UPDATE OF THE
SIGNAL TIMING MANUAL

PRELIMINARY DRAFT
FINAL REPORT

Prepared for
National Cooperative Highway Research Program
Transportation Research Board
of
The National Academies

TRANSPORTATION RESEARCH BOARD
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JUNE 2014
ACKNOWLEDGEMENT OF SPONSORSHIP

This work was sponsored by one or more of the following as noted:

☒ American Association of State Highway and Transportation Officials, in cooperation with the Federal Highway Administration, and was conducted in the National Cooperative Highway Research Program,

☐ Federal Transit Administration and was conducted in the Transit Cooperative Research Program,

☐ American Association of State Highway and Transportation Officials, in cooperation with the Federal Motor Carriers Safety Administration, and was conducted in the Commercial Truck and Bus Safety Synthesis Program,

☐ Federal Aviation Administration and was conducted in the Airports Cooperative Research Program,

which is administered by the Transportation Research Board of the National Academies.

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CHAPTER 1
INTRODUCTION

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CHAPTER 1. INTRODUCTION

1.1 FOCUS FOR THE SECOND EDITION

The first edition of the Traffic Signal Timing Manual (TSTM) was written as a comprehensive guide for engineers and technicians about signal timing principles, practices, and procedures. The second edition (STM2) is a standalone document that was developed based on TSTM user feedback. Key features of this edition include:

- Focused information written for new practitioners and those desiring a better understanding of signal timing fundamentals.
- Addition of four new chapters for more-advanced users.
- Material organized so that it is presented once and referenced as needed elsewhere in the document.
- Inclusion of essential information only (i.e. no “nice to know” information).
- References to other documents, instead of repeated material.
- Expanded use of graphics to aid in the explanation of more-complex topics.

STM2 has an increased focus on signal system users and their priorities. Current signal timing models tend to provide a one-size-fits-all approach to signal timing, which often leads to the incorrect assumption that the model provides the optimum solution. A traffic analyst simply inputs the data required by the model, hits the optimize button, and gives the optimized results to the appropriate person for implementation. The results largely reflect the model’s priorities (generally some version of vehicle delay) for system users, which may or may not fit the needs of the actual operating environment or users (including pedestrians, bicycles, and transit).

The STM2 introduces an outcome based approach to signal timing (summarized in Exhibit 1-1), which allows the practitioner to develop signal timing based on the operating environment, users, user priorities by movement, and local operational objectives. Performance measures are then used to assess how well the objectives are being met. Once the objectives and performance measures are established, timing strategies and timing values can be chosen. The final steps of the process involve implementation and observation (i.e. determining if the timing strategies and values are working), as well as sustaining operations that meet the operational objectives through monitoring and maintenance.

This process was developed with an understanding that there is not a one-size-fits-all method for signal timing. The approach is described in detail in Chapter 3, but brief descriptions of the eight steps in the outcome based process, and associated considerations, are provided below.

Step 1: Define the Operating Environment

Signal timing should reflect the character of the timing location, so the outcome based approach begins with an assessment of the operating environment. The operating environment goes beyond physical location characteristics, and also includes goals of the local operating agency and its regional stakeholders.
Step 2: Identify Users
The process continues with the identification of primary users at the focus intersections. This approach allows all users (people on foot, riding on bikes, riding transit, driving trucks, and driving cars) to be considered in the signal timing process.

Step 3: Establish User and Movement Priorities
Priorities should reflect the local operating agency and regional stakeholder goals for mobility. Priorities should be established by movement for the primary users, by location and time of day. For example, in a central business district (CBD), pedestrians might have the highest priority, while in a suburban environment, through vehicle movements on an arterial might have the highest priority during peak hours (and a lower priority off-peak).

Step 4: Select Operational Objectives
Once priorities are established, the process requires the establishment of operational objectives (e.g., pedestrian safety or vehicle mobility) by location and time of day. Non-vehicle-oriented operational objectives are often more difficult to assess because of their qualitative nature; however, performance measures can be selected for qualitative as well as quantitative assessment.

Step 5: Establish Performance Measures
Traditional optimization tools generally focus only on simple vehicle-oriented performance measures because they are easy to quantify and, therefore, easy
to “optimize.” However, vehicle stops and delay may be less important than transit and pedestrians in a central business district, as well as other existing or developing areas with significant pedestrian, bicycle, and transit activity. The practitioner needs to make appropriate adjustments to the traffic signal timing process to account for the operating environment and user priorities.

**Step 6: Develop Timing Strategies and Timing Values**

Once operational objectives and their associated performance measures have been determined, the process continues with the development of signal timing strategies (such as minimizing cycle length or favoring arterial through traffic) and with the selection of appropriate timing values.

**Step 7: Implement and Observe**

The next step is implementing the signal timing values, and making final adjustments to the timing parameters.

**Step 8: Monitor and Maintain**

After implementation, a successful program requires ongoing monitoring and maintenance. Collecting periodic (at least annual) volume data at a mid-block location on each arterial or subsystem is essential when determining if shifts in traffic characteristics occurred or if further investigation is necessary. A good maintenance management system can help an agency identify issues beyond the signal controller, including communication and detection issues, which are often significant contributors to poor operations.

**1.2 STM2 ORGANIZATION**

The outcome based approach not only guides the development and implementation of signal timing plans, but also guides the organization of the STM2. As shown in Exhibit 1-2, the manual has 12 chapters, which are organized into three parts:

- Part I – Signal Timing Fundamentals
- Part II – Basic Signal Systems
- Part III – Advanced Systems and Applications

Part I provides guidance on the elements used to support a successful signal timing program, as well as concepts necessary for understanding modern traffic signal operations. Because a poorly designed signal can never operate at its full potential, Part I also contains a chapter on signal design.

Part II presents the detailed, practical information necessary to appropriately time a traffic signal controller, and to operate it in a system with multiple controllers. This part includes important information about controller features that are often overlooked because they are not included in signal timing optimization tools. Part II is intended to help new practitioners achieve locally appropriate results and to serve as a reference for more-experienced practitioners.

Part III provides guidance on advanced signal systems and applications. The material begins with a brief introduction to Systems Engineering, as the features discussed throughout the rest of Part III vary widely among vendors. Systems Engineering is a process that reduces risk by clearly defining needs and the specific
requirements to meet local needs. Part III concludes with specific information about managing competing priorities in a multimodal system.

It should be noted that the STM2 relies on a number of important reference documents for details. It is intended to complement policy documents such as the *Manual on Uniform Traffic Control Devices (1)*, and is not intended to replicate or replace the *Highway Capacity Manual (2)*, national or local engineering documents on signal timing, nor is it intended to serve as a standard or policy document. The manual has been structured and written as concisely as possible, and because the manual only references these external documents, it should not become out-of-date as those documents are updated. Practitioners are cautioned to consult current documents for changes. For example, documents such as the *Manual on Uniform Traffic Control Devices (1)* are periodically updated, and some guidance in this document is based on the 2009 edition.
1.3 REFERENCES
