Taking Traffic Management Centers Beyond Automation to Optimization

Executive summary

Traffic management centers (TMCs) used to simply facilitate surveillance and incident-based reactions. Technological advances have allowed TMCs to automate operations so that certain conditions trigger predetermined response plans. Now data management systems that simulate, analyze, and predict traffic allow TMCs to proactively identify options for nearly any situation—even before it occurs. This paper discusses the changing role of TMCs, from reactive to proactive traffic management.

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Summary

Executive summary

The role of the Traffic Management Center (TMC) has evolved significantly as information management technology has advanced. Many TMCs that previously provided traditional functions of collecting data and instituting prescribed procedures for standard traffic management and incident response, now serve a vital role in implementing more efficient urban traffic and transport operation.

The advanced transportation management system (ATMS), consisting of field monitoring devices and control instrumentation, brought a level of automation of certain traffic conditions messaging and response functions. Integrating these control systems reduced, in part, the need for reactive decision-making on the part of the TMC operator.

Realizing the benefits of automated control, TMCs now are targeting traffic optimization – which can reduce infrastructure and operating costs and accident rates and improve traffic efficiency and greenhouse gas emissions. Data management systems that simulate, analyze and predict traffic situations put the TMC in the best position yet to identify suitable alternatives to nearly any congestion or incident situation – even before it occurs – and proactively manage like never before possible.

As a result, advanced information management systems are making the TMC a key entity in highly optimized transport and sustainable city operation, even as urban transport challenges grow increase.

Introduction

For many years, the role of the Traffic Management Center (TMC) was simply to facilitate surveillance and traffic incident management. More recently, advanced software and better surveillance data have allowed the TMC to automate certain functions and support the operator by providing pre-determined response plans for commonly occurring situations.

In this paper, we briefly review the progression of the service provided by the TMC, from ‘facilitation’ to ‘automation.’ We propose that the availability of advanced information management tools will prompt further leap in the value the TMC provides the network operator: optimization of transportation network management.

Following Automation:
Optimization

TMC as traffic facilitator

The TMC traditionally was built as a center for surveillance and coordination of response to both recurring and non-recurring changes in the transportation network that reduced the functionality of the network. In the early days of the Intelligent Transportation System (ITS), the TMC and its supporting infrastructure served primarily to facilitate network functionality. The TMC collected field data from devices integrated in the roadway and transit infrastructure and provided the integration necessary to see what was happening, where, and coordinate a response.

For example, the TMC response in the case of a crash typically involved supporting activities of first responders such as police and medical and fire personnel and informing travelers of the location and nature of the incident. Standard operating procedures (SOPs) were developed to guide operators on how to respond to given situations.

Software retired the SOP manuals

TMC operations necessarily expanded to deal with growing traffic volumes and associated incidents. It became increasingly impractical for TMC operators to refer to an SOP, which likely was buried in a three-ring binder with hundreds of pages and outdated or not even relevant.

Fortunately, the capabilities of TMC software also were growing, and many systems developed the ability to automate incident response. Data files made available a rich history of response experience for network areas experiencing frequent traffic incidents and/or recurring congestion. The best responses were captured in a standardized response plan. Pre-selected messages for Dynamic Message Sign (DMS) application were saved in a library and coordinated with Highway Advisory Radio (HAR) and other messaging systems for travelers.

With a prioritization system of incidents, an associated response plan for each and a limited set of tools such as DMS, HAR and other resources, the TMC had developed the ability to automate certain functions and more effectively deal with multiple incidents. The TMC operator needed only to confirm the incident or event and then accept the response plan automatically suggested by the system. Operators typically worked with a limited set of options – the suggested plan and maybe one alternate plan. Response plan modifications typically were limited to a system administrator or a traffic engineer who periodically reviewed system operations and results.

Some TMCs completely eliminated any operator decision making and only required the operator to confirm that the incident was real and not a false alarm. All subsequent response was automated.

How can a TMC be any more efficient and effective than streamlining traffic incident response through computer automation? The TMC connected to an instrumented and integrated set of field devices for monitoring and controlling the transportation network – an advanced transportation management system (ATMS) – is able to provide consistent, real-time information to operators, managers and travelers. And studies by the U.S. DOT reveal a benefit-to-cost ratio of 8:1 or better for these systems.

Beyond automated response

Yet, now the industry can do even better, thanks to data management tools that enable response well beyond that supported by than automated system management. With the support of tools such as traffic simulation models, multi-variant analytical models and decision support systems combined with the availability of multi-modal data (real-time and historical), the TMC now can optimize response to both recurring and non-recurring situations that otherwise would negatively impact transportation flows.

Without decision support tools

When an incident closes one or more lanes of a major roadway, traffic diversion to alternate routes is often an alternative of last resort because of the lack of information about conditions on the alternate route. Certainly, the TMC manager does not want to divert freeway traffic onto an arterial that also is congested. And, there is no way to determine if diversion is a better alternative to merely waiting for the original lane closure to clear.

Now, with decision-support tools

Real-time traffic data – even near-term predicted traffic demand – is now available from multiple commercial sources on all major roadways in every urban area in the U.S. Simulation models can be set up quickly and calibrated to represent the most critical roadway networks and possible diversion route alternatives. When the TMC manager needs to make a decision about the best management alternative – whether to divert traffic via Plan A; or implement Plan B; or do nothing – the manager has access to quantitative results upon which to base the decision.

Proactive, not just reactive, management

Active traffic management (ATM)

These new transportation management tools add more alternatives to the decision matrix and support more ‘aggressive’ management, or active traffic management (ATM), such as:

- management of all lanes of a facility, including HOV / HOT lane management of occupancy and/or pricing
- speed harmonization
- ramp metering, and other techniques

Integrated corridor management (ICM)

These decision-support management tools based on real-time traffic data and near-term traffic prediction also are the foundation of integrated corridor management (ICM) – the multi-modal management of transit modes, expressway lanes, arterial signal control and even parking management that optimizes the person-throughput of a given corridor on all modes

Conclusion

The ever-increasing availability of quantitative information defining the state of transit and traffic conditions and the advanced platforms to manage this information are expected to support decision making well beyond that previously considered possible in urban transportation management. With this added-value capability, the TMC becomes the monitoring center of extensively integrated and highly optimized transport systems – making transportation one of the most efficient aspects of the modern city.

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