type does focus on a specific aspect of transportation.

1. Freeway Management Centers

Freeway Management Centers typically are responsible for the monitoring and control of traffic on an interstate highway or comparable limited access roadway. The typical freeway management center will focus its efforts on:

- Detection, verification, and active management of incidents that reduce roadway capacity
- Distribution of information to travelers
- Optimization of roadway capacity through active congestion mitigation strategies such as reversible lanes

2. Transit Management Centers

Transit Management Centers typically are tasked with tracking and supporting fleets of transit buses or railcars. Systems may include traffic signal priority for transit vehicles, which can help buses or railcars to remain on schedule through early and extended green phases at the traffic signals along each vehicle's route.

3. Traffic Signal System Centers

Traffic Signal System Centers typically focus on the monitoring and control of traffic signal systems on surface street networks. The functions performed in such a network include monitoring of functional status of all equipment in the signal network and dispatch of resources to return malfunctioning equipment to operational status. The center typically monitors flow of traffic on the surface street network and intervenes by adjusting signal timing or alerting motorists to alternate routes whenever necessary.

Functions of a TMC

TMCs are used to perform three basic functions: gathering, synthesizing, and disseminating traffic and travel condition information. More specific system functions are described below. In addition to these, TMCs also can be used to perform fleet management and supervisory control and data acquisition (SCADA) functions as necessary.

Roadway Management

Roadway management is the monitoring and control of the flow of traffic by the TMC. Its most common components are active flow balancing between alternate routes and provision of relative travel times for alternate routes. Control of reversible lanes is included in this category. Operation of reversible lanes may include gates or movable barriers, such as those utilized at entry control facilities (ECFs).

Incident Management

Incident management includes two components: *incident prevention* and *incident response*. In prevention, the TMC acts to avoid impact from situations that could result in incidents (secondary or otherwise). Common approaches to incident prevention include the following:

- Providing traveler warnings of unsafe or congested roadway conditions
- Effective management of lane closures (often more a form of mitigation than prevention)
- Rapid dispatch of resources to repair road damage or to remove debris

Incident response aims to reduce the impact of an incident that has already occurred. The primary component is the rapid reduction of impact (reducing the number of lanes closed and creating alternate routes), termination of impact by incident clearance (and removal from view, if possible), and roadway cleanup. Incident management also includes providing traveler information regarding the incident (or incident impact) in hopes of reducing the number of vehicles delayed by the incident and minimizing the likelihood of secondary incidents.

Traffic Signal Control

Traffic signal control consists of monitoring and responding to traffic flow on the signalized roadways and to the condition of the traffic signal network. The TMC may adjust signal timing plans (either directly by altering the plan currently in operation, by activating an existing alternate plan, or by uploading and activating a new alternate plan) or may change the mode of operation of one or more signals (e.g., to flash, actuated operation, or fixed-time operation). The TMC also may dispatch maintenance resources to address signal system problems or may request dispatch of Military Police to direct traffic if signals at an intersection become inoperable. The TMC also may attempt to restart or correct faults in the signal system or with the communication with the signal system. If the traffic signal system center has appropriate assets, it also may perform incident management and may provide traveler information to travelers on the roadways under its jurisdiction.

Agencies refer to their TMCs using a variety of terms depending on function. Frequently used variations include:

TOC	Transportation operations center
TIC	Transportation information center
OC	Operations center
TMC	Traffic or transportation management center

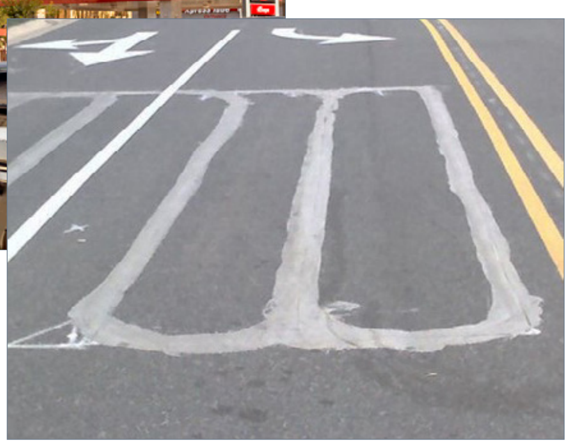
Applicable ITS Technologies

The keys to an effective TMC are early detection of incidents; timely dissemination of information to motorists, agencies, and media; and efficient resolution to any incident. There is a need for staff to be in the TMC for critical periods when incidents are most likely to occur: morning peak hours, afternoon peak hours, new and temporary work zones, special events, and weather events (if possible). Some agencies establish center-to-center linkages with public safety dispatch centers (local and/or State police) to gather incident information from their Computer-Aided Dispatch (CAD) systems. Absent those links, the use of ITS devices helps with timely detection and monitoring.

Dynamic Message Signs (DMS)

As an example, the use of ITS technologies—specifically DMS—has been suggested at Fort Campbell as a means to effectively convey gate access and usage information to approaching motorists. The DMS locations were chosen to provide motorist information in advance of motorist decision points associated with Fort Campbell entry control facilities (ECFs). This placement along arterial routes in advance of the ECFs would allow motorists to choose the most efficient route to their destination in the event of an incident or other types of non-recurring congestion. By placing the DMS in advance of all ECFs, the signs also can be used to provide gate status information.

To maintain the benefits of information dissemination via ITS devices, TMC operators should provide timely and intelligible information to motorists. Just as importantly, operators also should remove the information from the ITS devices once the incident is clear so that motorists do not begin to doubt the validity of the messages they are seeing.



Closed-Circuit Television (CCTV) Cameras

CCTV cameras give TMC operators the ability to follow live events at ECFs and locations across the installation. Real-time monitoring allows for timely response and dissemination of information. In addition to providing a means to monitor ECF operation and traffic flow along arterials, both entering and within the installation, CCTV cameras can be used to assist in determining when and what types of messages are needed for the DMS and to confirm those messages once deployed. Some camera models include analytics for actively monitoring an area for stopped traffic, debris, or other prescribed attributes, which can be used to trigger an alert to operators.

Vehicle Detectors

Vehicle detectors also can be used to provide cues or send alerts to the operator when there is abnormally slow moving traffic or long queues. Using the data, the TMC operator can notify the motorists of congestion and/or incidents via DMS, highway advisory radio (HAR), and online/mobile applications such as 511. The operator can designate alternate routes, advise motorists to slow or merge, or give other definitive guidance to assist motorists.

Information Sharing from Center to Center

Cross-center coordination should begin during the initial planning, design, and implementation of the center. Involving the military installation along with local municipalities and/or State agencies early in the planning process ensures that the center is optimally configured, equipped, and staffed to provide cross-center coordination for situations and events (such as traffic incidents, weather events, special events, etc.) that may cross or transcend jurisdictional boundaries. Ideally, a concept of operations will reflect the actions and methods of each partner in transportation management and will reflect the resources and capabilities necessary to achieve the chosen operational method.

The focus of cross-center coordination is the sharing of information. Information sharing is a cost-effective way for all parties to obtain real-time data and video from an agency that already has established system infrastructure in the area of concern. Information sharing also gives motorists a more complete understanding of conditions that may impact their travels and promotes coordination across jurisdictional boundaries (such as in the case of signal timing plan development), making borders appear non-existent between agencies.

Typical examples of infrastructure-based information sharing include messages on dynamic message signs (DMS) and highway advisory radio (HAR). Non-infrastructure intensive traveler information includes provision of information via broadcast media, press, Internet, and telephone systems.

Information sharing may occur:

During Event Planning

Agencies should work to comprehensively detail the actions to be performed, identifying who is responsible for each action and how information will flow during the event.

During the Event Itself

Sharing information on what is transpiring and how each agency is responding adds to the total effectiveness.

During a Post-Event Analysis

Careful consideration of how the event proceeded, step-by-step, and of how improvements can be achieved is beneficial. This includes both planned events (such as parades) and unplanned events (such as traffic incidents).

Installations need to discuss upfront with neighboring TMCs what information can be shared. The installation should be able to receive all video and data feeds from the neighboring centers for decision making and dissemination to motorists entering and leaving the installation. The installation may be limited in what information it can share with the outside agencies, particularly video feeds. Discussions regarding cross-center coordination should include the sensitivity of information and whether it can be disseminated to the public or needs to be limited to agency staff.

Additional guidance related specifically to sharing information between TMCs, EOCs, and fusion (combined emergency and traffic) centers for both day-to-day and emergency operations is contained in FHWA's *Information Sharing Guidebook for TMCs, EOCs, and Fusion Centers.*

Center-to-center coordination is of even greater importance for traffic signal systems. Where neighboring centers control signals along a signalized arterial corridor, coordination is critical to achieving optimal flow conditions. Interaction may take place in real time or may only be necessary during nonstandard conditions, such as for special events or construction-related lane closures. Installations can coordinate with neighboring agencies to help better manage traffic flow entering and exiting the installations to and from public roadways, whether it is for daily commuter traffic or special events on or near the installation. The installation could alert the neighboring agencies as to the volume of exiting traffic to enable a better optimization of traffic signal operations on the adjacent signalized systems.

Concept of Operations

Identifying needs and constraints in a concept of operations (also referred to as "ConOps") document will help avoid designs that are inappropriate for an installation's desired or actual operations. Therefore, the first steps toward implementing a TMC are to identify the needs of the installation's transportation system and determine high-level requirements based on needs, relationships, and resources. Since many installations may face staffing, funding, and/or spatial constraints, these constraints should be identified as early as possible to allow for proper accommodation in the concept of operations.

The concept of operations is often the first detailed examination of the idea for implementing a TMC. It will provide guidance and direction to help ensure that the subsequent procurements result in the type of facility and systems that best serve the installation's needs and that represent an effective utilization of limited budgetary funds. It also will ensure that the operational needs of the TMC are consistent with the resources and policies of the responsible agencies. This lays a path for successful operations and maintenance, realizing the maximum possible benefit from the investment.

FHWA's *TMC Concepts of Operation Implementation Guide* details the items to consider and actions to take when developing a concept of operations for a TMC. The concept of operations should contain a modest level of detail for each topic, adequate enough to clearly identify:

- The physical location of the TMC (e.g., new facility, within an existing building on the installation, within an existing outside agency's TMC)
- The functions to be performed within the TMC and the level of automation versus manual operator intervention
- The number of staff required and their areas of responsibility
- Roles and responsibilities of the participating agencies (e.g., which agency should have operations and maintenance responsibilities)
- The systems, tools, training, facilities, documents, and other equipment necessary for the staff to perform their duties
- The processes the staff will follow in performance of their duties, including interactions between the staff and between staff and external organizations
- The recommended communications protocol between various agencies

The concept of operations also will have to recognize standard operations and operations under nonstandard conditions, such as special events, possible evacuations, or where severe weather or other emergency conditions are common (e.g., rock slide, snowfall, high water).

Roles and Responsibilities

The concept of operations defines the roles and responsibilities of both the primary sponsoring agency of the TMC and of their partners in accomplishing the TMC's mission, vision, goals, and objectives. In order to achieve seamless operations and/or interoperability of systems, agencies and jurisdictions must agree on the benefits of ITS and the value of being part of an integrated system. Each stakeholder must agree on roles, responsibilities, shared operational strategies, policies, and standards. Because ITS often transcends traditional transportation infrastructure, it is important to involve nontraditional stakeholders in the development and visioning process. This can include internal agencies such as fire, police, EMS, and Command Headquarters as well as external agencies such as neighboring municipalities, regional transportation organizations, and State DOTs. In addition to the roles and responsibilities, the concept of operations defines how the organizations interact during certain incidents or situations. Another important element of interagency coordination is the designation of interagency points of contact, as well as who takes lead (e.g., police, fire, military, etc.) on scene during an incident/event.

For installations, it may be in their best interest to have neighboring municipalities operate and maintain those devices and systems located external to the secured fence line. For the example in which DMS are deployed along an arterial entering an installation, the neighboring municipality could be given sole control over DMS message deployment (type, duration, and location for message placements) and CCTV camera control (pan, tilt, zoom), while the installation could be given viewing privileges of the cameras and read-only access to the DMS software on a 24-hour basis. Both agencies could have the capability to provide messages for incorporation in message libraries for the DMS units. Some of the messages could be predetermined while others could be specific to a particular incident or special event, which would require coordination between agencies prior to implementation in the field.

Physical Design of a TMC

A typical spatial layout of a TMC includes the following:

- Control room
- Equipment room
- Conference rooms
- Offices and support facilities

These spaces need not be in separate rooms, and, in smaller TMCs, many of these spaces are co-located in the same room. What is most important is that the TMC remains functional, no matter the size or layout, so that it can support the installation as intended.

One of the main components of a TMC control room is the video wall. The video wall, which is designed to be viewed from a distance, can be multiple monitors that are flat screen or cube that can display different video feeds or be used together to display one large video feed. The video wall gives the TMC operator the real-time feeds from the CCTV and detection cameras around the installation.

Control rooms are typically designed to allow operators to perform their duties with only a minimum of movement. Most control panels in the TMC, therefore, will involve seated operator consoles. These generally involve a work surface and instrument console with a view of the video wall.

TMCs can vary greatly in size and complexity. They can be large, stand-alone facilities that include staff from multiple agencies and/or jurisdictions. Larger rooms located within an existing facility also can be designed to accommodate multiple work stations and a video wall. TMC functions also can be performed from a single small room meant to accommodate one operator with a work station and video monitor. Although there are many ways to customize a TMC, it is possible to keep the design simple, functional, and cost-effective.

The Wisconsin Department of Transportation State Traffic Operations Center is an example of a larger-scale TMC in a standalone facility.

The City of Newport News, Virginia, Traffic Operations Control Room is an example of a smaller-scale TMC integrated into existing office space.

The City of Portsmouth, Virginia, Traffic Operations Center is an example of a smaller-scale TMC integrated into an existing maintenance facility.

Power and Communications Requirements

Since TMCs come in all shapes and sizes and vary in complexity, there are no standard requirements for providing power and communications to the TMC. Two main factors need to be addressed to identify how to design the power and communications systems—**criticality** and **funding**.

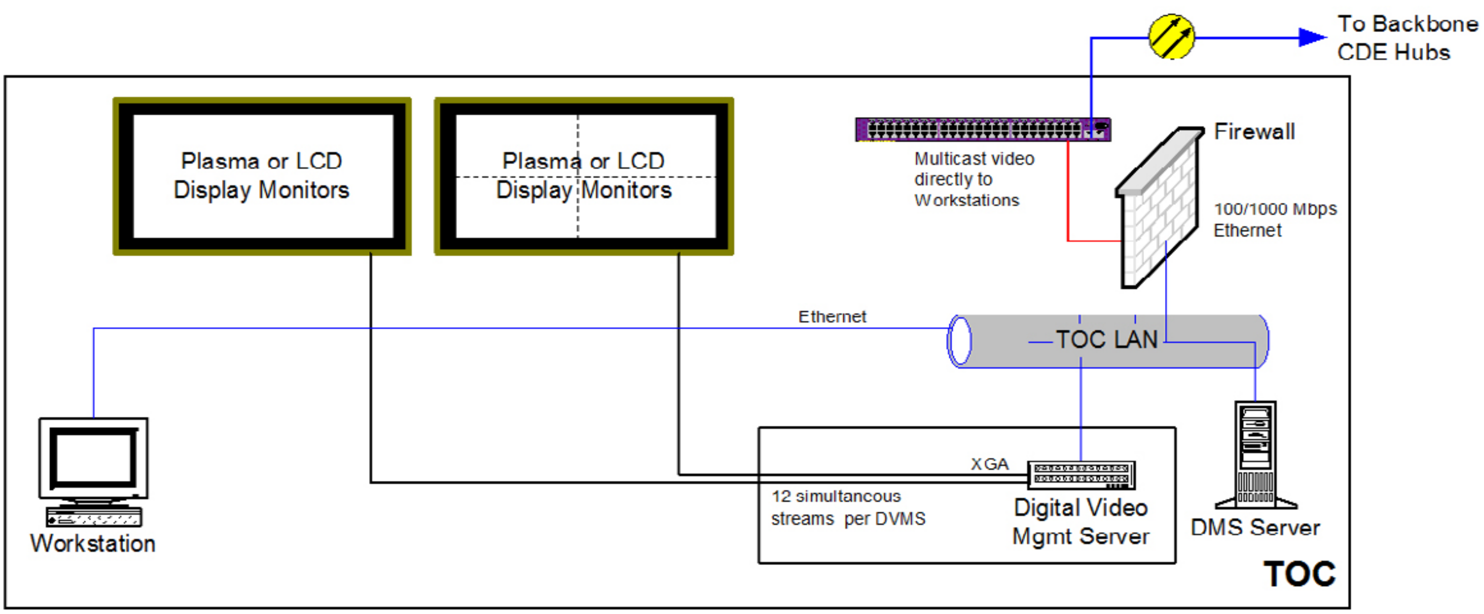
To determine the level of criticality, consider questions such as:

- How imperative is it that TMC equipment remains operational at all times?
- Does the TMC serve other purposes such as emergency operations?
- Are there information sharing opportunities with neighboring agencies?
- Are communications available to control local equipment from the TMC?

The most robust systems will have redundancies built into each system. For the power system, this means a dedicated alternate power source (second power feed or generator back up) and Uninterruptible Power Supplies (UPS) to provide smooth transition from normal to emergency power. For the communications systems, this means separate circuits coming into the building via diverse pathways to avoid loss of communications from a cut line.

The second factor is whether funding will be available for the power and communications systems' needs. It is important to communicate to the funding authority the critical role the TMC has in the daily activities on the installation so that appropriate funding is allocated to meet the TMC's needs.

The following block diagram depicts the typical components in a smaller-scale TMC.



Example TMC (TOC) Communications Components; Source: Kimley-Horn

Benefits of TMCs

NCHRP "Synthesis 270: Transportation Management Center Functions" identifies numerous additional expected benefits for TMCs based on their main system: highway, surface street, bridge/tunnel, and transit. ITS technologies in combination with TMC functions can improve the safety and efficiency of roadways when standard solutions and countermeasures (e.g., the addition of signing, pavement marking, or lane capacity) have been exhausted, cannot be identified, or are not financially feasible. TMCs integrated within installations can be expected to provide the following benefits on their roadways and for their commuters depending on the type of systems deployed:

- Reduced travel times and delays related to incidents
- Improved information dissemination to emergency services and their vehicles, information service providers, motorists, public agencies, and the media
- Reduced number of secondary crashes
- Improved signal timing coordination
- Quicker response to signal failures
- Increased roadway capacity and improved mobility
- Enhanced collection and centralization of real-time transportation data and information
- Reductions in emissions and fuel consumption
- Better monitoring and correlation of data and information between construction activities and traffic patterns
- Continuous and real-time monitoring of traffic signals in a central location
- Reduced time to implement, modify, and maintain signal timing plans
- Reduced incident detection, response, and clearance times
- Better congestion management, traffic management, and traffic diversion in response to various types of incidents

TMC operations have demonstrated numerous benefits in the areas of transportation safety, productivity, efficiency, communication, and environmental impact as described above. However, studies to date have yet to separate the benefits of a transportation management system or ITS implementation from the benefits of housing the system in a center. Several benefits specific to systems with a dedicated center, particularly those that may be co-located with other units or agencies, are demonstrated as follows:

- TMCs provide enhanced communication in all aspects of transportation management (planning, design, implementation, operation, maintenance) when the involved parties are co-located in the center. This includes both daily communication and communication for special circumstances such as special events or an unusually severe incident.
- Similarly, if each of the participating agencies had to staff its own full-time position when managed separately, the total cost might exceed that realized by sharing responsibilities between fewer staff in a dedicated TMC.
- Military Police and other installation agencies can utilize and benefit from shared traffic video feeds.
- Agencies working closely together in a TMC typically produce a more consistent, unified response to a situation, increasing the overall effectiveness of the transportation resources.
- Directorate of Public Works (DPW) and other installation agencies can monitor non-transportation assets on video feeds as needed.

Potential Issues and Challenges with TMC Implementation

As described in the Concept of Operations section, it is important for an agency to identify needs, constraints, and roles and responsibilities up front in the process to avoid designs that do not reflect the agency's intended operations. The following are some potential issues and challenges faced by agencies when implementing and operating TMCs:

- Managing rapidly evolving technologies
- Integrating multiple complex technologies and systems of varying generations
- Staff coverage and consistent training
- Reliability and maintenance of field infrastructure and communications
- Developmental costs of creating system coverage of ITS and signal equipment
- Limited funding for design, implementation, operations, and maintenance
- Spatial constraints
- Lack of or incomplete communication and coordination between agencies or among units within an agency
- Information technology (IT), data management, and classification policies that limit information sharing

FHWA's *TMC Concepts of Operation Implementation Guide* notes a number of potential issues and challenges and some potential solutions for addressing those issues. In addition, FHWA's *Information-Sharing Guidebook for TMCs, EOCs, and Fusion Centers* details challenges and barriers specific to information sharing as well as options to address those challenges.

Potential Operational Scenarios

Several operational scenarios are described below to illustrate how systems, components, and agencies can be integrated and function on an installation. The scenarios represent broad categories of operational applications, and describe and define the stakeholders' general roles and applicable resources that are needed to provide these services. Examples of the types of scenarios that can be incorporated into a concept of operations for an installation's TMC based on its needs include:

- An evacuation due to a hurricane, terror strike, or other limited-notice or no-notice event
- A long-term roadway construction project involving lane closures
- A multi-incident scenario during nonrecurring congestion

Evacuation Scenario

The first operational scenario describes how ITS technologies may be used during a major evacuation of an installation (and the surrounding region) due to a hurricane, terror strike, or other limited-notice or no-notice event. The following strategies, systems, and technologies can be beneficial in addressing this type of scenario:

- Instrumenting freeways and arterials surrounding the installation with CCTV cameras, system detectors, DMS, and potentially lane controls
- Providing connections between the installation, State, and local TMCs and Emergency Operations Centers (EOCs) as well as other key public safety agencies
- Installing road weather information system (RWIS) stations in areas that are prone to flooding or high winds
- Continuously monitoring all systems using an integrated network of detection and monitoring systems providing real-time information to the TMCs
- Assimilating and "packaging" real-time information from the TMC so it can be effectively disseminated to the public through the surrounding region's traveler information system website, regional traveler advisory radio, and/or 511 system

After an alert is put out to citizens to begin evacuating the area, the operating agency can monitor the freeway conditions through CCTV cameras and vehicle detectors to determine the level of congestion on roadways. The EOCs can work with State police and public safety dispatch centers to coordinate road/bridge closures. DMS can provide up to date information to motorists as they head away from the installation, and regional HAR can provide longer, more detailed messages regarding traffic as well as shelter location information. The arterial streets also can be closely monitored by the local and State TMCs through video at intersections as well as CCTV cameras on arterial streets. Neighboring agencies, responsible for arterial signal corridors, can override background signal timing plans with prepared alternative plans that prioritize the direction of flow along evacuation routes. The data and camera feeds to which the State and localities have access can be shared with other key public safety agencies, such as police and fire. As evacuation traffic increases, lane control signals can be used to initiate contra-flow along the freeways or designated arterials to open all lanes to outbound traffic. RWIS stations can be monitored for flooding and alert TMC/EOC staff.

Throughout the evacuation, data and camera feeds can be continuously sent to the media for broadcast alerts on traffic conditions. The improved accuracy of traveler information and the ability to monitor and control the arterial and freeway systems can contribute to a successful evacuation of the surrounding region.

Detailed guidance regarding how TMCs can cooperate with emergency response agencies to fully support emergency operations is contained in FHWA's *Role of TMCs in Emergency Operations Guidebook*.

Construction (Long-Term) Lane Closure Scenario

The second operational scenario describes how ITS technologies may be used during a road construction project along a major arterial on an installation. It is assumed that the road construction project will require lane closures for an extended period of time, which will impact the flow of vehicles through one of the major ECFs and affect traffic conditions along the surrounding arterials and freeway systems that served traffic destined to the installation. The following strategies, systems, and technologies can be beneficial in addressing this type of scenario:

- Instrumenting freeways and arterials surrounding the installation with CCTV cameras and DMS, supplementing with portable DMS as needed
- Coordinating with State/local TMCs to develop alternate route plans
- Disseminating information to the public through the surrounding region's traveler information system website, regional traveler advisory radio, and/or 511 system

Working together, the installation and State and local TMCs can develop several detour routes to alternate ECFs as well as around the construction once on the installation. The installation, State, and local TMCs can post the information about the lane closure on their websites, including the planned detour routes and contact the local media to notify them of the construction, planned detour routes, and anticipated traffic impacts prior to the closure.

The installation, State, and local TMCs can disseminate the information using HAR and DMS and can deploy additional portable DMS as needed to alert motorists of the potential delay associated with the construction. This would allow motorists to be informed of conditions and impacts prior to choosing their route onto the installation. The TMC also can notify the local and State police to be prepared for any incidents. CCTV cameras can be used to monitor the traffic conditions upstream of the construction and observe traffic, looking for potential incidents that could occur in the backup.

The adjacent local TMC can implement alternate timing plans in their signal systems that could accommodate diverted traffic along the detour routes. The local TMC can monitor interconnecting and parallel arterial routes, and notify the State and installation TMCs in the event of incidents or congestion along diversion routes.

Non-Recurring Congestion Scenario

The third operational scenario describes how ITS technologies may be used during non-recurring congestion due to multiple incidents on the external freeway or arterial system near one of the major ECFs for an installation. The following strategies, systems, and technologies can be beneficial in addressing this type of scenario:

- Instrumenting freeways surrounding the installation with CCTV cameras, system detectors, and DMS
- Instrumenting parallel arterials with coordinated traffic signals, dynamic trailblazer (interstate routing) signs, and CCTV cameras
- Integrating telecommunications/data interfaces for State and local TMCs, State police, and local public safety dispatch centers

Local police dispatchers notify the State, local, and installation TMCs of reported incidents along the arterial street automatically through a data connection from the CAD system. Similarly, adjacent local and State public safety dispatchers send a similar notification from their respective CAD systems. CCTV feeds in the vicinity of the incident site are accessed by emergency responder command centers to monitor progress at the incident site and help assess the need for further response support.

The local TMC posts updates on arterial DMS to alert motorists of the lane closures associated with the incident and helps provide public safety dispatchers with an alternate route for responders to reach the scene. Highway advisory beacons are turned on by the State TMC to provide motorists with additional details of the incident and estimated travel time delays. Regional traveler information websites post incident information, estimated delays, estimated time-to-clear, and offers camera views of alternate routes.

TRAFFIC ENGINEERING & HIGHWAY SAFETY BULLETIN

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