This document fulfills the requirements of Tasks 10, 11, 12, 14, and 15 in the study scope of work, which include developing site selection criteria, identifying and evaluating potential site locations, and outlining a general deployment strategy. This document identifies several high-priority deployment locations and discusses how to demonstrate the various system functions cumulatively at one or more initial deployment sites. Selection of one or more top-priority locations and specific scheduling and phasing of demonstrations and deployments is recommended for further study by the Regional Transportation Authority and its service boards based on physical conditions, service and operations characteristics, ridership, funding availability, policy issues, and other factors. The general deployment strategy outlines some of the major issues to be addressed in the process of installing and operating Parking Management Systems.
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1. INTRODUCTION

The Parking Management Systems (PMS) project is part of a larger effort of developing Advanced Traveler Information Systems (ATIS) in the Gary-Chicago-Milwaukee Intelligent Transportation Systems (ITS) Priority Corridor. The Regional Transportation Authority (RTA) is providing regional coordination for the development of an integrated system as part of its commitment to developing technological solutions to traditional transit problems.

With the implementation of PMS, it is the RTA’s goal to reduce congestion by seeking an efficient means to divert automobiles from the expressways, tollways, arterials, and other major roads. This goal will be accomplished by providing informational signage that allows for “road-to-parking lot” guidance. In addition, the PMS will provide lot-to-lot guidance within parking facilities or between nearby parking facilities where appropriate.

The projects will result in prototype projects demonstrating how multiple existing and planned information systems in the region can be coordinated to provide advanced real-time information. The prototype projects and their successors will be implemented by the service boards (Chicago Transit Authority, Metra commuter rail, and Pace suburban buses) under regional standards developed with this project.

The purpose of this document is to present a deployment plan for PMS at transit parking facilities, based on the preliminary design scheme presented in the Functional, Messaging & Integration Requirements Report previously submitted to the RTA. The deployment plan will provide a prioritization of locations where PMS are to be deployed along with a methodology for the operation and maintenance of these installations.

1.1. Review of Functional Requirements

The Functional, Messaging & Integration Requirements report established basic parameters for the system architecture, information requirements and data flows, and display signage.

The PMS will collect information in real time on availability of parking and

- location of lots where parking is available, and/or
- the location of available parking spaces, and
- next train/bus information to assist in identifying where to park.
The system will then in turn, provide the traveler with information on

- location of a parking lot with available capacity, and/or
- location of an available parking space, plus, potentially,
- time to the next train arrival and
- accidents or incidents on congested alternate expressway or tollway routes.

1.1.1. Classification of Parking Facilities

Two basic types of commuter parking facilities were identified:

- **Scattered parking:** A relatively large number of moderate to small parking lots in urban or suburban areas,

- **Concentrated parking:** Large surface parking lots or garages, with one or two facilities per station, generally owned or leased by Metra, CTA or Pace, and located primarily in suburban areas. This classification includes both surface lots and garages.

A third condition, limited parking facilities in congested urban areas, was considered to be a special condition of the scattered parking condition in which lots may consist of large garages. The RTA region does not include any designated commuter park-and-ride facilities located in this type of environment.

The PMS will focus on providing guidance to spaces in general use or daily fee parking lots, as opposed to permit-only lots. Daily fee lots do not require any prior arrangement to be made (e.g. obtaining a permit) and are thus available to casual and infrequent users and new riders to whom the PMS would be especially useful.

1.1.2. System Architecture

The basic system architecture of the PMS is illustrated in Figure 1.1. The system architecture consists of nine basic components:

1. Parking Monitoring Sensors
2. Parking Management Processors (In/Out)
3. Variable Message Signs (VMS) for Parking Lots
4. Variable Message Signs (VMS) for Arterials
5. Interface to Transit Vehicle Location Systems
6. Interface to Relevant Traffic Information
7. System Database / Processing Capability
8. Communication System (Local Lot System)
9. Communication System (Local to Service Board Hub or Gateway)
1.1.3. Information Requirements

The PMS requires four specific categories of data to determine the message displayed on the Variable Message Signs.

1. Overall Parking Lot Occupancy
2. Individual Space or Zone Parking Availability
3. Location/Schedule for Next Train/Bus
4. Alternate Traffic Route Information

* Each local control system will be adapted to meet station parking layout/type
The data required to provide proper messaging by facility type is depicted in Table 1.1. This demonstrates the required and optional data types as well as the potential for data sharing between agencies (public/public and public/private).

### Table 1.1: Data Collection Requirements by Facility Type

<table>
<thead>
<tr>
<th>Parking Configuration</th>
<th>Parking Lot Occupancy</th>
<th>Parking Space Availability</th>
<th>Location/Schedule for Next Train/Bus</th>
<th>Alt. Traffic Route Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scattered</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Lots</td>
<td>R</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Garages</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Shared Use</td>
<td>N</td>
<td>N</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Concentrated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking Garages</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Surface Lots</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

**Key:** R = Required; O = Optional; N = May require interagency agreements.

Note that “Parking Space Availability” is identified after the traveler is within the parking lot. This is referred to as “Internal Parking Management” while guidance to a lot with open spaces is referred to as “External Parking Management.”

#### 1.1.4. Types of Signage

The PMS uses three basic types of Variable Message Signs to display real-time parking-related information to transit customers.

1. Advance Signage on expressways, tollways, and arterials (External Parking Management)

2. Access Signage to guide motorists to lots with available parking (External Parking Management)

3. Facility Signage to guide motorists to spaces or zones within lots or garages (Internal Parking Management)
1.2. Organization of Report

This document consists of the following:

Section 1: This introduction plus summary of functional requirements (review of Task 4 to 6 activities)

Section 2: Site Selection Criteria (corresponding to Task 10 activities)

Section 3: Recommended Deployment Sites (corresponding to Task 11 activities)

Section 4: Implementation Plan (corresponding to Task 12 activities)
2. SITE SELECTION CRITERIA

The basic installation, operation, and customer feedback of the PMS will be demonstrated before deploying the system on a regional basis. In order to deploy, the region must first demonstrate the functionality of the system requirements developed in the Phase I Study.

*Demonstration* refers to the testing and evaluation of a prototype system to determine its feasibility for wider implementation. Demonstrations are performed at locations selected for their physical and operational characteristics that support testing of each of the basic functions of the PMS. Because many components of a successful prototype installation could remain in use after the technology is proven, economies may be achieved by demonstrating the functionality at high-priority deployment locations. Intensively used locations also enhance opportunities for collecting customer feedback information and measuring effects on travel behavior during the demonstration period.

*Deployment* refers to the regional implementation of the tested, and perhaps improved, system and follows the demonstration of one or more prototypes. Deployment locations are selected based on the degree of potential benefit of real-time parking information to current and latent transit customers.

The following section presents a methodology for the selection and prioritization of commuter parking facilities for demonstration and deployment of PMS. The methodology presented is based on a two-part screening procedure that separates facilities by type and evaluates facilities within each category.

2.1. Facility Categorization

The facility selection methodology begins with a universe of 238 commuter parking facilities throughout the RTA region in Illinois. This includes 197 Metra commuter rail stations with parking, 22 CTA rapid transit stations, and 19 Pace Park-and-Ride facilities. Where multiple rail stations are located in close proximity, such as in Evanston and Oak Park, the stations are included separately but screening data represents the combined facility configuration for each. A PMS implemented at one facility would ostensibly improve parking access throughout the combined facility.

These facilities are separated into three categories based on the type and configuration of parking lots. These categories reflect the scope of a PMS likely to be needed at the facility. For example, parking facilities with numerous, scattered, small lots are not as likely to require parking guidance systems within the lots as facilities with parking concentrated in one or two large parking lots or garages. Table 2.1 summarizes the major parking facility categories and the most probable scope of PMS at each. Of course, site specific requirements for PMS will be made during the design process, and needs assessed at that time will override any scope decisions assumed during the site selection process.
Scattered facilities are defined as those with more than five parking lots or fewer than 100 parking spaces per lot. Concentrated facilities are defined as all other facilities. The presence of a parking garage at a concentrated facility, although it may not constitute the total parking capacity at the facility, differentiates Category 3 from Category 2.

### 2.2. Definition of Selection Criteria

Within each category, facilities are selected based on various criteria identified during the Needs Assessment process and in subsequent meetings with Service Boards. The criteria described below represent data that are available on a consistent, region-wide basis to support objective selection from the universe of facilities in the RTA system. More detailed criteria, such as physical conditions, daily fee parking occupancy rates, fee structures, local traffic conditions, and other site-specific characteristics should guide the final selection of any facility for demonstration or deployment. The selection criteria used in this analysis include:

**Peak Parking Occupancy:** In general parking lots that are more than 90% full on the average weekday are most in need of internal guidance systems for finding an open space and/or external guidance systems for diverting customers to nearby stations with available parking. Facilities with greater than 90% occupancy were given preference. For Metra stations, parking occupancy is based on 1997 Metra parking occupancy data. Parking occupancy at CTA facilities is based on the 1998 Park-n-Ride User Census. Parking occupancy at Pace facilities is based on staff knowledge. Although parking occupancy data for Metra stations does not distinguish between permit-only and daily fee parking spaces, approximately 70% of spaces system-wide are available to commuters without a permit for a daily fee or free of charge. Additional studies are required to determine the extent to which parking is actually available for casual or infrequent transit riders.

**Total Number of Off-Street, Unrestricted Spaces:** In general, PMS will be most cost-effective in terms of the number of customers served when implemented at the largest commuter parking facilities. Because of the greatly increased complexity of collecting parking occupancy data at on-street metered spaces (a detector is required at every space), preference is given to the facilities with the most off-street parking spaces.
Parking facilities with the most spaces available for infrequent or casual users are also given preference. Reserved parking spaces that require some prior arrangement to be made, such as obtaining a permit or paying a monthly fee, before parking is allowed are not counted. Facilities among the top ten percent of all facilities (greater than 400 off-street, daily fee spaces) were given preference.

**Facility Entrance on Strategic Regional Arterial:** The presence of a facility on a major highway, such as a Strategic Regional Arterial (SRA), increases the effectiveness and exposure of external PMS by providing high-traffic routes for the installation of guidance signage. Facilities with at least one entrance on an SRA were given preference.

**Facility Proximity to Expressway:** PMS may be more effective at facilities near expressways where an opportunity exists for diversion of traffic from congested expressways to transit. Integration of parking management information with expressway variable message signs and highway advisory radio also supports the system goal of directing traffic from a full commuter parking facility to a nearby facility with open spaces. Of course, policy approval by applicable agencies is required for implementation of this function. Facilities on a direct route from an expressway interchange (generally located on the same street as the interchange) and within approximately one mile of the interchange were given preference.

**Availability of AVL Data:** Transit facilities on lines for which Automatic Vehicle Location (AVL) systems are scheduled for early deployment supports the system goal of using real-time transit service information to attract travelers from congested highways to transit. Because AVL systems are in various stages of implementation by service boards, only those scheduled for completion before the end of 2000 are included. Lines include the Metra Train Information Management System (TIMS) prototype on the Southwest Service, all CTA Rapid Transit Lines, and the CTA Bus Service Management System (BSMS) on Martin Luther King Jr. Drive and 79th Street in Chicago. Stations along these lines were given preference as demonstration sites.

**Inter-station Groups:** Facilities that belong to groups of rail stations between which commuters could be redistributed from full parking areas to nearby stations at which parking is available were given preference. Inter-station groups include “fill” stations and “borrow” stations. “Borrow” stations are defined as facilities with over 90% parking occupancy. “Fill” stations are all stations on the same rail line that are within 5 miles and have over 100 available (unused) spaces. Available spaces were calculated based on the parking occupancy and the number of total spaces. In general, the “fill” stations are closer to downtown than “borrow” stations to minimize the need for backtracking. Traffic impact studies should be conducted during the implementation process to determine the feasibility and desirability of directing commuters between stations, signage needs, and the degree of impact on local traffic conditions.

Six corridors were chosen as potential locations for inter-station groups of connected PMS. Five corridors are along Metra commuter rail lines. Only one corridor is along a CTA rapid transit line, primarily because CTA park-and-ride facilities are typically located at terminals and no other CTA park-and-ride facilities exist in the vicinity. Inter-station groups include:
1. **Governors Highway / Park Avenue** (Metra Electric Mainline): Four stations (Flossmoor, Homewood, Calumet, and Hazel Crest) have very high parking occupancy rates (100%, 99%, 96%, and 91% on the average weekday, respectively) and are all within about five miles of two stations (Harvey and 147th Street / Sibley) with a combined total of more than 600 spaces unused. Circulation between stations is relatively direct along Governor’s Highway and Park Avenue. Because many of the “borrow” stations have substantial parking restrictions in the form of permit requirements, a PMS connecting these stations could make commuter parking more user-friendly for infrequent or casual transit customers.

2. **211th Street + Matteson** (Metra Electric Mainline): The 211th Street / Lincoln Highway station is a large, heavily used station (737 spaces with 94% parking occupancy). The Matteson station is located 0.6 mile south of 211th Street, has two parking lots accessible by either Homan Avenue or Olympian Way / Main Street from the two parking lots at 211th Street, and has more than 175 spaces available on the average weekday. Although this group of stations is less of a corridor than the other inter-station groups identified in this section and it requires some backtracking for inbound commuters if 211th Street is full, it is included because of the large potential benefit an interconnected PMS could provide at this heavily used location and because of the relatively short backtracking distance that would be required.

3. **Interstate 80** (Metra Rock Island): Two stations (New Lenox and Mokena) have high parking occupancy rates (98% and 89%, respectively) and are located further out from the less intensively utilized, but rapidly growing, Hickory Creek station (53% parking occupancy and over 500 spaces unused based on 1997 data). Using arterial street signs on Wolf Road and 191st Street, motorists could be guided from Mokena to Hickory Creek when parking lots are full. Using signs west of the New Lenox exit, eastbound motorists could be directed along Interstate 80 to Hickory Creek when parking lots are full. Although the distance between New Lenox and Hickory Creek exceeds the five-mile limit established for this analysis, the ability to divert traffic using Interstate 80 to access these stations could hold travel times to comparable levels as for stations located along non-limited-access arterial streets. Although some backtracking may be required, it may be desirable to include the 80th Avenue station (95% parking occupancy) in the group. This opportunity is recommended for further study based on travel times and traffic impacts.

4. **Lake Street / Irving Park Road** (Metra Milwaukee District West): Two stations (Bartlett and Hanover Park) have high occupancy rates and are located within about four miles of Schaumburg, a station with more than 500 unused spaces. Access is relatively direct via Lake Street and the Elgin-O’Hare Expressway. Immediately adjacent in the inbound direction, the heavily utilized Roselle station is located less than one mile from the Medinah station (more than 150 spaces unused) along Irving Park Road. Likewise, the next station (Itasca) has 95% parking occupancy and is located about two miles from Wood Dale, a station with more than 120 spaces available on the average weekday. Further study should determine the extent to which these station groups should be
interconnected, i.e. whether a PMS connecting all seven stations is more desirable than three separate systems or some other combination. Because of the widespread use of permit parking restrictions among these stations, further study is needed to quantify the benefits of PMS at these locations, especially in terms of additional use by casual or infrequent riders.

5. **Northwest Highway** (Metra Union Pacific Northwest): The intensively utilized Palatine station (95% full) is located within about four miles of both the Arlington Park and Arlington Heights stations, at which a total of more than 400 spaces are available on the average weekday. Likewise, the next station in the inbound direction, Mount Prospect (97% full) is located less than three miles from both the Cumberland and Des Plaines stations, at which nearly 200 spaces are unused on the average weekday. All stations are easily accessible from Northwest Highway.

6. **Rosemont / Cumberland** (CTA Blue Line): The Rosemont station has more than 95 percent parking occupancy and is located approximately one mile from the Cumberland Park-and-Ride facility with more than 600 available spaces on the average weekday. Both stations are adjacent to Interstate 90 and/or Interstate 190. It may be possible to divert commuters from Rosemont to Cumberland using the expressway or surface streets, such as Devon Avenue or Lawrence Avenue. With its direct access from the Kennedy Expressway, Cumberland also offers the opportunity to divert commuters from the expressway to the Blue Line when congestion occurs downstream.

### 2.3. Selection of Demonstration Locations

Demonstration facilities should be chosen to accommodate the testing of as many of the basic functions of the PMS system as possible. These functions are described in the *Functional, Messaging & Integration Requirements* report. Basic functions define levels of integration required for demonstration of the functions. In increasing order of system integration requirements, the levels of integration that various prototypes could demonstrate include:

- **Level 1:** Installation of a PMS at a single location to demonstrate the operation of external guidance signage and potentially internal guidance signage. This facility could have either a scattered or concentrated configuration. Multiple facilities with different physical conditions could be demonstrated at this level.

- **Level 2:** Integration of PMS at nearby locations to demonstrate inter-station parking guidance. PMS at two or more facilities within an inter-station group would be required. Coordination between stations would require the construction of one or more Service Board Transit Hubs and associated station-to-hub communications.
Level 3: Display of parking occupancy and transit service information on one or more expressway/tollway Variable Message Signs. This function requires the integration of information provided by the PMS at one or more stations, schedule adherence information from one or more Automatic Vehicle Location (AVL) systems, and traffic congestion information from the Illinois Department of Transportation (IDOT) and/or the Illinois State Toll Highway Authority (ISTHA) via the GCM Gateway. This function would thus require the construction of a Wide Area Network (WAN) connecting one or more Service Board Hubs, the RTA Northeastern Illinois Transit Hub, and the GCM Gateway. This function would also require policy approval by applicable agencies.

Figure 2.1 on the following page shows the minimum amount of the PMS system architecture that would need to be in place to support demonstration of each functional level.
The optimal demonstration location would allow for implementation of a prototype in phases corresponding to each level. This facility would need to be part of an inter-station group and have proximity to an expressway or tollway. In this manner, the first phase would demonstrate a PMS operation at a single facility. The second phase would demonstrate how PMS could divert commuters from a full station to one with available parking. The third phase would demonstrate how PMS can promote transit services under congested traffic conditions. At locations that are not members of inter-station groups and are near expressways or tollways, testing could proceed directly from Level 1 to Level 3.

Each phase provides an incremental level of improvement that can be readily evaluated. Section 4 assesses specific issues associated with implementation, including institutional, physical, and technical considerations, and development of operational strategies.
3.  RECOMMENDED SITES

The basic installation, operation, and customer feedback of the PMS system should be demonstrated before deploying the system on a regional basis. Demonstration refers to the testing and evaluation of a prototype system to determine its feasibility for wider implementation. Deployment refers to the regional implementation of the tested, and perhaps improved, system and follows the demonstration of one or more prototypes.

Demonstrations are performed at locations selected primarily based on the presence of physical and operational characteristics that support testing of each of the basic functions of the PMS system. Deployment locations are selected primarily based on the degree of need for real-time traveler information by current and latent transit customers. Because many components of a successful prototype installation could remain in use after the technology is proven, economies may be achieved by demonstrating the functionality at high-priority deployment locations. Intensively used locations also enhance opportunities for collecting customer feedback information and measuring effects on travel behavior during the demonstration period.

This section identifies high-priority locations for both demonstration and deployment. In Section 3.1, candidate locations that meet certain minimum criteria for either demonstration or deployment are identified. In Section 3.2, service board selections from the candidate list for demonstration are discussed. In Section 3.3, high-priority deployment locations are identified. Further study based on more detailed criteria than could be evaluated in this region-wide analysis is recommended at each of the facilities to make final selections.

3.1.  Candidate Locations

This section identifies and ranks a group of facilities that meet certain minimum criteria for implementation of PMS – either demonstrations or deployments. Candidates for either demonstration or deployment meet the following minimum criteria:

- Have 90 percent or greater parking occupancy, OR
- Are “fill” stations in inter-station groups, OR
- Are near expressways or tollways where available capacity could be promoted,

AND

- Offer at least 400 off-street, daily fee parking spaces.

A database was developed to record the supporting data required to screen and rank facilities based on the criteria described in Section 2.2. Screening was conducted using database queries for each facility category described in Section 2.1.
After screening facilities based on the above criteria, facilities were ranked based on the existence of characteristics that may allow PMS to provide greater benefits. These characteristics include high visibility entrances along Strategic Regional Arterial routes, proximity to an expressway or tollway to allow for coordination with traffic management systems, and membership in an inter-station group that could be used to direct commuters to available parking at nearby stations. Facilities that meet the most criteria were given the highest priority. Because each criterion addresses major system functional requirements and system goals differently, no attempt was made to weigh one criterion more importantly than another.

Table 3.1 summarizes the results for Category 3, Concentrated Parking Facilities with Garages. Only the CTA Cumberland Park-and-Ride facility meets all of the criteria for implementation of PMS in this category.

Table 3.1: CANDIDATE LOCATIONS: Category 3

<table>
<thead>
<tr>
<th>Operator Name</th>
<th>Route</th>
<th>Daily Fee Spaces</th>
<th>Parking Occupancy</th>
<th>Daily Boardings</th>
<th>SRA Entrance</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTA Cumberland / Kennedy</td>
<td>Blue</td>
<td>1,651</td>
<td>62%</td>
<td>4,700</td>
<td>☑</td>
</tr>
</tbody>
</table>

Table 3.2 summarizes the results for Category 2, Concentrated Parking Facilities with Surface Lots. No stand-alone Pace Park-and-Ride facilities were selected due to their relatively low parking capacities (less than 400 spaces).

Table 3.2: CANDIDATE LOCATIONS: Category 2

<table>
<thead>
<tr>
<th>Operator Name</th>
<th>Route</th>
<th>Daily Fee Spaces</th>
<th>Parking Occupancy</th>
<th>Daily Boardings</th>
<th>SRA Entrance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metra New Lenox</td>
<td>RI-ML</td>
<td>602</td>
<td>98%</td>
<td>861</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Hickory Creek</td>
<td>RI-ML</td>
<td>1,107</td>
<td>54%</td>
<td>719</td>
<td>☑</td>
</tr>
<tr>
<td>CTA Rosemont</td>
<td>Blue</td>
<td>736</td>
<td>96%</td>
<td>5,400</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Route 59</td>
<td>BNSF</td>
<td>2,882</td>
<td>95%</td>
<td>3,322</td>
<td>☑</td>
</tr>
<tr>
<td>CTA Skokie</td>
<td>Yellow</td>
<td>776</td>
<td>66%</td>
<td>2,600</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Arlington Park</td>
<td>UP-NW</td>
<td>1,210</td>
<td>75%</td>
<td>1,980</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Schaumburg</td>
<td>MILW-W</td>
<td>1,194</td>
<td>67%</td>
<td>1,647</td>
<td>☑</td>
</tr>
<tr>
<td>Metra 211th Street / Lincoln Hwy.</td>
<td>ME-ML</td>
<td>737</td>
<td>94%</td>
<td>1,159</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Lake-Cook Road</td>
<td>MILW-N</td>
<td>723</td>
<td>54%</td>
<td>1,128</td>
<td>☑</td>
</tr>
<tr>
<td>CTA Forest Park</td>
<td>Blue</td>
<td>1,051</td>
<td>75%</td>
<td>4,000</td>
<td>☑</td>
</tr>
<tr>
<td>Metra 80th Avenue</td>
<td>RI-ML</td>
<td>1,394</td>
<td>95%</td>
<td>1,585</td>
<td>☑</td>
</tr>
<tr>
<td>Metra 147th Street / Sibley Blvd.</td>
<td>ME-ML</td>
<td>1,269</td>
<td>65%</td>
<td>1,334</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Harvey</td>
<td>ME-ML</td>
<td>818</td>
<td>79%</td>
<td>1,266</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Matteson</td>
<td>ME-ML</td>
<td>759</td>
<td>76%</td>
<td>907</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Wood Dale</td>
<td>MILW-W</td>
<td>462</td>
<td>77%</td>
<td>709</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Northbrook</td>
<td>MILW-N</td>
<td>518</td>
<td>99%</td>
<td>1,459</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Aurora</td>
<td>BNSF</td>
<td>703</td>
<td>97%</td>
<td>1,387</td>
<td>☑</td>
</tr>
<tr>
<td>Metra 144th Street / Ivanhoe</td>
<td>ME-ML</td>
<td>415</td>
<td>100%</td>
<td>1,163</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Villa Park</td>
<td>UP-W</td>
<td>502</td>
<td>93%</td>
<td>1,015</td>
<td>☑</td>
</tr>
<tr>
<td>Metra Waukegan</td>
<td>UP-N</td>
<td>537</td>
<td>94%</td>
<td>806</td>
<td>☑</td>
</tr>
</tbody>
</table>
Table 3.3 summarizes the results for Category 1, Scattered Parking Facilities with Surface Lots.

Table 3.3: CANDIDATE LOCATIONS: Category 1

<table>
<thead>
<tr>
<th>Operator Name</th>
<th>Route</th>
<th>Daily Fee Spaces</th>
<th>Parking Occupancy</th>
<th>Daily Boardings</th>
<th>SRA Entrance</th>
<th>Potential Demonstration Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metra Hanover Park</td>
<td>MILW-W</td>
<td>731</td>
<td>96%</td>
<td>1,460</td>
<td>☒</td>
<td>☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒</td>
</tr>
<tr>
<td>CTA Harlem/CTA Green</td>
<td>Green</td>
<td>471</td>
<td>83%</td>
<td>2,150</td>
<td>☒</td>
<td>☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒</td>
</tr>
<tr>
<td>Metra Mount Prospect</td>
<td>UP-NW</td>
<td>416</td>
<td>97%</td>
<td>1,754</td>
<td>☒</td>
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</tr>
<tr>
<td>Metra Oak Forest</td>
<td>RI-ML</td>
<td>1,039</td>
<td>95%</td>
<td>1,594</td>
<td>☒</td>
<td>☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒</td>
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<tr>
<td>Metra Arlington Heights</td>
<td>UP-NW</td>
<td>565</td>
<td>88%</td>
<td>2,572</td>
<td>☐</td>
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<tr>
<td>Metra Palatine</td>
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<td>95%</td>
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<td>☐</td>
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<tr>
<td>Metra Barrington</td>
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<td>1,758</td>
<td>☒</td>
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<td>1,628</td>
<td>☐</td>
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<tr>
<td>Metra Richton Park</td>
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<td>1,716</td>
<td>☐</td>
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<td>Metra Belmont</td>
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<td>97%</td>
<td>1,495</td>
<td>☒</td>
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<td>Metra Crystal Lake</td>
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<td>99%</td>
<td>1,495</td>
<td>☐</td>
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<tr>
<td>Metra Midlothian</td>
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<td>661</td>
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3.2. High-Priority Demonstration Locations

The selection of demonstration facilities was conducted using a two-step process. In the first step, candidate locations were selected from the universe of CTA and Metra park-and-ride facilities based on the presence of certain minimum characteristics needed for testing the basic functions of the PMS. These locations are listed in Section 3.1. In the second step, service boards were asked to select a small group of high-priority demonstration facilities from the candidate list based on more detailed service, ridership, parking occupancy, parking policy, physical, and other criteria than were evaluated in the high-level regional analysis. The service board selections are summarized below.

Hickory Creek (Metra Rock Island): Hickory Creek belongs to the Interstate 80 inter-station group. It is a large facility (1,107 spaces – all daily fee) with very convenient access to both Interstate 80 and LaGrange Road (U.S. 45), a Strategic Regional Arterial. The parking occupancy rate in 1997 was observed at 53%, but this utilization level has been rising with increasing development in the area. Despite its growing usage, Hickory Creek could remain an attractive “fill” station in an area characterized by heavily utilized park-and-ride facilities. With a single large lot, an internal parking guidance system to direct motorists to aisles or spaces with available parking could be demonstrated as Phase 1. As a potential “fill” station for other nearby stations (such as New Lenox, Mokena, and/or potentially 80th Avenue), implementation and connection with PMS at one or more of those locations could be demonstrated as Phase 2. Expressway integration could follow as Phase 3. Hickory Creek ranks among the highest priority deployment locations for PMS (see Section 3.3). It is recommended that further study of parking occupancy patterns and station access routes throughout the Interstate 80 inter-station group be conducted as designs are developed for this facility.
Route 59 (Metra BNSF): With 2,882 spaces in two large lots, the Route 59 station typifies the concentrated surface lot category. With a distance of more than 0.6 mile separating the entrances to the north and south lots along Route 59, the station also functions much like an inter-station group of nearby stations. Route 59 offers the opportunity to demonstrate both internal and external parking management. In a subsequent phase, an interface with Interstate 88 tollway variable message signs (and potentially the Active Transit Station Signs system) could also be demonstrated. Route 59 is the largest park-and-ride facility in the region and is among the most heavily used (95% full on average). This location would provide opportunities not only for demonstration of basic functions, but could also address a substantial need for parking guidance and provide substantial customer feedback on the functionality of the system.

Schaumburg (Metra Milwaukee District West): The Schaumburg station consists of three main daily fee lots with a total of 1,194 spaces. There are also two permit-only lots with a total of 529 spaces. Two daily fee lots (810 spaces) are accessible from the Elgin-O'Hare Expressway north of the tracks. One daily fee lot (384 spaces) is accessible from south of the tracks. The lots are located in different counties, are operated by different agencies, and have different fee structures. The circulation layout of the north lots is particularly appropriate for the demonstration of internal PMS. Opportunities also exist for real-time transit information signage as motorists enter the western end of the Elgin-O'Hare Expressway and along Irving Park Road. Trailblazer signage with active and static components could also be used along Irving Park Road, Gary Avenue, and Rodenburg Road to guide motorists between north and south lots. As a “fill” station in the Irving Park Road inter-station group, demonstration at Schaumburg could provide the foundation for subsequent phases of testing at nearby facilities.

Lake-Cook Road (Metra Milwaukee District North): Lake-Cook Road is a newly constructed park-and-ride facility near key intersections on three major highways that provide parallel service to the rail line. The highways include Interstate 294 (Tri-State Tollway), Waukegan Road (Illinois Route 43), and U.S. 41 / Interstate 94 (Edens Expressway). As such, Lake-Cook Road provides an opportunity for the demonstration of an external PMS, including expressway, tollway, and arterial integration. A relatively simple parking lot layout (one lot with relatively few entrances and exits, all spaces are daily fee) allows concentration to be given to the details of demonstrating expressway, tollway, and arterial signage. With policy approval from the appropriate agencies, substantial available parking capacity at this station on the average weekday (300 or more spaces) could be promoted to motorists on the nearby expressway, tollway, and arterial streets.

Cumberland (CTA Blue Line): Cumberland is a large facility with 1,651 parking spaces in a multi-level parking garage. It is located adjacent to both the Kennedy Expressway (I-90) and Cumberland Avenue, a Strategic Regional Arterial. The layout of the garage, with one-way ramps connecting levels, provides a practical opportunity for demonstration of an internal parking guidance system. The proximity and visibility from the often-congested Kennedy Expressway provides a potentially beneficial demonstration opportunity for integration with expressway variable message signs. In conjunction with the Rosemont station on the Blue Line, the Cumberland station could become a part of a small inter-station group where the distribution of parking demand...
between the two stations could be demonstrated. Cumberland is also a high-priority demonstration location for Active Transit Station Signs and thus provides an opportunity for integration with this system.

3.3. High Priority Deployment Locations

The screening results presented in Section 3.1 imply a prioritization of facilities for implementation of PMS. The ability to demonstrate the advanced features of the PMS, such as inter-station guidance and expressway/tollway integration, correspond to qualities that enhance the usefulness of the system to the customer. As such, some of the highest priority demonstration locations are also high-priority deployment locations. Within each category, locations are listed in descending order of the number of desirable features they offer (in addition to the minimum criteria). Locations with three or more checked boxes in Tables 3.1 to 3.3 were used to identify high-priority locations.

Medium-priority stations may be defined as facilities that scored highly but that were not included among high-priority stations. Stations without any of the desirable characteristics for PMS may be considered for implementation in the long term.

In all cases, the decision to implement a PMS at any facility rests with the RTA, and the service board or local agency that will be responsible for operating and maintaining the system. This decision should be based on further study of local conditions outside the scope of this analysis.

Facilities that are recommended for consideration as high-priority locations for implementation of PMS based on this analysis are described below. At this time, the relatively low levels of parking capacity at Pace Park-and-Ride lots does not justify demonstration or deployment projects for PMS.

3.3.1. High Priority Category 3 Locations

Cumberland (CTA Blue Line): The only facility in this category that meets the minimum criteria for deployment of PMS is the Cumberland CTA Park-and-Ride facility. Cumberland is a large facility with 1,651 parking spaces in a multi-level parking garage. It is located adjacent to both the Kennedy Expressway (I-90) and Cumberland Avenue, a Strategic Regional Arterial. The layout of the garage, with one-way ramps connecting levels, provides a practical opportunity for development of an internal parking guidance system. The proximity and visibility from the often-congested Kennedy Expressway provides a potentially beneficial opportunity for integration with expressway variable message signs to communicate the availability of parking. This integration could also include a comparison of travel times to downtown by highway and rapid transit by interfacing with GCM Gateway expressway travel time data and the Active Transit Station Signs system. Of course, policy approval by applicable agencies is required for implementation of this function.
In conjunction with the Rosemont station on the Blue Line, the Cumberland station could become a part of a small inter-station group where parking demand may be distributed as needed between the two stations. Rosemont is also a high-priority Category 2 location for PMS, as described below. With 1997 ridership of 4,700 and 5,400 average daily boardings, respectively, Cumberland and Rosemont are among the most heavily used stations on the CTA Blue Line.

3.3.2. High Priority Category 2 Locations

New Lenox (Metra Rock Island): New Lenox belongs to the Interstate 80 inter-station group described in Section 2.2. Its 602 daily fee spaces are very heavily utilized (98% full). The facility is located with convenient access to Interstate 80 via Maple Avenue (U.S. 30), a Strategic Regional Arterial. Its multiple adjacent lots could be suitable for an internal parking guidance system to direct motorists to aisles or spaces with available parking. To function as a “borrow” station for Mokena and/or Hickory Creek, PMS would need to be implemented at those locations as well. Daily ridership in 1997 averaged 861 boardings.

Hickory Creek (Metra Rock Island): Hickory Creek belongs to the same Interstate 80 inter-station group as New Lenox. It is a large facility (1,107 daily fee spaces) with relatively low utilization (54% full) and is located with very convenient access to both Interstate 80 and LaGrange Road (U.S. 45), a Strategic Regional Arterial. With a single large lot, an internal parking guidance system to direct motorists to aisles or spaces with available parking could be suitable. To function as a “fill” station for other nearby stations (such as New Lenox, Mokena, and/or potentially 80th Avenue), PMS would need to be implemented at those locations as well. With New Lenox and Hickory Creek both ranked as high-priority locations and 80th Avenue ranked as a medium-priority location, the Interstate 80 inter-station group has the highest overall ranking among its peers and would be a high-priority corridor for implementation of an interconnected PMS. Daily ridership in 1997 averaged 719 boardings.

Rosemont (CTA Blue Line): The Rosemont station consists of a large parking lot with 736 spaces at the interchange of several major interstate expressways and tollways. Rosemont is part of an inter-station group with Cumberland. In order to implement external parking management, guidance between the stations could occur along the Interstates 190 and 90, Devon Avenue, and Lawrence Avenue. Daily ridership in 1997 averaged 5,400 boardings.

Route 59 (Metra BNSF): With 2,882 spaces in two large lots, the Route 59 station typifies the concentrated surface lot category. Route 59 is the largest park-and-ride facility in the region and is among the most heavily used (95% full on average). There is considerable potential benefit associated with providing parking guidance to available spaces. With two lots lying on opposite sides of elevated railroad tracks across which there is no convenient vehicular access and a substantial distance between entrance points from Illinois Route 59, the station functions similarly to two separate rail stations. A PMS could direct motorists to available parking in the north and/or south lots before they reach the facility. With the large lot sizes and high occupancy, it may also be desirable to direct motorists to specific aisles or spaces within each lot. With its
proximity to Interstate 88, Route 59 also offers the potential for interfacing with tollway variable message signs (and potentially the Active Transit Station Signs system) to provide parking availability information (and potentially comparative transit and highway travel times). Of course, policy approval by applicable agencies would be required for implementation of this function. Daily ridership in 1997 averaged 3,322 boardings.

Skokie (CTA Yellow Line): The Dempster Street terminal of the CTA Skokie Swift service consists of two large lots (776 total spaces) approximately 0.5 mile from a major interchange with Interstate 94 (Edens Expressway). The north lot is farther from the boarding area than the south lot and its entrance is not directly accessible from Dempster Street. When the south lot fills, an external PMS could provide guidance to available parking in the north lot before the customer reaches the facility. Integration with expressway variable message signs may also be possible, pending the approval of appropriate agencies. Daily ridership in 1997 averaged 2,600 boardings.

Schaumburg (Metra Milwaukee District West): The Schaumburg station consists of three main daily fee parking lots with a total of 1,194 spaces. Two lots (810 spaces) are accessible from the Elgin-O’Hare Expressway north of the tracks. One lot (384 spaces) is accessible from south of the tracks. The lots are located in different counties, are operated by different agencies, and have different fee structures. The circulation layout of the north lots are particularly appropriate for the development of internal PMS. A combination of active and static trailblazer signage could be used on the expressway, Irving Park Road, Gary Avenue, and Rodenburg Road to direct motorists to available parking. Schaumburg is a “fill” station in the Irving Park Road inter-station group. Daily ridership in 1997 averaged 1,647 boardings.

Arlington Park (Metra Union Pacific Northwest): The Arlington Park station consists of two lots (1,139 and 71 daily fee spaces) along the railroad tracks. Arlington Park is a “fill” station in the Northwest Highway inter-station group. With its proximity to Illinois Route 53, comparable travel time or other congestion related information could be provided to southbound motorists en route to downtown. As with other locations, policy approval by applicable agencies would be required for implementation of this function. Daily ridership in 1997 averaged 1,980 boardings.

211th Street / Lincoln Highway (Metra Electric Mainline): The 211th Street station consists of two large lots (470 and 267 spaces) on opposite sides of elevated railroad tracks. Access between lots is available via Lincoln Highway (U.S. 30). A PMS could direct motorists to available parking in the east and/or west lots in part using signs on U.S. 30. The system could also provide internal parking guidance to aisles or spaces within the lots. With its proximity to Interstate 57, 211th Street also offers the potential for interfacing with expressway variable message signs (and potentially the Active Transit Station Signs system) to provide parking availability information (and potentially comparative transit and highway travel times). As at other locations, policy approval by applicable agencies would be required for implementation of this function. The 211th Street station belongs to an inter-station group with Matteson. An interconnected PMS could direct customers from full lots at 211th Street to available parking at Matteson. Matteson has two large lots (557 and 202 spaces) on opposite sides of elevated railroad tracks. Access between lots is available via Front Street. Matteson would be a good candidate for a PMS based on its parking lot configuration, although its overall score is
low because it lacks SRA or expressway access. Daily ridership in 1997 averaged 1,159 boardings.

**Lake-Cook Road** (Milwaukee District North): Lake-Cook Road is a newly constructed park-and-ride facility near key intersections on three major highways that provide parallel service to the rail line. The highways include Interstate 294 (Tri-State Tollway), Waukegan Road (Illinois Route 43), and U.S. 41 / Interstate 94 (Edens Expressway). As such, Lake-Cook Road provides opportunities for the integration of an external PMS with expressway and tollway variable message signs. As with other locations, policy approval by applicable agencies would be required for implementation of this function. Daily ridership in 1999 averaged 1,128 boardings.

### 3.3.3. High Priority Category 1 Locations

**Hanover Park** (Metra Milwaukee District West): Hanover Park is part of the Lake Street / Irving Park Road inter-station group. The station has 731 daily fee parking spaces in four lots. Four additional lots are reserved for permit holders. Parking occupancy is 96% on the average weekday. Potentially in combination with Bartlett, a Medium Priority Location, a PMS could direct customers to the Schaumburg station when lots are full. The internal layout of the Schaumburg station provides a favorable opportunity for the development of an internal PMS and may be useful as a demonstration site that could be expanded into an inter-station group. Overall, the Lake Street / Irving Park Road inter-station group ranks fourth out of five groups in terms of average station score. Daily ridership in 1997 averaged 1,460 boardings.

**Mount Prospect** (Metra Union Pacific Northwest): Mount Prospect is part of the Northwest Highway inter-station group. With 819 spaces distributed over seven lots (one is reserved for permit holders only), Mount Prospect typifies the Scattered Surface Lot category. Two lots along Northwest Highway contain 302 daily fee spaces. An additional daily fee lot south of the station contains 114 spaces. A PMS could direct customers between lots with available parking and, by connecting with PMS at other locations in the corridor, could direct users between stations with available parking. To function as part of an interconnected system, PMS would need to be implemented at one or more of the other locations as well. Daily ridership in 1997 averaged 1,754 boardings.
4. IMPLEMENTATION PLAN

This section presents guidelines for PMS implementation. These follow the requirements of Title 23 of the Code of Federal Regulations, Part 655, sub-part D (also known as 23 CFR 655d), which typically serves as a basis for provision of Federal funding for transportation management projects, including ITS activities. The Implementation Plan includes the following elements:

1. Legislation – Summary of legislation and jurisdictional compliance to permit the necessary parking management and information activities identified in this and other study documents.

2. System Design Considerations – Reviews specific field design issues based on the three categories of implementation defined in Sections 2 and 3 of this report.

3. Procurement Methods – Determines the appropriate methods or alternatives to be considered for deployment of the PMS. This also includes those activities required in support of review and evaluation of PMS activities.

4. Construction Management Procedures – Provides guidance for oversight of PMS implementation, including relationships between the service boards and contracted system managers or integrators.

5. System Start-Up – Provides guidelines for acceptance testing, stages of installation (including phasing of system installation, documentation and training, operational support, and media interface activities).

6. Operations and Maintenance – Provides guidance in identifying operations and maintenance activities and alternatives for performing or contracting system maintenance activities.


4.1. Legislation

The following sections provide an initial assessment of the types of activities where changes to current local ordinances and laws may be required in support of PMS activities.
4.1.1. Sign Placement

While legislation may not be required, it will be necessary to receive permission to place PMS signage on non-Service Board property or right-of-way. PMS signage design standards, while they must initially be derived from principles identified in the Manual on Uniform Traffic Control Devices (MUTCD), may need to be modified in order to conform to local sign ordinances and aesthetic requirements.

4.1.2. Support of ITS Activities at the Local and State Level

Local and regional support of ITS activities will be necessary in order to enact the programs and projects herein, regardless of funding source. The PMS design is being developed in a coordinated fashion with other public transit-oriented ITS activities in the region, and supports both the GCM Corridor ITS Strategic Plan and the ultimate configuration of the GCM Corridor Multi-Modal Traveler Information System. To assure that this is accomplished, the GCM Corridor Steering Committee will need to formally incorporate specific public transportation information requirements for future implementation into the Gateway Traveler Information Pipeline currently being deployed.

In doing this, it will be necessary for the RTA and the three service boards to agree to a coordinated regional transit ITS architecture and adoption of information exchange standards. The U.S. Department of Transportation has recently identified the ATIS Data Dictionary and 16 other information and communications standards as the basis for future ITS deployments in the U.S.

4.2. System Design Considerations

The following system design elements are essential for development of field and central design of PMS components. These should be a part of every PMS deployment (for one or more stations or for central component procurements).

- Identify responsibilities and methodologies for system design and system implementation.
- Define basic design parameters, including design life of the system.
- Geographical and operational coverage of the specific project elements must be established.
- Theory of operation for specific project elements, along with overall operational scheme for regional system; relate elements being procured into larger system framework.
- Project subsystem architecture is required as a basis for software, hardware and communications design and procurement.
• Design documents must identify how components developed by specific projects will integrate with other activities and the overall regional ITS architecture.

• System communications elements within the project subsystem architecture must be identified along with elements that interface with other systems as well as the overall regional ITS architecture.

• Minimum functional requirements and functional design elements to be incorporated into the individual project must be identified.

• Project phasing, design and implementation schedule is to be developed as a basis for project monitoring and updates.

The above elements should be incorporated into each work scope related to design of a specific PMS implementation.

4.2.1. System Design Overview

4.2.1.1. General Nature of Design Activities

The procurement of design services, as covered in the Code of Federal Regulations, Title 23, Part 172 (23 CFR 173), has traditionally required, for Federally-funded state and local procurements, a strict separation of services associated with “design and engineering” from those associated with construction and operation of the system. Although this has worked well for traditional low-bid construction contracts, there are additional complexities for implementation of ITS activities. This is given the dynamic nature of technology development as well as the higher degree of subjectivity associated with operations and software-related activities versus traditional public works and equipment procurement activities.

4.2.1.2. Procurement Approaches and Impact on Design Activities

Section 4.3 presents a more detailed examination of various overall system procurement approaches, including traditional Engineer-Contractor procurements along with System Manager/System Integrator, and Design-Build procurements. The initial demonstration project, along with all deployments that follow, need to include the activities below, reflecting the considerations presented above. It is noted that the initial demonstration project may provide the basis for future activities; future deployments may present revisions or updates to the basic components presented below, particularly as they relate to local system configuration and interfaces with other components.

• Requirements analysis

• Technology trade-off analysis

• System architecture development
- Field component design
- Cost estimates
- Software design
- Communications interface design
- Development of contract procurement documents

The design of the PMS projects should follow the above requirements-based approach utilizing this and other PMS Study Documents as the framework. The difference in the various approaches to be examined in Section 4.3 include identifying the level of detail required as well as specific responsibilities associated with preliminary and functional design efforts (already completed for the PMS) versus detailed design specifications and contract documents.

4.2.1.3. System Design Life

The lifespan of different ITS components depends on the nature of the technologies, environmental conditions, and developing standards that may force obsolescence on components currently on the market. The advent of communications and interface standards through such activities as the National Transportation Communications for ITS Protocol (NTCIP) effort will require different compatibility standards for both central and field components.

Candidate technologies related to several of the basic architecture components (reviewed in Section 1.1.2) are summarized below along with their estimated design life. This information assists in establishing both annual operations and maintenance costs, along with the frequency of capital outlays. This is especially an issue if capital outlays are required at relatively frequent intervals in order to replace a component due to wear and tear (e.g., detectors), or due to upgrades and changes in computer systems (e.g., replacement needed due to changes in currently-available operating systems and compatible software).

**Variable Message Signs**

- Display and hardware (10 years)
- Replace bulbs/LED’s (2-5 years depending on level of use)
- Control computer (5 years)
- Control software (5 years)
System Database / Processing

- System computer hardware (3-5 years)
- Software (upgrades every 2-3 years)

Controller Hardware / Software

- PMS Controller hardware (5-10 years, assuming Model 2070 or equivalent device)
- PMS software / firmware (5-10 years)

Parking Monitoring Sensors

- In-pavement sensors (5 years)
- Non-intrusive sensors (5-10 years)
- Video processors
  - Camera (5-10 years)
  - Computer (3-5 years)
  - Software (upgrades 2-3 years)

Above data is based on review of ITS National Architecture documents along with representative experience of systems in Illinois, California, New York, Florida, and other regions. Some technologies do not have substantial operating experience to determine expected replacement frequency; physical deterioration is generally a problem with field equipment and physical components receiving heavy repeated use, obsolescence is largely due to technological advancements and changes in standards rather than physical deterioration.

4.2.1.4. System Coverage

PMS are recommended for implementation in the fashion identified in Sections 2 and 3. System coverage may be defined in two basic ways:

1. Coverage of PMS at the individual transit facility, defined in terms of the local roadway network and parking lot configuration (sign locations, communications routings or wireless links)
2. Connectivity of PMS installations at multiple transit facilities, networked into regional transit ITS telecommunications scheme based on the concept of centrally-implemented transit hub computers.

As it is not expected that all (or even most) transit facilities would eventually have PMS implemented, it is not expected that the coverage will be “global”. However, the connection between the stations and the Service board hub, the Service Board and Northeastern Illinois (RTA) Transit Hub, and between the RTA hub and the GCM Gateway, will provide a data exchange capability that is regional in nature.

4.2.1.5. Nature of Deployment

Section 3.1 presented phased “building blocks” that are essential in allowing one or more PMS implementations, particularly for inter-station groups, to be deployed in a logical manner that maximizes the benefits provided at any stage of deployment. Given that the PMS, as a relatively unfamiliar type of transportation activity associated with public transit, may be under close scrutiny by public sector officials (including elected officials), the delivery of incremental benefits commensurate with the incremental deployment of the PMS is critical.

The benefits of the PMS will be first shown through one or more station demonstrations of the PMS system. Other elements and information exchange capabilities will be implemented when the system is later deployed on a wider basis.

4.2.1.6. Strategic Deployment of PMS

The deployment locations and general implementation strategy for the PMS was discussed in Sections 2 and 3 of this report. The process of implementation may be summarized as follows based on the general implementation strategy:

Demonstration Sites

1. Selection of several demonstration sites (Service Boards, RTA)
2. Develop PMS operations plan for demonstration site, identify initial sign locations and display schemes; develop evaluation plan
3. Prepare design package (detailed field and communications plans and specifications, control system requirements and specification). For the first demonstration, this will involve development of system software that would be the basis for other PMS deployments in the future. For implementations that follow, upgrades to the software may be incorporated as required.
4. Award construction and software contracts
5. Operate and evaluate
Inter-station Groups - Deployment of High-Priority Locations

1. Prepare traffic impact analysis identifying potential impacts of redirecting traffic to other parking facilities. Identify means of mitigating potential delay or safety issues.

2. Develop PMS operations plan for site along with inter-station operations strategy based on the results of #1; develop evaluation plan

3. Prepare design package (detailed field and communications plans and specifications, control system requirements and specification)

4. Develop design package that integrates information exchange capabilities within the framework of the Service Board transit hub. For inter-station deployment, this will involve implementation of appropriate central software schemes and data exchange capabilities.

5. Award construction and software contracts

6. Operate and evaluate

4.2.2. System Design And Operations / Maintenance Philosophy

The primary operational concept for the PMS has three levels:

- Identify the availability of parking at and within specific parking lots located in the vicinity of a transit station, and provide this information to travelers planning on using that station

- If parking is not available at the station, identifying an alternate location where parking is available and the same service is being provided to the traveler’s destination

- Identify the time to the next train or bus arrival in order to assist in parking space selection or reassure the traveler regarding making the train or bus on time

- Provide traffic information on alternate modes and routes in conjunction with providing information on available parking at the transit station, thus potentially encouraging use of transit

As part of the last two functions of the system described above, exchange of information between a local PMS, other station PMS’s, and other transit and transportation agencies is required. This would be accomplished through connection of all PMS’s supporting a particular service board to a service board transit hub, along with connecting the service board hubs to the RTA Transit Hub and thus to the GCM Gateway.
The information exchanged will include parking lot availability, transit vehicle location/arrival time, congestion on freeways/tollways, and text advisories associated with delays or other changes of service. This information exchange will require linking to the ATSS and GCM Gateway. These other systems will use information provided from the PMS for signs under their authority. Likewise, PMS will provide information from others on its sign as determined through ongoing message plan development.

4.2.2.1. Operations and Maintenance

The nature of PMS, due to the distributed nature of its activities (e.g., much of the data collection will occur in the vicinity of the station and will directly drive the type of messages provided) would be that of an automated system. At the same time, it is recognized that no ITS system operates “by itself.”

The principal implementation, operational and maintenance responsibilities of each PMS installation for different types of facilities should be carried out by one of the three service boards, as summarized in Table 4.1.

Table 4.1: Recommended Operations Agencies

<table>
<thead>
<tr>
<th>Facility, Primary Service</th>
<th>Other Services</th>
<th>Recommended Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metra Rail Station</td>
<td>CTA or Pace buses</td>
<td>Metra</td>
</tr>
<tr>
<td>CTA Rail Station</td>
<td>CTA or Pace buses</td>
<td>CTA</td>
</tr>
<tr>
<td>Metra and CTA Rail</td>
<td>CTA or Pace buses</td>
<td>Select either CTA or Metra</td>
</tr>
<tr>
<td>Bus-only Park n’ Ride</td>
<td>CTA or Pace buses</td>
<td>CTA (city); Pace (suburbs)</td>
</tr>
</tbody>
</table>

PMS’s operated by specific service boards would eventually be connected into that agency’s transit hub, where it would then be networked to the Illinois Transit Hub, and in turn to the GCM Corridor.

Operations and maintenance will be facilitated through the standardization of specific components, including technologies such as LED display modules and internal hardware, system control hardware and software, and, most importantly, definition of standard communication interfaces for PMS information between the Service Board Hubs and the Local PMS Controller.
Although it is not expected that manual operations will be utilized on a regular basis, the following represent situations where a “human override” of automated displays would be appropriate:

- Display of advisory messages involving delays or alternations in normal transit service (for signs on roadways with line matrix or full-matrix displays, well in advance of specific transit parking lots). This would require override capabilities located at the main service board management facility where their hub is implemented. The operational strategy would be downloaded to the Local PMS Controller.

- Specific localized parking guidance messages (e.g., closure of a parking lot even if spaces are available or it is not in use). This would be done through remote connection by designated operations / maintenance staff (e.g. via a laptop computer), or network dial-in by operators located at the main service board management facility where their hub is implemented.

In considering human override capabilities, the local jurisdiction (e.g., city or village) may have certain policies that may need to implemented. Thus, the operational strategy may differ between PMS installations.

4.2.3. System Architecture

The system architecture framework depicted in Section 1 of this report should be the basis for detailed design activities. Given that the PMS implementation will consist of initial demonstrations followed by additional deployments, it is important that the following common elements be established:

- Sign display and operational standards, permitting interchangeability of components between locations, regardless of service board operation. This would require a board level specification, along with specification of interfaces and connection hardware.

- Data interface between local PMS Controller (system database / processing capability) and Service Board Hub. The information exchanged will include parking lot availability, transit vehicle location/arrival time, congestion on freeways/tollways, and text advisories associated with delays or other changes of service.
• Data Interface between parking monitoring sensors and local PMS operations computer (system database / processing capability). This would include the following:

- Vehicles entering (previous $n$ minute interval) lot $y$ entrance
- Vehicles departing (previous $n$ minute interval) lot $y$ entrance
- Vehicles entering (previous $n$ minute interval) lot zone ($x_y$)
- Vehicles departing (previous $n$ minute interval) lot zone ($x_y$)

…where $n$ is the time interval between system updates, $y$ represents a specific lot identification and ($x_y$) represents any lot zone (aisle or floor) identifier $x$ within lot $y$.

• Interface between local PMS operations computer (system database / processing capability) and variable message signs (VMS). Recommendation is for use of the National Transportation Communications / ITS Protocol (NTCIP), Class B with Dynamic Messaging Objects as presented in NEMA standard TS 3.6. This would assure interoperability of signs regardless of vendor. This would also permit other devices (e.g. Highway Advisory Radio (HAR) transmitters and messaging systems) to be supported.

• “Portable” software modules to be implemented where specifically required by the local PMS implementation. These portable software modules are to include the following:

- software which relates the data from the parking facilities to specific sign messages to be displayed, as well as future means of dissemination (e.g., highway advisory radio)

- software that obtains messages provided from the Transit Hub / GCM which reflect parking conditions at other stations or traffic conditions on alternate routes, and displays the information in message form on those signs which provide the capability to display full text messages; support of future means of dissemination (e.g., highway advisory radio) will be provided

• Transit hub software will support the exchange interfaces developed above, and will permit information from adjoining parking lots within an inter-station group to be exchanged and utilized as part of local PMS messages.
4.2.3.1. Standards/Interfaces/Communications

Appropriate standards are vital to the development of an open ITS architecture. Standards enable the deployment of consistent, non-interfering, reliable systems at the local and regional levels as well as at the national level. Standards also provide for more competition; the fewer proprietary elements, the less control one manufacturer has on a product, therefore increasing competition through price and features.

ITS standards recommended as a basis for the system architecture are described below, based on the comparison completed earlier in the study as part of the architecture development activities.

National Transportation Communications for ITS Protocol (NTCIP)

The NTCIP allows the use of multiple vendors for various ITS technologies, since all will be required to follow the same communications protocol. The NTCIP is based upon a suite of international recognized communication protocols. The following parts of the overall NTCIP standard are planned and/or published by the National Electrical Manufacturers Association (NEMA):

In addition, there is a subset of the NTCIP related to this project, the Transit Communications Interface Profiles (TCIP). These profiles shall be adopted where appropriate and when available in order to provide conformity with Federal guidelines and to provide for an open-system design for the PMS.

Controller and Other Hardware Standards

Given that the PMS configuration will likely be standardized across the region, it is recommended that open hardware standards be utilized for Local PMS Controllers, server interfaces, and communications components. Some standards to be considered include:

- Model 2070 Advanced Traffic Controller standards developed by several states and the Electronic Industries Association (EIA). These include standard back panel connections using RS-232 and other EIA standards.

- Standardized EIA rack-mounted sensor amplifiers. This would be required regardless of the detection technology used (e.g. loop, infrared, radar, or video imaging).

Other ITS Standards

**Database Standards:** It is important to use a standard database for all information storage and sharing, to allow for ease of data movement. For example, such query languages as SQL can be used to query from different, proprietary databases.

**User Interface Standards:** It is important for system users to have consistent, well-known interfaces when dealing with the PMS. The typical Windows-based interface for operators would be a good, standard solution. Federal military specification MIL-STD-1472E provides a commonly followed standard for person-machine interfaces.

Communications Subsystems

For the development of individual project implementation plans, communication schemes will need to be defined that provide compatibility with the entire architecture. To accomplish this, a preliminary communications topology should be developed as needed in order to provide initial deployment of ITS activities.

4.2.4. Project Phasing and Scheduling

Each of the Service Boards should utilize the guidance provided by Sections 2 and 3 of this document as the basis for selection of PMS implementation sites and development of implementation priority.

4.3. Procurement Methods

Traditional procurement and contract procedures used for public works activities are generally not well suited to the unique characteristics of ITS projects. ITS projects generally require extensive interagency cooperation and coordination. ITS projects involve the acquisition and placement of high-tech equipment that may require special procurement considerations. Public-private partnerships are sometimes used in order to accomplish activities such as traveler information. Therefore certain aspects of traditional procurement and contract procedures of the public agencies may have to be changed to accommodate ITS projects.

The recommended ITS elements for the PMS have characteristics to be addressed. This section identifies specifically the various options relative to procurement and contracting procedures of the proposed PMS.
4.3.1. Procurement Issues

4.3.1.1. The Move to Open Systems

Increasingly, the deployment of ITS requires procurement of software for different system components with other systems using standard protocols, and can be implemented on a standard operating platform (e.g. Windows, UNIX), often with other existing software. Further, the addition of other components should not alter the ability of existing elements to operate properly. (For example, the addition of a new printer to a local area network should not alter the operation of the computers or the other printers.) This requirement for “open” systems means that many existing software applications that are based on specific hardware platforms (such as closed-loop signal systems) or vendor-developed, proprietary programs (such as custom display maps not based on off-the-shelf geographic information platforms), need to be revised extensively. More often, public agencies want to maintain the rights to software ownership without the need to pay licensing fees for the specific ITS applications. This reduces the dependence of the public agency on single vendors and increases competitive opportunities for further enhancements to ITS programs.

4.3.1.2. Software Developers and System Vendor Concerns

Direct procurement of off-the-shelf software products that are proprietary in nature is one option. This can be successful and often financially prudent if the vendor is reputable and provides technically competent and timely maintenance support and upgrade of software as well as hardware projects. However, as the traffic control/management/information industry has changed and former defense and industrial firms have entered the field, many of the traditional vendors and system developers, along with their products, have either been merged into larger firms or are no longer as prominent.

Generally, a major concern for the developers of ITS products is being profitable. The aforementioned defense firms in general do not make nearly as much profit from the transportation projects as from defense or industrial systems engineering contracts. Conversely, the firms that have been involved in transportation systems software for many years may not be well prepared to develop larger-scale systems as may be required for ITS deployment. The use of National ITS Architecture (i.e., open systems) standards also reduces opportunities for profit associated with the licensing of proprietary software packages and communications protocols for agency use.

4.3.2. Activities Required For System Implementation

ITS projects are best deployed through a structured process based on well-defined functional requirements. The system architecture process used as part of the PMS preliminary design provides a very high-level, “big picture” view of how ITS should be deployed for the PMS. However, much greater detail is required after the preliminary design stage, as summarized below:
**Detailed Design (Field):** Finalizing of technical decisions for each system element, preparation of plans, specifications and estimates for each location(s), along with all necessary installation, testing, documentation and training requirements.

**System Design (Software/Computer/Communications Systems):** Finalizing of technical decisions for each system element, establishing detailed software requirements related to system operations and interfaces, including logical and physical architectures, interface and interconnection specifications and schematics.

**Software Development:** Writing or customization of software, as required for information sharing, local detector processing, VMS control, and other elements; integration of software/firmware with system hardware; integration of field components with communications network and central hardware (as required); development of system data base (as required); fine-tuning of control and information algorithms; and system start-up.

**Integration:** Integration of various separate control and operational modules into a single system, fully operational and meeting all the requirements identified during design (as required).

**Construction Technical Services:** Includes assisting the Service Board during pre-bid/pre-construction conferences, review of contractor submittal, providing technical advice to the Service Board, inspecting the construction/design activities, and making recommendations regarding contract changes.

**Acceptance Testing:** Review of technical information and test procedures submitted by contractors and vendors, observing and monitoring factory acceptance tests and other contract conducted tests specified in the contract documents, and conduct of the software and system acceptance tests.

**Training and Documentation:** Documentation on system operations and maintenance, and providing operational support to the Service Board during the initial period of system operation.

**Liaison Assistance:** Preparation and presentation of public information programs, and technical coordination with utilities and other ongoing ITS projects.

### 4.3.3. Alternative Procurement Methods

Five basic procurement options are available for ITS activities:

- Engineer/Contractor (“Low Bid”)
- Systems Manager
- Sole Source
- Design-Build (operate)
• Public/Private

4.3.3.1. Engineer (Consultant or Public Agency)/Contractor Approach

The Engineer (Consultant or Public Agency)/Contract method (“conventional” or “low bid” procurement) represents the traditional procedure used by public agencies for public works projects. Based on project requirements and preliminary studies, the Engineer prepares the final study and/or design plans, specifications and estimates (PS&E) for the proposed project. An agency employee or a consultant can act as the Engineer. The completed PS&E is then presented to the Contractor community and bids received in accordance with established procedures.

The Contractor bids on the PS&E and agrees to provide a complete system consisting of hardware and software – procured, installed and implemented by the Contractor. Hardware may be manufactured by the Contractor’s organization and/or subcontracted within the conditions imposed by the contract. The Contractor may also be responsible for system startup assistance. Also, the calibration of the system and the development and implementation of database elements may be required. The Engineer is responsible for inspecting and acceptance of project components and the entire system.

Effectively, the Engineer/Contractor method places the responsibility for overall project completion on the Owner rather than the system developer. The owner must oversee the system software developer/integrator (for which, increasingly, agencies are precluding firms who had done the prior design work), the general contractor (e.g., building requirements if any), and the electrical contractors (e.g., field equipment and communications). It becomes the agency’s responsibility to assure that all the pieces of the system are in place. The means to assure that this approach is successful include providing the appropriate staff continuity, including an agency project manager who is proficient in both administrative and technical skills. Given typical methods for agency technical staff, it can be difficult to impossible to provide the level of attention needed for this method. Likewise, consultants, acting as the “Engineer,” could be contractually at risk should the contractor activities not result in a successfully integrated system.

4.3.3.2. Systems Manager

The Systems Manager option requires the public agency to select a single firm or consulting team as Systems Manager. The Systems Manager (a software firm or system contractor) is responsible for system design, PS&E preparation, systems integration, documentation and training.

The project is divided into several components, each of which can be contracted by using the agency’s normal bidding processes. The Systems Manager oversees all work by the various contractors. The sub-project contractors can be selected on the basis of specific skills required for each sub-project. This permits the selection of experts for various steps of the system. The Systems Manager is responsible for integrating the sub-projects into an overall operating system.
The contract between an agency and the Systems Manager is a negotiated contract that allows contract flexibility when projects are refined. This procurement method assigns responsibility of total system success to one entity and creates an environment to more easily meet project requirements.

Conversely, a System Manager approach also means that the system developer or the system provider may also have been the designer of the project; in essence, the firm that develops the detailed requirements for the system may also provide a system that meets those requirements. This is of concern if the System Manager is known to rely on proprietary software and also requires a license by the Owner-Agency to operate the software.

4.3.3.3. Sole Source Approach

Sole Source procurement is used when there is documented existence of only one technical or cost effective solution to the requirements of a certain project. Sole Source procurement is most often used when compatibility with existing equipment and/or systems is required.

In the early stages of ITS system development, Sole Source procurement should not be necessary. In later stages of development, Sole Source procurement may need to be employed to ensure system-wide compatibility, especially if specific products or systems are only available from one source.

As standards for hardware and software interfaces are developed, Sole Source procurement should become less and less necessary, unless the component provides particularly unique functionality that is necessary for system operations.

4.3.3.4. Design-Build/Design-Build-Operate Approaches

The Design-Build approach provides a great deal more flexibility in the system and software design and implementation alternatives than presented in the previous alternatives. In addition, a Design-Build-Operate procurement permits the selected contractor to operate and maintain the system for a fixed amount of time, relieving agency staff from additional, often unfamiliar responsibilities, as well as mitigating the effects of staff hiring freezes due to budget constraints. However, the Design-Build approach is generally used for large systems, not systems at the scale of a local PMS.

Design-Build contracts are based on a clear set of functional requirements defined by the agency or an agency’s consultant. The Design-Build Contractor develops detailed location and design plans and specifications for development of system hardware and software, and is responsible for constructing the system based on the detailed plans and specifications. The agency (either directly or through a General Engineering Consultant, who may be involved in construction inspection and review of acceptance testing) oversees the Contractor’s work to assure it meets the functional requirements in a satisfactory manner.
Very often, this type of procurement will involve multiple agencies. One such procurement in the Salt Lake City region will involve the Utah Department of Transportation, Salt Lake City and Salt Lake County. The project will utilize public domain software obtained from Georgia Department of Transportation for freeway management applications. Public domain signal system software will be developed to operate on City, County and State traffic platforms, allowing full compatibility and interoperability between the different agencies.

4.3.3.5. Public/Private Approach

This approach establishes a Public/Private partnership for financing and implementation of a project. Several ITS projects have utilized Public/Private partnerships. The majority of these projects solicit private funding and operations of projects to encourage early development and deployment of ITS activities that are not deemed to be appropriate public agency activities (e.g., in-vehicle systems integrated with real-time traffic data sources).

The Model Deployment Initiatives (MDI) and Traveler Information Showcase projects in Atlanta and Washington, DC are examples of Public/Private partnerships. These will often involve privately-operated services that receive public subsidies, e.g., the SmarTraveler program in the Washington, DC area and in Boston, MA.

There have been several deployments of traveler information systems that have utilized procurement of services (e.g., SmartRoutes, Metro Traffic, and others). Incorporated with these services has been proprietary software that creates a multi-modal, multi-agency travel information clearinghouse of real-time information. However, in most cases, the contracts for providing these services and software are limited, and replacement of the traveler information service provider often in turn requires replacement of the traveler information systems as well.

In deciding to contract traveler information services out fully, care needs to be taken to assure that interfaces from traffic management systems as well as to the media are well-defined, such that the traveler information service provider components are truly modular relative to other system components. To be more specific, traffic management and media users do not need to revise their software and hardware.

Each proposed Public/Private partnership activity must be addressed individually to assess whether issues exist such as conflict of interest or unfair competitive advantage for the partnership member. Many projects (including operation of TMC’s, management and operation of traveler information services) may appear to be good candidates for a Public/Private partnership. Creativity and close study of regulations will be needed to insure Public/Private partnerships are viable projects that have benefits for all involved parties.
4.3.4. Evaluation Of Procurement Options

The above section presented a summary of activities required for system implementation. The various procurement options presented previously address these activities in different ways – the notable differences being the extent of responsibility throughout the deployment process.

Table 4.2 compares each procurement option in terms of the implementation activities carried out.

**Table 4.2 Comparison of Procurement Options**

<table>
<thead>
<tr>
<th>Implementation Activity</th>
<th>Engineer/Contractor</th>
<th>System Manager</th>
<th>Design-Build</th>
<th>Sole Source</th>
<th>Public/Private Partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept Design</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Preliminary Design</td>
<td>E</td>
<td>• or E</td>
<td>E</td>
<td>E</td>
<td>• or E</td>
</tr>
<tr>
<td>Detailed Design (Field)</td>
<td>E</td>
<td>•</td>
<td>•</td>
<td>• or E</td>
<td>• or E</td>
</tr>
<tr>
<td>System Design (Software Coms)</td>
<td>E</td>
<td>•</td>
<td>•</td>
<td>• or E</td>
<td>SP / •</td>
</tr>
<tr>
<td>Software Development</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>SP / •</td>
</tr>
<tr>
<td>Integration</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>SP / •</td>
</tr>
<tr>
<td>Construction Tech Services</td>
<td>E</td>
<td>•</td>
<td>E / •</td>
<td>•</td>
<td>• / E / SP</td>
</tr>
<tr>
<td>Acceptance Testing</td>
<td>E</td>
<td>•</td>
<td>E / •</td>
<td>•</td>
<td>• / E / SP</td>
</tr>
<tr>
<td>Training/Documentation</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>• / SP</td>
</tr>
<tr>
<td>Liaison Assistance</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
</tbody>
</table>

• = By Procurement Contractor  
E = By Engineer (Either Agency or Consultant) *  
E / • = Involvement by Contractor and Engineer  
P = Separate Public Relations Firm/ Liaison Specialist  
SP = Private Firm ("Service Provider")

* May be same or different entity for each activity

In general, the Study Team’s experience indicates the following:

- Initial ITS deployments require an extensive definition of functional requirements and construction details (as required), as they are the basis for future work.

- Partnerships often help provide information flows that are necessary for efficient and effective ITS operations. Partnering with the GCM Gateway public agency/coalition is recommended. Public/private partnering arrangements are
typically best suited for operations contracts (discussed later in this Report) and development of traveler information services, whether collection/dissemination from a TMC, the information delivery, or user interface activities.

- “Low bid” procurement of standard products, e.g., variable message signs, detectors, is appropriate provided the items meet the Engineer’s specifications.

4.3.5. Recommended Procurement Approaches

In general, for new systems and establishment of new standards and interfaces, a combination of a Design Engineer and a Systems Manager assures both that an impartial requirements development effort is completed and that standard system components are designed. The Systems Manager would assure that the entire system is fully operational, thus reducing the levels of coordination that are needed for completion. Some electrical contracting and telecommunications work typically are procured through separate contracts based on the detailed specifications developed by the Systems Manager. The detailed specifications are based on the detailed requirements and preliminary design completed by the design engineer.

4.4. Construction Management

Management of the PMS implementation must address the following:

- Installation, approval and acceptance responsibilities
- Scheduling and progress monitoring
- Mitigation of conflicts or potential issues
- Coordination with other projects.

4.4.1. Definition of Responsibilities

Each procurement approach identified in the previous section has a number of implications related to agency oversight. In general, each PMS installation will need to be managed by the Service Board whose facility is being supported by the PMS. Recognizing that the technical expertise and skills associated with implementation of roadside ITS components (as well as parking facilities) are not typically found within the Service Boards (since they differ from the principal functions of these agencies), it is recommended that an ITS design and oversight engineer (potentially a consultant) be utilized by the Service Board implementing the specific PMS project.
This engineer would supervise and oversee the System Manager’s software development and integration as well as hardware procurement and installation (possibly done by an electrical contractor, along with integration of the central systems). Illinois Tollway and other agencies in the U.S. have been using this approach in implementation of ITS systems.

Each PMS project will be required to identify, consistent with the format of this Implementation Plan, a definition of specific agency staff responsibilities, developed for the one or more agencies that may be involved in that specific project.

Further, given that there is a certain degree of uniformity associated with the standards being developed in this Study, it will be important for the RTA to be involved in the review and implementation process, such that regional standards and interfaces are being followed.

Demonstration Projects

For the initial PMS demonstrations, the RTA and service board(s) involved must take the lead as the operating agencies. Under the proposed System Manager approach for the software portions of the “Test” deployment(s), the designated “Lead” Agencies would review and coordinate with the selected System Manager in development of the software design. The design engineer will develop the installation details for field elements and produce an RFP for a qualified contractor. The Service Board (as lead agency) would utilize the design engineer to provide oversight of the System Manager and any field installation contractors in order to assume that the system design requirements are met.

Agency staff (or Design Consultant) requirements with respect to construction management include the following:

- Provide project manager for contract(s)
- Review proposals and select System Manager based on technical qualifications and cost estimate
- Review and approve detailed design submittals, including equipment specifications and samples
- Process payments for contractor
- Work with System Manager on development of an Integration Plan (an example is shown in Figure 4.1)
- Attend construction meetings, supervise acceptance testing of hardware and software (based on distant milestones)
- Review and verify field testing and integration testing results
Ultimately, the System Manager is responsible for insuring that a fully functional and satisfactory product is delivered. However, the Agency (or its Consultant) is responsible for identifying the functional, operational, maintenance, environmental and other requirements in a manner that permits verification and testing of the system. If these are not adequate, the system is not adequate.

4.4.2. Scheduling

Project scheduling must be developed as part of all design activities. The Contractor’s schedule must be developed in a manner that is consistent with deadlines of other system deployments and legislative deadlines related to availability of funds.

If the general construction contractors are properly monitored and schedules clearly defined, the field deployment of PMS elements can be readily accomplished. However, this will require strong oversight.

4.4.3. Conflict Mitigation

The recommended procurement approach should minimize the potential for conflicts that can occur when multiple parties are involved in the development and execution of a project of this scope. System acceptance tests should seek to isolate system operation and integration problems down to the subsystem or component level so that responsibility for the problem is clear and energy can focus on corrective action and not on the assignment of blame. Careful project scheduling by the System Manager in conjunction with the Service Board and its engineer will help to minimize conflicts brought about by conflicting participant schedules and resulting delays to one or more parties.

In order to improve the working relationship of all contractors along with Agency staff involved in this project, typical projects of this nature are undertaken through a “partnership” approach. This approach involves all of the participants meeting at the outset of the project, clearly defining their goals for the project, agreeing on methods of conflict resolution and entering into a formal “agreement” with regard to commitment to the conflict mitigation process.

4.4.4. Coordination with Other Projects

As discussed elsewhere in this study, the PMS demonstration will initially be a “stand alone” effort, although the individual components developed in this effort will be the basis for future similar efforts. As these systems are expanded, the use of interface standards and the larger regional transit ITS architecture framework will assist in assuring compatibility between different components.
The work underway by the service boards involving automatic vehicle location systems will not directly impact PMS development, except that the AVL information eventually provided will support display of advisory and routing information. Additionally, a regional system framework consolidating similar ATSS and PMS activities has been developed as part of the concept design process. This is illustrated in Figure 4.2, and represents the basis for development of common communications links and server schemes.

Each PMS installation will add a portion of communications infrastructure required to support central communications. Developing a process in the PMS Demonstration projects for selection of specific communication technologies at a local level will reduce headaches and aid further PMS deployment.

Coordination with IDOT and ISTHA

Part of the PMS implementation effort at selected locations (notably Metra’s Route 59 station on the BNSF Division line and the CTA Cumberland station) will involve coordinating information presented by the IDOT and Illinois State Toll Highway Authority (ISTA) traffic management systems. Both agencies have or are implementing changeable message signs. Part of the success of the PMS deployment may be measured in its ability to draw transit users through providing comparative travel time information and advising that parking at the transit facility is available.

It is recommended that such coordination occur within the framework of the GCM Corridor, in particular the Variable Message Sign committee.

Figure 4.2: Regional Transit ITS Framework Incorporating ATSS and PMS
4.5. System Start-Up Plan

This section will address several key issues associated with the start-up of new ITS components – acceptance testing of system components, the transition process between existing and new systems (where applicable), documentation and training requirements, operational support and media coordination. References in this section to “Agency” refer to the entity or entities responsible for contracting the implementation.

4.5.1.1. System Testing

The testing of ITS components, both in a stand-alone and integrated system environment, represents a critical stage in the process of ITS installation. In addition to providing a tool that measures whether the system meets design criteria and expectations, it is necessary to establish that the work also meets contractual obligations and, if not, the remedial actions required.

Testing requirements and procedures shall be developed by the Systems Manager, Procurement Contractor, or Design-Build Contractor and be reviewed and approved by the Agency. Actual testing is conducted by the Contractor, with oversight from Agency staff. Basic categories of acceptance testing include:

- **Equipment Information:** Review of equipment lists, catalog cuts and shop drawings, etc.

- **Pre-installation Tests:** All electronic components are pre-tested prior to delivery for installation in the field or at the central site or certified by the Contractor. The Agency is notified prior to the testing of this equipment so they can be present. Test results shall be approved by the Agency in full prior to installation.

- **Component Tests:** After installation, system components and assemblies will be tested on an individual basis to verify proper operation. This may be done either as an individual piece of equipment or in a sub-system environment.

- **System Acceptance Test:** The integrated components of a construction package will be tested after integration into the system to determine reliability and performance at the system level. All development of software, firmware, and user interfaces shall be thoroughly tested. System test plans will be developed for review and approval by the Agency. These test plans will be the mechanism by which the Agency reviews and ultimately approves, the contract work and the completed, fully-operational system.
4.5.1.2. Documentation

To fully utilize the capabilities of all new ITS components, each project must include activities that assure the subsystems are fully documented and staff trained in their operation and maintenance.

Documentation for all field and central hardware and commercially available software incorporated into the system should be acquired. This documentation should consist of the individual hardware product manuals and commercial software manuals developed by each of the manufacturers/suppliers.

All central system software shall also be fully documented. The Contractor, System Manager or Design-Build Team shall develop a User’s Manual, designed for use by both engineering and technical personnel to clearly define the theory of operations for each system and related components. Topics shall include, but not be limited to, the development and implementation of system control strategies, including preplanned and automated response plans, special events, all control algorithms and software routines and their interdependencies. The User’s Manual shall also contain the step-by-step procedures necessary to exercise the various functions of the system.

Database Development and Maintenance Manuals shall also be developed when necessary. Full documentation of the use of the database editor, and all database entries, is required for the system to be properly utilized. For object-oriented database programs, the characteristics and interfaces of each system object must be clearly defined.

Other manuals shall be required for all special features and functions. Copies of manuals, as appropriate, shall be provided to each system user (i.e., workstation). Technical special provisions for the procurement documents must require Contractors/System Managers/Design-Build Teams to also provide documentation on all ITS equipment provided, including the following:

- Operations and maintenance manuals
- Wiring diagrams and electrical schematics
- As-built plans.

4.5.1.3. Training

The specifications for all ITS projects shall require the contractors/vendors to provide technical training to Agency operations and maintenance staff for all field and central hardware installed. Training should consist of formal classroom lectures as well as “hands on” training. At least two training sessions – each one similar in content and lasting 1 to 2 days – should be provided for each equipment category, thereby ensuring that all staff receives the appropriate training.
The training sessions must provide basic understanding of the equipment/subsystems provided for the specific projects and their operational and maintenance requirements. The sessions should include the following:

- Background on concepts of the equipment/subsystem, and theory of operation
- Functional description of subsystem equipment components. Procedures for installing and setting up equipment and components. Basic troubleshooting and fault determination procedures.
- Procedures for “mail-in” repairs
- Preventative maintenance procedures and schedules

All training shall be supplemented with appropriate, professionally-made training tapes that can be used for future staff training.

The Contractor shall be responsible for providing training on all system hardware delivered, including basic operation, maintenance requirements and repair procedures. The training courses on all aspects of the operation and maintenance of the field components (e.g., VMS and detection equipment) to be supplied as part of the project should be conducted by representatives of the controller hardware and software supplier(s) and manufacturer(s). The training course should be held at the maintaining agency’s maintenance shop.

Training on communications equipment shall include all aspects of the installation, operation and maintenance of the field, control and test equipment furnished for the project.

4.5.1.4. Operational Support and Warranties

Support by the developer of subsystems developed under each project should be required by the operating agency. Any system control software should be updated on a regular basis to take advantage of new techniques and features and to resolve inconsistencies in operation that may become obvious after initial implementation. Changes in operating system and upgrades in hardware may also require software updates.

One approach to the assurance of continued support after the implementation of the system is the selection of system developers with an established history in the systems field – a firm that is likely to remain in existence throughout the design life of the new system. The procurement contract should thus be structured to provide for a period of technical support beyond the initial contract phase to install the system.

System software may either be customized off-the-shelf products in the public domain, or may be fully proprietary. To assure that operational support is available with or without technical support contracts, the Agency should require that the source code for the new system be provided to the Agency. Proprietary software should be maintained
“in escrow,” thus providing a level of protection to the Agency should the system developer cease operations or support of the software. In any case, the source code should be available to any RTA service board for utilization by another system developer in the event of upgrades or component replacements.

Hardware items shall be provided with the standard warranty as provided applicable agency purchasing guidelines. In addition, software suppliers should be required to provide future upgrades at no charge for a specified period of time after installation.

4.5.1.5. Coordination with the Media and Public

The PMS should be a recognizable part of RTA’s ITS development effort for Chicago area transit systems. Clearly, deployment of the VMS at transit station parking lots will be a visible allocation of public funds. The PMS should be looked at as a visible public resource; education and informational material should be developed for public consumption. The RTA may want to use existing Public Relations staff or contractors for this effort. Activities may include the following:

Media Releases Announcing Project Activities

Media releases may be prepared and distributed through normal agency channels at the time project contracts are initially signed and at substantial completion of the project. These should inform as to what the project is expected to accomplish (directions to available parking spaces at current or nearby transit station). Media releases may also be developed to provide “progress updates” on specific projects of public interest.

Coordination of Permanent TMC Deployment

Deployment of the “Test” PMS deployment and of the complete PMS should provide opportunities for major media events. Media releases and “media event” activities should be coordinated through the media consultant mentioned above.

4.6. Operations and Maintenance Plans

The concept of PMS operation for the RTA and its service boards is to have a system with coordinated real-time signage that provides information to make riding transit a more efficient experience. To accomplish this, it is recognized that certain PMS functions are “full-time” in nature, while others may be oriented to recurring or non-recurring congestion (peak hour traffic), as well as scheduled special events or construction activities.

Operation and maintenance of the system must be oriented to maintaining the basic services required to provide benefits to the public, even if certain system elements fail or operate less than optimally.
4.6.1. OPERATIONS

The following activities will be carried out through the deployment of ITS projects as discussed in this report:

Table 4.3: Deployment Activities

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>NATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing parking lot availability information to the public</td>
<td>Full-time during parking lot operating hours</td>
</tr>
<tr>
<td>Providing traffic advisory messages/ information</td>
<td>Non-recurring conditions, events, construction</td>
</tr>
<tr>
<td>Receive transit vehicle location information for potential display on PMS signs</td>
<td>During non-recurring conditions</td>
</tr>
<tr>
<td>Coordinated traffic response plans (control/advisory/rerouting), i.e., “Ride Transit / Parking Available”</td>
<td>Non-recurring conditions, events, construction, upon incident confirmation</td>
</tr>
<tr>
<td>Collection and processing of parking space availability data</td>
<td>Full-time during parking lot operating hours</td>
</tr>
</tbody>
</table>

In summary, operations of the PMS could be classified as follows:

Table 4.4: Operations Summary

<table>
<thead>
<tr>
<th>Function</th>
<th>Operations Staff Needed?</th>
<th>Operational Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking Information</td>
<td>No (unless manual control is desired; use existing staff?) Central operations staff</td>
<td>Parking Lot hours Operating hours</td>
</tr>
<tr>
<td>Traffic Advisory</td>
<td>Yes (For response plans)</td>
<td>Non-recurring conditions events, construction</td>
</tr>
</tbody>
</table>

4.6.1.1. Operations Staff

Operations to control and monitor the PMS elements should be available during peak daily travel periods along with scheduled special events and scheduled construction activities that may cause congestion and require traffic re-routing or increased transit usage for limited periods.
Hours of operation are recommended to be those of the parking lots. Additional hours during major events near stations and for unusual construction activities requiring temporary re-routing and traffic control strategies are also recommended.

4.6.1.2. Interface With Other Services

The PMS will complement the ATSS by providing two major components of transit-related information. Coordination between the systems will be required from an administrative and policy standpoint. Additional coordination with other Gateway agencies may be required in order to provide information in response to incidents on Tollways or Freeways, for example.

4.6.2. MAINTENANCE PLAN

An effective maintenance plan is essential for effective PMS operations. The system architecture will be composed of physical components which collect and process system performance data; communication systems to transmit and receive data; and components, many deployed in the field, which provide advisory displays, and assist in delivery of information to the traveler. All of these components will require maintenance, both centrally and in the field, such as variable message signs and traffic sensors. Communications equipment associated with hardwire, leased-line and wireless media will need to be maintained as well.

Three types of maintenance activities should be considered in the development of system maintenance plans for the components implemented under the various proposed PMS components:

**Functional:** This category involves the continuing effort of updating system data bases, optimizing signage plans or automated response plans, and improving communication data flows between central and other system users. This provides continuous enhancement of the system’s functional capabilities.

**Hardware:** This category involves the actual maintenance of physical components, primarily electronic, whether in the field or in an agency’s control room. The number of field components and the labor-intensive nature of these repairs makes this category a formidable task. This category also includes provision of a spare parts inventory.

**Software:** This third category is critical to successful system operation. It includes debugging of software, ongoing documentation, data base maintenance, and the maintenance of operating logs. In many ways this category is closely tied to the functional category.

4.6.2.1. Functional Maintenance Activities

The design of the various PMS components should be modular in nature. This modularity will separate various database and decision support elements from the
system computers ("servers") involved in actual device operation. The elements in turn are connected through a Wide- or Local Area Network (LAN). The advantage of this is that database and message plan revisions could be made without requiring system operations to be curtailed.

The provision of staff (operations and technical staff) to monitor and maintain the functionality of the system is crucial. Many systems have been implemented that provide resources and functionality that is often not used due to the lack of resources to provide adequate staff.

The staff mentioned above may be RTA or service board staff or contracted staff; the contracted staff would operate under the supervision of one or more of the region's operating agencies.

4.6.2.2. Software Maintenance

Software maintenance for various systems consists primarily of keeping the software updated as needed. To the extent written into the initial procurement contract, the original software developer can be made responsible for providing these upgrades. Beyond the initial contract budget, funds should be programmed to have the software supplier provide future upgrades as well as specific modifications requested by the operating agency after it gains system operating experience or as system requirements change.

To protect the investment in the new operating software in the event the software supplier becomes unable to support their product, it is crucial that the supplier provides source code and system documentation for any code that is proprietary, that code should be kept in an escrow account accessible only in the event the supplier cannot or will not provide the required support.

4.6.2.3. Maintenance Training

Thorough training of system operations and maintenance personnel is critical to the ultimate success of the system. Training should be provided both during initial deployment and at periodic intervals as new employees are added. This training should also be videotaped at the initial deployment phase and be made available for future training activities. Proper documentation of system maintenance requirements is also critical. Software logic and self diagnostics must be clearly documented and all required maintenance for hardware components must be clearly spelled out and followed by the maintaining agency.

4.6.2.4. Hardware Maintenance

Maintenance of system hardware involves both field and central elements. Field elements, depending on the procurement contract, may differ by manufacturer; however, specifications and standard installation details need to be developed prior to
installation activities. These activities assure that there will be operational and functional compatibility based on clear functional requirements and standard communications interfaces with central system operations.

In particular, VMS equipment can differ between vendors, even if the displays and communications interfaces are standardized. These differences are related to how displays are internally operated, and may even extend to the actual configuration of circuit boards and mounting of display pixels. Thus, it is possible that multiple sets of maintenance requirements for VMS may be required, even if different signs are otherwise operationally compatible.

To address the maintenance issues as described above, it is typical to require VMS vendors to provide maintenance support for an extended period. Another alternative is providing contracted maintenance staff.

4.6.2.5. Maintenance Contracts

For initial operations, it may be appropriate to hire contractors to perform ITS maintenance activities. This is necessary as it is likely many of the system components will require technical expertise that current agency staffs may not have. Advantages associated with contract maintenance are:

- Better assurance of satisfactory performance through tight contract requirements
- Generally more cost-effective than adding staff
- Experienced staff available
- Capability available in near term
- Staffing/training problems are contractor’s
- Maintenance contracts can be budgeted in work program – more stable than zero-based budgeting.

Contract maintenance is cost-effective, particularly in the light of the known difficulties of acquiring additional positions, and with hiring, training, and keeping qualified personnel. Agencies such as Florida DOT, Illinois DOT, and many local agencies have a history of utilizing the private sector for maintenance of a wide range of items, from litter removal and mowing to lighting systems and computer repair.

4.6.2.6. Contract Maintenance Procedures

Preliminary design of ITS projects will include deployment of procurement specifications. These specifications should require the contractor to provide maintenance support activities.
The owning agency should be responsible for managing specific maintenance contracts. To successfully manage the maintenance contracts, the following must be defined:

- Description of what is to be maintained
- Identification of specific maintenance required
- Identification of equipment required for maintenance
- Identification of skill level and number of personnel required for maintenance
- Specified time intervals for routine maintenance
- Identification of the number of non-routine maintenance calls to be expected based on industry standards
- Explanation of how to physically access field components
- Procedures on how to maintain the equipment
- Specified payment structure

Agencies will require this detailed breakdown to evaluate a candidate maintenance contractors’ ability to perform the work and to evaluate the accuracy and reasonableness of their bids and company qualifications.

4.7. Institutional Arrangements

Roles for developing, implementing and managing the PMS and other transit ITS activities may be defined in terms of:

- Establishing a framework for overall management of ITS activities
- Determining forums for interagency coordination – both policy and operations
- Identification of formal interagency agreements – RTA, Service Boards, IDOT, ISTHA, local agencies, etc.
- Definition of agency responsibilities in development, implementation, and operation of specific ITS components

4.7.1. Overall Management Framework

In order to achieve the overall objective of improving the provision of information for transit users, it is important to depend on the continued efforts in development of a consensus between the RTA, Service Boards, and the municipalities where PMS will be installed. Some major issues include:
Who operates the PMS (service board, lot owner, etc.)?

How is permit parking addressed (fully managed, ignored by system, etc.)?

The consensus developed by these agencies will be a significant aid to obtaining non-local funding. The Federal Transportation Equity Act for the 21st Century (TEA-21) considers multi-agency ITS projects to be more worthy of funding than single-agency projects.

The overall framework for ITS management entails the following responsibilities:

- Program Management and Policy Decisions
- Technical and Project Review/Supervision
- Policy and Operations Planning

4.7.2. Interagency Agreements

The following provides a number of types of institutional arrangements and agreements that may prove beneficial in implementing PMS. Various operational alternatives (automated operations vs manual or semi-automatic operations), levels of intervention responsibility (station personnel vs. central personnel), and deployment approaches (contractor-engineer (conventional); system manager (detailed design-software-integration, self-oversight); design-build with engineer oversight; or design-build-operate) influence how these agreements are structured.

Master Institutional Agreement: RTA, service boards, Gateway agencies, municipalities.

Operations Agreement: interagency partners; operational entity (e.g., public, privately-contracted).

Mutual Aid Agreement: all law enforcement, fire, EMS (primary); all other interagency partners.

Memorandum of Understanding (MOU): a non-binding statement of understanding between two or more parties. It can address a wide range of agreements, from operational responsibility to the exchange of funds between agencies.

Cooperative Agreement: a cooperative agreement is similar to a contract, but usually involves the exchange of funds for services, or other agreements involving financial matters.

Contract: a common legal instrument between parties, would be the typical form for an ITS arrangement between the public and private sectors.
**Partnership:** a legal instrument in which agencies take on joint responsibility for a project. Costs, rewards, and penalties would be shared or incurred according to formulas set up on the partnership agreement. A true partnership between a public and private entity for a transportation-related project would be unusual.