Milwaukee, WI, USA’s Summerfest Advanced Parking Guidance System

This third and final feature in a series on Milwaukee, WI, USA—site of the ITE 2006 Annual Meeting and Exhibit—focuses on the City’s plans to implement an advanced parking guidance system (APGS). Traffic congestion along the lakefront in Milwaukee swells during the City’s popular summer festivals, the largest of which is known as Summerfest. The APGS will provide real-time information about parking availability to help visitors find a parking space and reduce congestion, as well as promote the use of a shuttle bus through the downtown area and connect to the festival grounds.

INTRODUCTION

The City of Milwaukee, WI, USA, has a long, rich relationship with its lakefront and successfully has preserved much of it for public use. One of the most popular lakefront destinations is Henry Maier Festival Park, site of the festival grounds. A different event is held every weekend during the summer. The most popular event is Summerfest, a highly successful 10-day series of concerts and events held every year in late June and early July. The festival grounds are bounded by Lake Michigan on the east, Interstate 794/Lincoln Memorial Drive on the west, Clybourn Street on the north and the Milwaukee River/Port of Milwaukee entrance on the south (see Figure 1). These natural and manmade barriers restrict the amount of available parking near the grounds.

Traffic congestion in the immediate area during Summerfest and some of the other weekend festivals is considerable.

The City received a Congestion Mitigation and Air Quality grant to reduce this traffic congestion and improve air quality by implementing an advanced traveler information system for parking.

This feature describes the conceptual design for the planned first phase of the Summerfest Advanced Parking Guidance System (APGS).

The APGS is intended to provide motorists with real-time traveler information about available parking in the downtown area. This information will help motorists make informed decisions about their travel route, reducing the amount of circulating traffic caused by motorists searching for parking.

The APGS also will promote the use of the Summerfest shuttle bus that runs through Milwaukee’s downtown along Wisconsin Avenue between Interstate 43 and the lakefront. The shuttle bus provides an excellent alternative for festival attendees who park downtown at selected parking facilities within a one-block walk of the shuttle bus route.

The APGS conceptual design process used a systems engineering approach. This involved developing a concept of operations document that described the rules and responsibilities of partner agencies: system functional requirements that defined “what” the system should do; and a high-level overall system design. Building upon the conceptual design, a plan, specifications, and estimates (PS&E) package was prepared to construct, integrate, and test the system in 2006.

During and after implementation of the APGS, the system will be tested against the components of the conceptual design to demonstrate that the system requirements have been met and that the overall operation of the system is consistent with the goals set forth in the concept of operations.

CONCEPT OF OPERATIONS

The concept of operations describes, at a high level, the Summerfest APGS from the perspective of system users. Starting with the project goals, it identifies the participants in the Summerfest...
APGS: roles and responsibilities for each partner agency; and areas of interagency integration and cooperation.

To guide the development of the project, stakeholders from all partner agencies were invited to serve on either the executive or technical committee. The executive committee provided policy-level guidance for the overall project; the technical committee gave technical guidance on various key design issues. To provide a focused direction for the project, the committees helped define a number of goals for the project:

- Reduce traffic congestion and improve air quality;
- Improve safety, especially for pedestrians;
- Promote the use of Summerfest shuttle buses;
- Maximize the use of existing downtown parking facilities and
- Provide timely, accurate and useful traveler information to visitors.

**Partner Agency Roles and Responsibilities**

A number of agencies and organizations were involved in the development of the Summerfest APGS and will continue to play critical roles during the implementation, operation and ongoing maintenance of the system. They include the City of Milwaukee Department of Public Works, the Wisconsin Department of Transportation (WisDOT), various public and private parking facilities, the Milwaukee County Transit System, the Milwaukee Police Department, the Milwaukee County Sheriff’s Department and various information service providers such as local businesses and downtown organizations.

**Interagency Agreements**

The City has entered into interagency agreements with participating private parking facility owners/operators. These agreements detail each party’s responsibilities in the development, operations and maintenance of the system. The City will be responsible for all operations and maintenance expenses for system infrastructure located within public right of way.

Each owner/operator will be responsible for system infrastructure within its facility, attending meetings for the design and deployment of the system and allowing access and/or making any modifications to hardware and software at its facility that is required for proper system operation. The parking operator agreement also requires parking operators to provide the system with accurate, "real-time" information about the number of parking spaces available to the public.

**SYSTEM REQUIREMENTS**

The conceptual design includes the identification of a number of system requirements for the Summerfest APGS. The requirements are not intended to identify specific implementation techniques and are independent of technology.

High-level system requirements for the APGS initially were developed from the concept of operations, then were refined and expanded through discussions with partner agencies. The resulting list of system requirements served as the basis for more detailed specifications prepared during the detailed design of the APGS. The system requirements can be categorized as follows:

- Functional requirements, which define the necessary tasks, actions, or activities that must be accomplished—or what the system or one of its components must do.
- Performance and capacities requirements, which define the performance parameters of some capability within the system.
- Interface requirements, which define the interfaces between both internal subsystems and existing or proposed external systems. This type of requirement does not include human-machine interfaces.
- Human-machine interface requirements, which define the interface between the end user (defined as either the general public or the system operator) of the system and components of the system.

**CONCEPTUAL DESIGN**

The conceptual design for the Summerfest APGS consists of three primary components: field elements, control center and communications infrastructure.

**Existing Conditions**

A number of existing conditions factor into the development of the Summerfest APGS. These conditions include the Milwaukee StreetScape Project, various parking facilities, the downtown street system, the City of Milwaukee municipal building and the City’s communications infrastructure.

The Milwaukee StreetScape Project provides uniform street lighting, signing and landscaping styles to designated corridors in the Milwaukee central business district (CBD). It also includes a new pedestrian wayfinding system that uses directional signs. The wayfinding system divides the downtown into five districts: Westown, Riverwalk, East Town, Lakefront and the Historic Third Ward (see Figure 1). Each of these districts has a distinct color scheme used on all direc-
tional signs located in the district or referring to the district.

Field site visits were performed at all potential parking facilities in the CBD. The collected data led to the selection of nine parking facilities for participation in the project based on several factors:

- Proximity to the Summerfest shuttle bus route;
- Automatic parking availability monitoring;
- Existing communication that can link into the Summerfest APGS; and
- Prevalence of available transient parking spaces.

The participating parking facility operators use different hardware (ticket spitters, gates, counters, etc.) and software to operate and monitor their facilities. Each of the nine participating parking facilities have monitoring software to count the number of available spaces in real time. These parking facilities use one of two different software packages, both of which have the capability to differentiate between monthly and transient (daily) parkers.

The Milwaukee downtown street layout is a grid system comprising north/south and east/west streets (see Figure 1). Most of the streets within the system are two-way streets. Most of the downtown streets are undivided, with the exception of Water Street and Kilbourn Avenue. The most common width of a sidewalk on the defined routes is 12 feet; the largest is 15 feet and the smallest is 10 feet.

The municipal building is located one block east of City Hall on the corner of Kilbourn Avenue and Broadway. The APGS central system software will run on an existing City-owned and maintained server located in the municipal building's data center.

The City of Milwaukee owns and maintains a communications network that uses several transmission media, including fiber-optic cable, twisted-pair copper cable and wireless. The City has a fiber-based metropolitan area network linking all of the primary City buildings.

All City buildings provide points of presence and can provide access to the City's network, which is very reliable and has 24/7 on-call maintenance. The City network has an Ethernet connection to the WisDOT traffic operations center. In addition, the City currently is deploying a pilot project to connect street lighting substations controllers using serial wireless radios.

**System Model**

The APGS system model consists of field elements, a control center and the communications links that support the transfer of information between them (see Figure 2). The number of parking spaces available to the public is collected from each of the parking facilities, and the data are processed and stored. Based upon thresholds defined as part of the system requirements, messages are generated automatically and sent to the appropriate dynamic signs. Likewise, messages are published automatically for other agencies using private networks or the Internet.

**Field Elements**

Field elements included in the Summerfest APGS fall into two categories: guide signs and parking facility equipment. The most visible aspect of the APGS will be a series of wayfinding parking signs located along entrances to the CBD on arterial routes and freeway exit ramps and at the participating parking facilities.

These signs will consist of dynamic, electronic message signs that display real-time parking availability information and static guide signs. Together, this wayfinding system will assist motorists approaching the downtown and destined for various points of interest, including the Henry Maier Festival Park, in finding their way to available parking.

Figure 3 depicts the static and dynamic guide signs that will lead motorists to the participating parking facilities. The Streetscape Project provided the basis for the architectural design of these signs; input provided by the technical and executive committees. The City staff and the Streetscape Advisory Committee refined the design. The design process generated several alternatives for the placement and design of each piece of critical information on the signs: the directional arrow, the
international “P” parking symbol, the destination and the light-emitting diode matrix panel (dynamic sign only).

The static sign is a four- or six-panel sign that directs travelers to both parking facilities and districts in the downtown. It has a crown and decorative support identical to the Streetscape Project sign. The white-on-blue “P” parking symbol is situated between the directional arrow and the parking facility address.

The static signs have 4.5-inch-high text on each 9-inch-high panel. Parking facility addresses and districts each use a distinctive text, and each district panel has a defined color. Each district also has its own unique area icon situated in the crown of the sign. These colors and area icons were determined through an extensive public outreach process as part of the Streetscape Project.

The dynamic sign is a three-panel sign with a crown and decorative support that directs travelers to parking facilities and districts and also provides motorists with the number of available spaces at the parking facilities. The “P” symbol is located below the guide arrow on the left side of the sign to designate guidance to parking facilities.

The fonts for parking facility addresses and districts on the dynamic signs are consistent with the static signs, but use a larger 5-inch text height on a 10-inch-high panel. In addition, a six-character digital matrix is included in each parking guidance panel to display the number of available spaces or messages (such as FULL, CLOSED, OPEN) in real time.

The sign placed outside each of the parking facilities is a standard 24-inch by 30-inch parking sign. The “P” symbol and directional arrow are placed at the top of the sign. The horizontal placement of these elements varies based on the direction of the directional arrow. The fonts for the parking facility address on these signs are consistent with the static and dynamic signs, but use 3.5-inch-high text.

The following criteria were used to define the different APGS system routes:

- Each street that a route follows should have at least four lanes of traffic;
- Combine routes from different system entry points whenever possible; and
- Major CBD entrance points, including freeway exits.

Using these criteria, major entrance points into the downtown were used to identify five APGS routes to guide motorists to the parking facilities (see Figure 4). It was determined that the guide signs needed placement at the following locations along the routes:

- The defined major entrance points into the downtown (static sign location);
- Points where a motorist would have to turn onto a different street along the route (static sign location);
- Points where a motorist would have to choose a parking facility (dynamic sign location); and
- Outside the entrance of a parking facility within the system (static sign location).

Each of the nine parking facilities included in the initial phase of the Summerfest APGS currently operates some type of parking availability monitoring software. To collect the real-time parking availability information from these facilities, an interface is needed to link the Summerfest APGS central system software with the software in the separate parking facilities. Each facility will connect to the central system with a wireless serial link. At each facility, a wireless transceiver will be installed and connected to the existing parking facility computer.

Because the wireless transceivers require line of sight (or nearly so) to work properly, they will be located near the street edge. CAT-5E cable and the necessary serial communication equipment are required to connect a wireless transceiver to that facility's existing computer. Computers at City-owned facilities will not use wireless serial links, but will instead use an existing connection to the municipal building via the City's existing metro area network.

Control Center

The control center will be located at the municipal building. That building and the police administration building will serve as the two information collection points. Parking availability information will be collected from the parking facilities and processed at the municipal building.

Once the information is processed, the central system software will transmit to the appropriate dynamic signs, using a wireless connection, the number of available parking spaces. The process of collecting, processing and transmitting information will be done in real time with updates expected every 1–2 minutes.

Processed parking availability information from the central system software will also be transmitted to the WisDOT traffic operations center using an existing City network connection, and to other partner agency centers and the public via
either the Internet or the existing City metro area network. Processed parking availability information from the central system software also will be published to a public traveler information Web site.

Communications Links

Of the existing transmission media currently being used by the City, wireless serial radios were selected for use in the Summerfest APGS for the following reasons:

- The parking facility and dynamic guide sign locations did not correspond well with the City’s fiber optic points-of-presence locations, and installing new fiber optic cable under pavement and sidewalk was deemed too expensive.
- Similar to the City’s fiber optic cable, the City’s twisted-pair copper outside plant does not correspond well with the project’s parking facility and dynamic guide sign locations.

The parking facilities connect to the central system via the wireless serial network that the parking facilities will use. This network uses the same serial radio at the municipal building and the same repeaters. The design again uses the same installation practices demonstrated on the City’s pilot projects.

FUTURE SYSTEM EXPANSION

The design of the first phase of the Summerfest APGS considers the City’s desire to expand the system in the future. Several expansion issues were taken into account when designing the system, such as placing the wireless repeaters in locations where they could be used by both designed facilities and future facilities; leaving blank panels on the static guide signs to allow for the addition of parking facilities and selecting data collection points that will be convenient for future phases.

The second phase of the Summerfest APGS will incorporate additional parking facilities and signing locations in other areas of downtown Milwaukee that were not included in the initial deployment. It also will expand the coverage area to include parking facilities located within two blocks of the downtown trolley route, incorporating other special event venues like the Bradley Center and Midwest Airlines Center.

The second phase of the project will relieve traffic congestion and overcrowding of parking facilities near the Bradley Center, Midwest Airlines Center and other major destinations. When the second phase is completed, the APGS will provide real-time traveler information for an estimated 15,000 public parking spaces, most of which will be located within two blocks of the shuttle bus or trolley routes. Figure 5 shows the locations of the parking facilities proposed for inclusion in the second phase.

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CHRIS J. FORNAL, P.E., is the planning, development and ITS engineer for the City of Milwaukee, WI. He previously was in charge of traffic signal engineering for the City. He received a B.S. and an M.S. in civil and environmental engineering from the University of Wisconsin–Madison. He is one of the leaders of the Local Arrangements Committee for the ITE 2006 Annual Meeting and Exhibit in Milwaukee and is a fellow of ITE.

GARY F. RYLANDER, P.E., PTOE, is vice president and Midwest regional director of traffic engineering and ITS for Edwards and Kelcy in Chicago, IL, USA.

He served as the consultant team project manager for this project and has 30 years of experience in the public and private sector. He received a B.S. and an M.S. in civil and environmental engineering from the University of Wisconsin–Madison and is a fellow of ITE.

MATTHEW J. LETOURNEAU, P.E., PTOE, is a senior transportation engineer with Edwards and Kelcy in Chicago, IL. He served as the deputy project manager for the project consultant team and has eight years of experience in the planning, design, and analysis of traffic engineering and ITS initiatives. He received a B.S. in civil engineering from Marquette University in Milwaukee and is an associate member of ITE.