During the summer of 2002, Bill Eidson and Montasir Abbas coordinated the review effort of the FHWA Traffic Control Systems Handbook. The reviewers for the chapters were Robert Chamberlin, Bill Eidson, Roelof Engelbrecht, Carol Pearce, Gary Shoup, Frank Nemes, Eric Nelson, Montasir Abbas, Darcy Bullock, Abbas Mohaddes, Alejandra Medina, Mike Ziegler, Bob DeSanto, and Paul Olson. The reviewers' contact information is provided in Table 1 and their comments are organized by chapter on the following pages. Several of the reviewers had had no prior involvement with TRB in the past.

In general the comments can be summarized as:

?? The manual is generally complete in its coverage of Traffic Control Systems. However, due to the age of manual, it is out of date in many areas. Though specific updates are recommended in the chapters below, the manual in general needs updating throughout.

?? The Communications chapter needs to be thoroughly updated due to the rapid growth of developments and applications in telecommunications field. Since the Communication Systems Handbook is currently under contract to be updated, the contractor responsible for the Traffic Control Systems Handbook update will need to coordinate with the contractor updating the Communication Systems Handbook.

?? Formatting of the document in general, and specifically the tables and graphics, needs to be closely reviewed. Attention should be to consistency in style, format and layout to allow readers to easily follow document and locate information.

?? Figures should be updated throughout to provide readers with information about the most up-to-date projects and take advantage of improved graphics and printing technology.

?? An effort should be made to keep the document readable; not a collection of disjointed notes, but a fluid document. Along those lines, the chapters should generally be independent so that a reader can read one chapter that applies to his or her work and understand the material without searching for basic definitions in earlier sections.
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</table>

**Table 1: List of Chapter Reviewers**
TABLE OF CONTENTS

CHAPTER 1 – INTRODUCTION - Chamberlin
1.1 Scope and Objectives
1.2 Organization of Handbook
   o Move table 1-1 to the end of section 1.2
1.3 Role and Impact of Traffic Control Systems
1.4 Travel Demand Management (TDM)
   o In the list of TDM actions, change the “Promotion of non-auto and high occupancy vehicle (HOV)” to “Promotion of non-auto modes of travel.” Also, add a bullet item for “Parking cash-out” and “General commuter fringe benefits.”
   o Under the “Many TDM measures” section, consider combining the bullets listed as “For example” together into a paragraph format – it should work better.
1.5 System Evolution
   o States can be omitted from obvious city names in the historical overview section.
   o It would be good to include examples of at least 2 more cities where SCOOT has been applied.
   o Condense the Traveler Information Section into one or two sentences and move it into the preceding list of Freeway Traffic Management activities. The section does not seem substantial enough to set it apart.
1.6 Present Status – Traffic Surveillance and Control
   o Move Table 1-2 to locate it immediately after its text reference.
1.7 Intelligent Transportation Systems (ITS)
   o Closing is abrupt. It could be improved by adding a summary paragraph with the key points from the chapter.

References – Chapter 1
General Comments - Chamberlin, Olson
   o The first chapter would really benefit from a few more graphics. The text is ok, has lots of bullets, but generally is not the nice attention-grabbing lead in you would like. I suspect that most users of the manual go directly to the chapter that is relevant to them. This is likely more common than anyone sitting down to read the entire manual. That being said, a few photos showing the historic and cutting edge technologies would help the overall readability of the chapter.
   o Add these three sections after 1.4
   - 1.5 Systems Engineering Approach, configuration management and more. Life cycle costing analysis, System wide implementation issues to include programming issues which part to I install first. Discussion of piggy backing with other projects such as for conduit installation.
   - 1.6 Concepts of Operation
   - 1.7 National Architecture and FHWA Policy (maybe put this in Chapter 14)

CHAPTER 2 – AVAILABLE AND EMERGING TRAFFIC CONTROL SYSTEMS TECHNOLOGY – Eidson
2.1 Introduction
   o Update figure 2-1 to reflect contemporary efforts on traffic information or cutting edge projects in another aspect of traffic control systems.
2.2 Control and Management System Functions
2.3 Integrated Traffic Management Systems (ITMS)
2.4 Range of Agency Needs
   o Update the status of the National Architecture effort or rework the chapter to focus more on this effort.
Either update Figure 2-5 or correct several misspellings and inconsistencies in the chart.

2.5 Range of Available Options

- Update the references to the “new” Federal regulations, currently citing Chapter 11 and Appendix A of this document.

2.6 Available Technology

- Update Table 2-10 to more accurately reflect the technologies available, currently emerging technologies, and the technologies discussed in the revised chapters that follow.
- Update the list and descriptions of traffic models and traffic control systems near the end of the section to include current products and removing products that are unavailable (or note their unavailability).

2.7 A Look to the Future

- Update this entire section with modern “future” projects and developments. Especially, include an update on the status of the RT-TRACS project (and follow on ACS-Lite), which is the focus of the current chapter.
- Add discussion of hardware in the loop and software in the loop simulation
  - Paper by Larry Head on software in the loop simulation

References – Chapter 2
General Comments – Eidson, Olson

- Generally, updates need to be made to include new technologies developed since the last edition and to reflect the changing emphases of traffic control systems.
- Attention should be paid throughout the chapter to the organization and formatting of the text, figures, and tables. In several sections, readers have to flip back and forth to view the text and the referenced figures and tables.
- Add this section after 2.2
  - Travel time calculations and dissemination, AVL, estimates from loop data and more. Policy issues involved with dissemination of travel time information.

CHAPTER 3 – CONTROL CONCEPTS-URBAN AND SUBURBAN STREETS - Engelbrecht
3.1 Introduction

- Under “Signalized intersection control concepts”, insert a second bullet point: “Interchange and closely-spaced intersection control – provides progressive traffic flow through two closely-spaced intersections, such as interchanges. Control is typically done with a single traffic signal controller.”
- Under “Signal-related special control concepts”, 2nd bullet: what about rail and draw-bridge preemption?
- Under “Signal-related special control concepts”, 3rd bullet: what about changeable lane assignment signs?

3.2 Control Variables

- Table 3-2, Eq. 3.2: Change $D = $ detector dropout time – detector pickup time.

3.3 Sampling

3.4 Filtering and Smoothing

- Eq. 3.12: Change $K = $ Filter coefficient in the range 0 – 1; (K = 1 represents no filtering)

3.5 Traffic Signal Timing Parameters
3.6 Traffic Signal Phasing

- Fig. 3.10: This figure may be misunderstood. Remove it and give the definitions of leading and lagging left turns in the text.
- Fig 3-12 caption: Change “left-turn first” to “leading left turns.”

3.7 Isolated Intersections

- Basic Considerations: make type of vehicle delay consistent with 2000 Highway Capacity Manual (HCM) definitions such as control delay, etc.
- Traffic Flow: “In terminating traffic flow, some time is also lost at the end of a green indication.” This statement is not correct. Vehicles entering the intersection on yellow extend the effective green time (hence the fall in flow rate after the end of green), but this has no effect on lost time.
- Intersection Timing Requirements: Yellow Change and Red Clearance interval times must also be determined.
- Intersection Timing Requirements, Traffic-Actuated Controller: “Traffic actuated control equipment automatically determines cycle length and phase lengths based on…” This is only true for fully-actuated (free) control, not for semi-actuated (coordinated) control.
- Table 3-9: Driver expectancy should be taken into account when setting minimum green times.
- Table 3-10: The original Webster delay equation is different from the delay equation used in the 2000 HCM. The more commonly used HCM equation should be shown, not Webster’s.
- Eq. 3.15: Variable “C” not defined.
- Eq. 3.15: Variable(s) \( DG(\text{effective green time}) \) not defined.
- Table 3-13: State that a yellow change time of 4 seconds is assumes in this example. Variable \( A_1 \) and \( A_2 \) not needed; replace with 4 seconds.
- Intersection Timing Requirements, Critical Movement Analysis: Remove reference to previous versions of the HCM.
- Intersection Timing Requirements, Traffic Actuated Control: “To perform a simple check on traffic-actuated controller performance, for a given amount of green time…”, elaborate on exactly what “green time” is intended; total green time per cycle, critical phase green time, maximum green time?
- Intersection Timing Requirements, Available Computer Software: Add Synchro, aaSIDRA, and TEAPAC to signal timing optimizations software list.
- Table 3-14: Add other signal timing optimizations software to the table.
- Consider adding a new section between 3.7 and 3.8 on closely-spaced intersection and diamond interchange control, where control is typically done with a single controller.

3.8 Arterial Street Control

- Basic Considerations: The term “coordinate” should be used rather than “interconnect” because interconnect is merely one way of providing coordination.
- 2000 MUTCD provides guidance that traffic signals within 800m of each other should be coordinated. How does this compare with the “70 times average speed criterion”?
- Fig. 3-19 (b): The red times at a particular intersection appear to vary. This is not correct. It should be constant.
- Time-Space Diagram, “Good two-way progression depends on signal spacing which, ideally, should”: Insert a bullet saying: “For optimal two-way progression, the travel time between intersections should be approximately half of the cycle length.
- Off-Line Computer Techniques: TRANSYT-7F has been replaces by Synchro as the most popular delay minimization model.
- Tables 3-17, 3-18, and 3-19 need to be updated with information from the latest versions of the software.
- Computer Assistance: PASSER II-90 has been superceded by PASSER II-02
- PASSER III-90: PASSER III-90 has been superceded by PASSER III-98
- PASSER III-90: The statement “PASSER III-90 can also evaluate the split diamond free interchange…” is incorrect. Remove Fig. 3-22 and 3-23.

3.9 Network Control

- Off-Line Timing Techniques, TRANSYT Model: update with information from the latest release of TRANSYT-7F.
3.10 Special Controls

- On-Line Network Traffic Control Techniques: cut down on the amount of information given on UTPSC. Include information on new adaptive control algorithms such as RHODES. Update SCOOT and SCATS information.
- Network Simulation, TRAF-NETSIM Model: Update with information from TSIS. Add VISSIM and SIMTraffic.
- Network Simulation, NETFLO Level 1 and 2: consider removing these sections, since NETFLO is not widely used any more.

3.11 Benefits

- Table 3-40: Update with most recent information.
- Update MOBILE5C information to MOBILE6, and CALINE3 information to CALINE4.
- Table 3-41 and 3-44: Update with latest data.

3.12 Measures of Effectiveness (MOE)

3.13 A Look to the Future

References – Chapter 3

General Comments – Olson

- Add discussion on the Signal Control Priority standards work to 3.10
- Add this section after 3.12:

3.13 System simulations to include a discussion of “hardware in the loop”. CORSIM and others.

CHAPTER 4 – CONTROL AND MANAGEMENT CONCEPTS-FREeways - Pearce, Balog, Clark

4.1 Introduction

- Maintenance and construction activities can often result in congestion, but probably should not usually be characterized as recurrent congestion.

4.2 Ramp Metering

- Table 4-8 It may be true that origin-destination surveys are the best way to measure actual demand, but I don't think we use this method very often anymore. For the most part, planning gravity models and the like have taken over.
- Table 4-9 The remaining capacity percentages when lanes are blocked looks overly optimistic. Updated sources may be available to provide more accurate values.
- Reference is made to Caltrans recommendations regarding ramp metering. The most current source of this information is the Ramp Meter Design Manual which can be found on the internet at: http://www.dot.ca.gov/hq/traffops/systemops/ramp_meter/
- Table 4-13 - Caltrans has had success metering with 2 cars per green using a fixed sign plate under the signal head - this table says a changeable sign is required.

4.3 Mainline Control
In addition to mainline metering at the San Francisco-Oakland Bay bridge; we sometimes meter mainline I-80 in the eastbound direction leading up into the Sierra Nevada Mountains when chain controls are in effect. This is maybe a unique use of metering where we meter the mainline below the snow line, as much as 40 miles upstream of where the restriction actually exist. However it is successful in limiting the number of vehicles in the high altitude snowy “chain-on” area to a manageable level.

4.4 Diversion to Surface Streets

4.5 Incident Management

4.6 High-Occupancy Vehicle Priority Control

HOV updates should include Part-time operation (operates as HOV lane during peak periods and then is open to mixed flow use during other times), and Contiguous operation (HOV lane entry involves continuous merging along the lane line, not a buffered or separate facility with specific entry points).

Reserved Freeway Lanes

Table 4-37, Figures 4-24 and others need to be reformatted on the page so that title is directly above tables or figures.

3rd para, 1st sent: Experience with take-a-lane projects has revealed significant public opposition, as borne out by reaction to the diamond lane on the Santa Monica Freeway in California.

3rd para, 2nd sent: Enforcement is the primary problem concern in concurrent-flow lanes.

3rd para, 3rd & 4th sent: Violating vehicles have virtually unrestricted access to the lane and positioning enforcement officers at proper locations proves difficult. Thus, the need has arisen for a special enforcement plan. (California also has concurrent flow with restricted access (paint buffer) which tends to have lower violation rates.) Suggest: Nonetheless, an enforcement plan or policy plays a key role in public perception and successful performance of all HOV lanes.

Table 4-38: More helpful to describe “separation type” (i.e., fixed barrier, moveable barrier, etc.) rather than “buffer lane”.

Last para: Disadvantages of temporary freeway contraflow lanes include: . . . The use of traffic cones to separate even temporary contraflow HOV lanes is a great safety concern and would not be practiced in California. Suggest omitting both bullet statements.

Metered Ramp Bypass

Table 4-37: Descriptions of operating selected existing HOV facilities.

Change I-10 El Monte to I-10 El Monte Busway, L.A. Also, this facility allows 3+/2+.

For SR-91, L.A., change No. of HOV lanes to 1/direction, length to 14.3 miles, Hrs. of Service to 24, and Peak Period Lengths to 4/4.

Change SR-55 Orange, L.A. to SR-55 Orange County. Also, this facility has 4 freeway lanes not 3.

For Bay Bridge, S.F., change No. of HOV Lanes to 4 (WB only) and Frwy. Lanes to 18.

For SR 101, S.F. not sure where this is? We have a SR-101 Marin, Santa Clara, and San Mateo, but not a S. F. Suggest using Marin.

Figures 4-23 and 4-24: Per most recent data obtained from the year 2001 Annual District reports, Caltrans, please make the following corrections:

I-10, El Monte Busway, L.A. (A.M.) .................................5.8 pphpl – HOV and 1.8 pphpl – frwy lane

I-10, El Monte Busway, L.A.(P.M.) .................................5.4 pphpl – HOV and 2.1 pphpl – frwy lane

Moanalua freeway, HA should be HI

SR-91, L.A. (A.M.) .........................................................3.3 pphpl – HOV and 2.2 pphpl – frwy lane

SR-91, L.A. (P.M.) .........................................................3.7 pphpl – HOV and 1.6 pphpl – frwy lane

SR-55, Orange County (A.M.) ........................................3.2 pphpl – HOV and 2.7 pphpl – frwy lane

SR-55, Orange County (P.M.) ........................................3.8 pphpl – HOV and 2.3 pphpl – frwy lane

Figure 4-25:..........................................................................................It seems the chart should reflect peak direction to arrive at the higher time savings in the corridor.
Per most recent data obtained from the year 2001 Annual District reports, Caltrans, please make the following corrections:

- El Monte Busway, L.A. - 21 min, 2.0 mpm (A.M.)
- Moanalua freeway, HA should be HI
- SR-91, L.A. – 17.8 min, 1.3 mpm (P.M.)
- I-80, Bay Bridge – 24 min, 26.7 mpm (A.M.)

4.7 Simulation

- Update to include FREQ12 (replaces FREQ) and other new programs and versions. Recommend to contact Dolf May regarding his current updates.
- FHWA’s Corsim is being phased out at many agencies, while packages such as Paramics and Vissim are entering the picture. Both use similar animation components and are generally easier to use.

4.8 A Look to the Future

References – Chapter 4

CHAPTER 5 – CONTROL AND MANAGEMENT CONCEPTS-INTEGRATED SYSTEMS -Shoup

5.1 Introduction

- Add a sketch of an actual or hypothetical freeway management system that includes at the minimum an adjacent arterial, a transit system, and a freeway response service. This sketch should show pictorially hardware along the corridor (VMS, CCTV, signal locations, ramp metering, detector stations, etc.). The sketch needs to show the reader what a system is with a picture, not a table. With this sketch, what agencies are involved with what activities should also be shown. For example, a city may monitor the signals on the arterial and some detector stations, but not the VMS, the DOT may observe all hardware items, and the local transit authority may only monitor bus travel time activities via GPS. The objective of this sketch is to show that the ITS hardware elements need to be integrated as well as the passing of traffic data among different agencies. This is what I consider a true integrated systems to be.

- Add two separate sections:
  - 5.2 Hardware Elements
  - 5.3 Software Elements

- Table 5-2 just indicates what various hardware and software elements can be used in freeway management systems. Rather than provide a table, the hardware items should be discussed more under 5.2 Hardware Elements. In addition to a brief description for each item, hardware integration aspects need to be considered. Discussions on communications between equipment (NTCIP protocols, proprietary protocols, etc.) and how the hardware selected must be compatible with the software selected should be noted. It is important for the reader to understand that selection of the hardware may dictate what software is available to integrate the system. Also, a discussion on how traffic data can be transmitted among agencies should be included. I think the average person thinks this is a no brainer with the internet and all, but the transferring of data between agencies is not such an easy thing to accomplish at times.

- Section 5.3 Software Elements should describe the various software options available for freeway management systems and the pros and cons of off the shelf software versus custom software (software support from vendor, proprietary protocol issues, etc.). Most people don't understand how difficult it is to bring a system "on-line". Some governmental agencies will keep adding special features to the software without truly understanding the difficulty in implementing it. The difficulty with this needs to be stressed. The ability to share software among different agencies to access the same data also needs to be mentioned. A paragraph or two on the testing needed to accept an integrated system after construction should also be mentioned. Lastly, it should be stressed the software and hardware elements go hand and hand. They need to be easily integrated among one another.

5.2 Traffic Corridors

- Include examples of systems in Section 5.5 Traffic Corridors.

5.3 Strategies for Control of Traffic Corridors
This section is not of much value. What does it really add to the chapter? Perhaps, strategies on how to share responsibilities for the system among different agencies would be more useful (i.e. transit responsible for bus travel times recorded via GPS, City responsible for monitoring and updating of signal timings, DOT responsible for VMS messages, etc.). A true system needs to be monitored by various agencies.

5.4 A Look to the Future

This section is important. It needs to discuss how centralized Traffic Operation Centers built like a NASA Control Center at Cape Canaveral may not play an important role in the future. Decentralized systems accessing data from a desktop computers through the internet may occur in the near future. Hardware operating through the internet via TCP/IP protocol should happen someday, hopefully in the near future. Doesn't it make sense that I should be able to monitor a closed loop system by entering a webpage for a master controller? Shouldn't I be able to communicate with each controller via an IP address with wireless technology. I'm sure someone with enough time on their hands is working on developing this. I can't be the only traffic engineer who wants this ability. By using this technology with TCP/IP protocols, just think of what could happen. Information between on-board vehicle systems (GPS, mayday systems, etc.) could all communicate across the internet with freeway ITS systems. I'll keep dreaming.

References – Chapter 5

General Comments - Shoup

I'm not too much a fan of Chapter 5 as currently provided in the handbook. The title of the chapter, "Chapter 5- Control and Management Concepts - Integrated Systems", implies to me that it should discuss the basics of understanding system integration (hardware, software, coordination between government agencies, etc.). Unfortunately, it seems to only discuss a few freeway management examples and provide a few tables that aren't of much use. I think it would be much better if the chapter focused more on the various aspects needed to design an integrated system as well as provide a few examples.

CHAPTER 6 – DETECTORS - Nemes

6.1 Introduction

6.2 Detector Types

6.3 Detector Operations Summary

- Tables, such as 6-9, could benefit from being reformatted or laid out in a completely different way.
- The conclusions of a study by Parsonson/Tarnoff is referred to, but their conclusions are not specifically mentioned. For the sake of completeness, their results should be summarily discussed, if they are still appropriate.

6.4 Vehicle Detector Location and Configuration

- Under the OPAC description, the word “farther” should be used instead of “considerably” to describe the upstream detector location.
- In the “ILD Application . . . ” sub-section, spell out the words Inductive Loop Detector in the section title. This allows readers unfamiliar with the concepts to locate their topic of interest by scanning or through the Table of Contents.

6.5 A Look to the Future

References – Chapter 6

General Comments - Nemes, Olson

Be careful to define acronyms in each chapter. By this time in the handbook, readers may have forgotten a definition or may be reading the chapter by itself without catching definitions from earlier sections.
- Include in 6.5 a discussion of future concepts where a detector would send data such as vehicle classification and more in lieu of or addition to simple contact closures. Provisions for serial communications from the detector to the controller.

CHAPTER 7 – LOCAL CONTROLLERS - Nelson

7.1 Introduction
7.2 Types of Operation

7.3 Range of Applications

- In Table 7-5 under Volume-Density / Full-Actuated there is a line that reads “To avoid long minimum green intervals, count vehicles arriving during yellow…” – sounds awkward.
- Also a line in this table that states “Extensible initial timing similar to computed initial technique except that minimum green interval expanded based on preset time increments per vehicle…” – sounds awkward.

7.4 Controller Evolution

- Appears to be a hard return after the first line in this section (short paragraph)

7.5 Types of Local Controllers

- Add Model 2070 ATC
- “The two major controllers currently available in the US are the Model 170 controller and the NEMA TS2 controller” – Didn’t realize that TS2 was that popular -> Perhaps should just say NEMA, as there are still far many more TS1 cabinets and many agencies still purchasing and using these types of units.

7.6 Pretimed Controllers

- Where it talks about Explicit Coordination, the term Hardwire-Interconnect should likely be mentioned for this, as it is a more common term.

7.7 Full-Actuated Controllers

- Under other previously described types of actuated control operation, it should list semi-actuated and fully-actuated (instead of volume-density), as volume-density is a mode that can be enabled on any actuated phase in either of these modes.
- Perhaps mention that red-rest and recalls (minimum, maximum, ped) are not intended to be used together (seen this before and it causes constant red reverting until conflicting call). There should be no recalls if using red rest.
- Under special operations features replace “left-turns first” with “leading-lefts” and note that “through movements first” would be the same as saying “lagging-lefts” thereby implying leading through movements (more common terminology). Table 7-11 should be updated to match this terminology as well.
- The paragraph that begins with “Figure 7-5” and the part that the term lead-lag covers both the main street (lead) and the cross street (lag) is not correct, particularly when one is doing lead-lag on both streets. In this case it may be lead-lag_lag-lead (5-1_3-7) to cover both streets or lead-lead_lag-lag (5-1_3-7). Need to keep the concept of dual-ring operation in mind, as both left-turns do not always need to time concurrently.
- In Table 7-9 the part about a single-ring controller containing 2 to 4 sequentially timing phases is incorrect. A single-ring controller should allow for any number of sequentially timing phases up to the limit of phase limit of the controller.
- In Table 7-9 the part about a dual-ring controller containing 2 interlocked rings is no longer the case. There are controllers like some software for the ATC’s that allow for any number of interlocked or partially interlocked rings.
- The Diamond Interchange section needs to be entirely rewritten to get out of the concepts of using states and instead use dual-ring / conditional clearance interval approaches using the standard NEMA phasing convention. Important emphasis should be placed on detector locations to allow for the most efficient and flexible operation for all Diamond sequences. Think it is wrong and confusing to come up with an entire new convention for Diamonds (Phase 1, 2, 3 etc). Seems very out of date for what many controllers can now do rather easily.


- In Table 7-10, don’t understand why they are defining minimum green as the “initial portion of the interval plus one extension interval”. The extension interval is not considered part of minimum green unless they are referring to Added Initial, in which, they should list that interval separately. Should note that Walk + PCLR will override any interval, whether minimum, maximum, force-off, etc.
- Should update Table 7-11 to make the sequence options previously discussed (leading-lefts, lagging-lefts, etc). Should also have an entire section on yellow-entrapment and the dangers of doing lead-lag or unequal dual-lag with permissive only or protective-
permissive turn indications. The part under Lead-Lag or Thru movements First (change to lagging-lefts) fails to mention how these sequences should only be done with protected only phasing.

- Perhaps discuss a little about the Arlington or Dallas phasing that is used to avoid yellow entrapment under these conditions.

- Also see www.kittleson.com/pplt

- In Table 7-13 the definition of inhibit maximum termination should be elaborated. Yes it is a per ring feature, and it does disable the termination function from the max timers (Max I or Max II) while allowing them to continue to time. However once they hit zero they have no effect as the only thing obeyed in this mode (inhibit max) is coordinator force-offs. If the intersection is running free and inhibit max is selected then the intersection can become stuck in the event of a maximum recall or a failed detector. The max timer would hit zero but termination would be prevented. Hence inhibit max should likely not be used under free operation.

- Table 7-17 for diamond operation appears to be very confusing as the phasing does not attempt to follow the NEMA convention and the descriptions do not appear to be correct with what is currently done today. In some controllers, the same software that runs local intersections can also run diamond interchanges.

- In Figure 7-10 there are now controllers that will allow one to split out Phase 2 and 6 pedestrian movements at the diamond so that the movements on the same side of the interior left can carry-over.

7.8 Model 170 and NEMA Controllers

- Explain 2070 ATC Concept

7.9 Local Controller Coordination

7.10 Factors in Controller Selection

7.11 A Look to the Future

References – Chapter 7

General Comments – Nelson, Olson

- Consider changing “Full-Actuated” to “Fully-Actuated”
- Define functional requirements in 7.2
- 7.6 Do you really need to discuss electro mechanical units?
- Add after 7.8:
  
  - Advanced Transportation Controller, You can use the ATC Overview document and the ATC2070 specifications for parts of this.

- Before a look to the future section, add these sections:
  
  - Hardware vs. Software
  - Migration strategies

CHAPTER 8 – SYSTEM CONTROL - M. Abbas

8.1 Introduction

- The introduction part of the chapter needs to be rewritten in a more cohesive and appealing manner, probably using some of Table 8-1 contents.
- In the definition of arterial and network system, replace the word “supervised” with the word “operated”.
- Place Table 8-1 before section 8.2

8.2 Arterial and Small Network Systems

- Modify last statement to: “Small network systems may be treated as open networks for practical purposes.”
- In “Coordination of Systems” section, revise fourth line from bottom to: “…agencies may overcome this constraint by coordinating their traffic operations centers with those of adjacent systems.”
- In “Open-Loop Systems”: Master controller that changes plans according to feedback from system detectors should be in the closed-loop category. A master controller that changes plans by a TOD can be categorized as an open-loop system.
- 6th line before table 8-2: revise to: “…National Transportation Communications for ITS Protocol (NTCIP) will permit…”
8.3 UTCS and Derivative Systems

- Relevant text from chapter 3 should be moved to this section.

8.4 Other Network Based Systems

- Relevant text from chapter 3 should be moved to this section.
- Add sections about OPAC and RHODES.
- Include more text about foreign systems (PRODYN, UTOPIA, etc.)
- First statement in SCATS section needs to be revised: compared with TOD control under plans developed with TRANSYT?...

8.5 Time-Base Coordination

- This is a very small section and should be removed. The text should be moved to the similar subheading under chapter 7-section 9.

8.6 Traffic Operations Centers

- This is a well-written section.
- In Concepts and Function
  - Second paragraph “The TOC typically obtains detector traffic data 1”: surround the number “1” by a circle and apply the same treatment to following numbers.
  - Third paragraph “… uses raw data, five”: “Five” should be “5” in a circle.

8.7 A Look to the Future

- Should be updated with current research issues.

References – Chapter 8

**Abbas, Olson**

- In general, the chapter has very good contents. However, I got the feeling that (except for 8.6) the chapter is a collection of notes rather than a coherent and appealing text; the text in this chapter should be revised such that it has a “spirit”. Most of the tables in this chapter need to be moved to immediately follow their associated text.
- Under 8.3, include subsections:
  - Adaptive Systems
  - Center to center

**CHAPTER 9 – COMMUNICATIONS - Bullock, Olson**

9.1 Introduction

- This section is currently very weak. Instead it should be expanded to explain why communication infrastructure is needed. In my opinion it exists for the following reasons:
  - Synchronization of time for offsets (Most important)
  - Synchronization of plan changes
  - Upload/download of plans
  - Remote monitoring/diagnostics
  - Alarm Reporting
  - Traffic Responsive Operation
  - Emerging Adaptive control algorithms
  - Surveillance Video
  - Incident Detection
  - Uploading of preemption logs
  - Emerging GPS based transit and emergency vehicle preemption/AVL.

9.2 Basic Concepts

- Provide brief history of communication infrastructure used (and perhaps still in use).
  - Examples should be specific and identify cities, and include 7 wire interconnect, low speed copper, higher speed copper, old style cable modems (Lafayette, LA), spread spectrum radios, CDPD (Houston), proprietary protocol over fiber, IP based communication over fiber. I think the technology details should not be emphasized (those will be addressed in the communications handbook), instead this should chapter should identify specific cities
implementing this technology… perhaps with an intersection count and approximate installation costs.

9.3 Alternative Communication Media and Technologies

- This should discuss a summary of best practices for each of the following elements.
  - Architecture (with figures, tie back to items in 9.2)
  - Media (with figures, tie back to items in 9.2)
  - Protocols (Summarize issues with proprietary and NTCIP)
- Add a discussion on the use of Ethernet for field communications
- Add discussion on system installation techniques and considerations
  - New standards in Telecommunications
  - DSL/Cable Modems, CDPD/GPRS
- More discussion on video compression techniques, packetized video transmission using internet protocols.
  - NTCIP Communications Protocols
  - Bandwidth analysis
- Added depth to fiber optics, discussion of cable types and applications (Tight Buffer vs Loose Tube)
  - Packet Switching vs, circuit switching

9.4 Communication System Planning

- Case studies of example cities that have undergone this process. Discuss scope of work in those contracts.
- Lease vs build analysis and not via an estimation of the breakeven point
- Shared Resource agreements etc.

9.5 A Look to the Future

- Need to be updated to discuss wire and wireless based IP communication.

General Comments – Bullock

- The communications systems handbook is currently under contract to be updated. That manual has several hundred pages on the technology, so it is important not to include too much redundant material in this chapter. This chapter should probably be completely rewritten as above.

CHAPTER 10 – TRAVELER INFORMATION SYSTEMS - Mohaddes

10.1 Introduction

- The introduction needs to be expanded to include "Web Based information," "Mobil information," "Integrated ATMS/ATIS (ATMIS) Systems", "personalized Traveler Information Systems", "National 511." I am not necessarily suggesting that these subjects to be covered in any particular format or fashion but rather somehow be included due to their relevance and importance. also suggest removing the existing Figure 10-1 and replacing it with another attribute of traveler information system as the Kiosk (as shown) is not a very good representation of this subject anymore (if it ever was) . Obviously table 10-1 should be revised to expand of the foregoing subjects suggested.

10.2 Static Signs

- This chapter doesn't seem to need much revision.

10.3 Changeable Message Signs

- This is a well written chapter requiring minor modifications as follows:
  - Page 10-23 Controller should be expanded to address 2070. Installation, Maintenance, and Operation (page 10-24) should be expanded to reflect several new reference as well as perhaps a new table discussing lessons learned or basically examples of various installations, and perhaps O&M cost.

10.4 Portable Signs

- This chapter needs to be expanded to include diversified use of the portable message signs particularly in work zones. discussion of various technologies and communications should be added (expanded) and new pictures to be added (replaced).

10.5 Highway Advisory Radio
10.6 Motorist Aid Systems

- This section doesn't need much modifications except perhaps expanding on the applications and additional references of new articles/reports.

- I suggest changing the title to "motorist Information Systems". This chapter needs to be rewritten and shift emphasis for example much less emphasis should go to "call boxes" and much more to "Mobil assist", new sections on "web Based information," as well as "National 511" should be added. In addition, a section perhaps on "personalized traveler Information Systems" could be added. Obviously new tables and figures should be added to reflect the modifications.

10.7 Commercial Radio

- This section should be expanded to reflect the state-of-the-practice.
  I suggest for discussion adding a new section to deal with "commercial Vehicle Information System" it might have some merits.

10.8 A Look to the Future

- Significant expansion is proposed as state-of-the-practice is evolving rapidly with significant commercial opportunities for various vendors and companies to get into this space. Also, since the "then" latest projects are mentioned, it should be revised to include several program nationwide.

General Comments - Mohaddes, Olson

- Traveler information systems is an area that perhaps been evolving significantly since the publication of the last Handbook. I envision that significant modifications would be necessary to bring it up to date.

- Add a new section on Standards.

CHAPTER 11 – SELECTION OF A SYSTEM – Olson

11.1 Introduction

11.2 Federal-Aid Requirements

11.3 System Selection Process

- Maybe this is where the Systems Engineering process fits in., life cycle costs, M&O, Lease vs. Own

References – Chapter 11

General Comments - Medina

- Chapter approach
  - The chapter as it is only refers to the selection of a system more at the project level, however when competing for funds with other traffic projects or infrastructure project in general a more general approach is also needed.. The chapter can benefit form a more holistic approach such as the ones used in asset management

- Chapter Information
  - Also the chapter information can be intergraded in a more systematic approach for the components of the system
  - That will help in select a system and also will result in less cost and effort for future projects.

DATABASE
Inventory
Condition

ANALYSIS TOOLS
Performance Prediction
Needs / Life-cycle
Optimization / Programming

REPORTS

GRAPHICAL
INTERFACES

PERFORMANCE MONITORING
Selection of alternatives

When evaluating alternatives a broader range of evaluation methods must be mentioned to the user:
- Prioritization by performance measurement
- Prioritization by a Usage Weighted performance Function
- Prioritization by Composite criteria
- Prioritization by First cost
- Prioritization by Least Life Cycle cost, including the Present Value method
- Prioritization by benefit cost ratio or Cost Effectiveness
- Optimization
- Advantages and disadvantages

CHAPTER 12 – DESIGN AND IMPLEMENTATION – Olson

12.1 Introduction

12.2 System Implementation

12.3 Procurement Approach

- Software procurement should be a separate issue. Take cues from the Road to Successful Software

12.4 Design Plans and Specifications

12.5 Deliverable Services

12.6 Project Management

12.7 Implementation Pitfalls

References – Chapter 12

General Comments – Ziegler

- My changes reflect a design, bid, build approach to a typical project. I did add a section that would include a discussion of design/build alternative, which could be applicable to this type of project and has been done in the past. The proposed sections are as follows:
  1. Introduction
  2. Procurement Approach: Engineering Services
  3. Deliverable Services
  4. Design Plans and Specifications
  5. Protypical Plan Format/Standards/Contract Documents
  6. System Implementation Guidelines
  7. Procurement Approach: Construction
  8. Construction Management
  9. Design/Build Alternatives
  10. Implementation Pitfalls
  11. References – Chapter 12

CHAPTER 13 – SYSTEMS MANAGEMENT – Desanto, Decker, Mona

13.1 Introduction

- See no reference to type skills in the Organization Chart eg; traffic engineer, electrical technician, etc.
- The INFORM organizational chart is probably not a good example of a typical traffic management system agency structure. Suggest using another example.
- Modify “Changeable Message Signs” to “Dynamic Message Signs”

13.2 An Integrated System Management Concept
System operation requires proper system maintenance and continuous updating of traffic timing plans to conform to changing traffic conditions.

Considering the above interrelationships, management must organize personnel into a cohesive unit with upward mobility in order to retain skilled workers.

There should be more emphasis placed on using standards for interoperability from center to center. Using standards is very general but data elements, communication, architecture all have their respective standards either underway, or balloted at this time. Maybe a look to the future would be appropriate for this section.

**13.3 Operations**

- System Modification and Updates, in addition to noted strategies, should include field review of modifications to ensure maximum effect. This includes, queuing, utilization of storage space, proper progression, adequate cycle lengths, splits and offsets.
- Update table 13-4 and 13-5 -- many of the control systems described are obsolete.
- The topic of staffing does not reference appropriate titles.
- Too many times when new operation centers start up, personnel are drawn from various areas to staff the center. Organizations often forget to match duties against actual job classifications when meeting the criteria established to hire new operations personnel.

**13.4 Maintenance**

- Hardware: Scheduled time-delay runs should be performed and included when performing traditional maintenance activities.

**13.5 Evaluation**

- Looking for a performance requirement which could evaluate system performance for systems like an incident management system including diversion practices, implementing timing changes on signals located on diversion routes, time to resume normal flow, time to clear an incident. All of the above could be part of a performance module which measures how quickly drivers respond to resources like vms, har, detector and surveillance equipment. A benefit/cost ratio could then derived based on the above. Haven't seen much out there to use.

References – Chapter 13

**General Comments**

- Change all “CMS” references to “DMS”

**CHAPTER 14 – ITS PLANS AND PROGRAMS - Olson**

**14.1 Introduction**

**14.2 ITS Program Planning in the United States**

- TEA 21 and Next TEA (or what ever they are calling it this week)
  - FHWA programs for technical assistance
  - Standards Programs
  - More case studies, several from different locations/projects
  - Operations and Management movement

**14.3 Worldwide ITS Programs**

**14.4 Standards Applicable to ITS Technologies**

- Make this a separate chapter and move it towards the front of the document.

References – Chapter 14

Appendix

Glossary

Index