License-Plate Enabled Parking: The Key to an Enhanced Parking Experience

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Today’s parking landscape is characterized by a plethora of parking technologies and models. This diversity can be attributed to two fundamental factors: consumers looking for ways to make payment faster and more convenient so they can move on to their destination quickly, and parking operators trying to leverage technology to drive growth in their top line and extract further efficiencies to improve their bottom line. Each successive generation of parking technology has attempted to improve the parking experience for these two groups.

License plates uniquely identify a vehicle and are the next mainstay in the evolution of parking operations. This insight is central to one particular advance in parking: License Plate-Enabled Parking (LEP). LEP is an ecosystem of technologies using the license plate as a key identifier to access an enhanced parking experience. LEP offers advanced features not available with other parking models and it benefits both consumers and parking operators.

This white paper discusses various parking models and presents the benefits and drawbacks of each. It introduces LEP as well as the T2 LEP product offering.
• Consumers can use a space without paying if there is time remaining on the meter from the previous user (piggyback).
• Enforcement is highly inefficient as it involves visually inspecting every parking meter.
• Single-space meters negatively impact urban streetscape and take up valuable sidewalk space.

**Multi-Space Pay Stations**

Multi-space parking pay stations are more sophisticated devices that serve on- or off-street parking spaces. They are installed at regular intervals on city streets or in off-street surface lots or parking structures. Multi-space devices address a number of single-space meter shortcomings:

• Pay stations almost universally accept more flexible forms of payment than single-space meters, such as credit cards, bills, coins, coupons, smart/value cards, Pay-by-Phone and Extend-by-Phone.
• Multi-space pay stations serve numerous parking spaces, so there are fewer pay stations to maintain, when compared to single-space meters, reducing spare parts inventory requirements.
• Collections costs are also reduced, having to collect from fewer devices, and less often.
• Pay stations equipped with wired or wireless communication systems can notify a central management system of failures, expediting repairs.
• The most sophisticated multi-space pay stations provide a full audit trail and rich reporting and analysis.
• In the event of a pay station failure, a consumer can use an alternate station to pay for parking, thus eliminating lost revenue associated with non-functioning meters.

• Aesthetically pleasing multi-space pay station designs (shown below) can actually enhance the look of the streetscape, reducing visual clutter and opening up sidewalks to pedestrians.

**Pay-and-Display**

Pay-and-Display (PND) was the first widely deployed multi-space parking model. With PND, consumers go to the pay station, purchase time, and then return to their vehicle to display the permit (shown on following page) on the dashboard. The consumer benefits from the convenience of more flexible payment methods and a printed permit. The operator gains the advantages offered by multi-space pay stations as discussed earlier. There are, however, a number of drawbacks to the PND model for both operators and consumers. From an operator’s perspective, enforcement is rather inefficient, as officers need to peer through each windshield and visually inspect each permit. Equally, the possibility exists for permits with time remaining to be passed from one consumer to another (pass-back), thus eroding operator revenue. For consumers, the most significant irritant with PND is that they need to return to their vehicle to display the permit.
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Pay-by-Space

Pay-by-Space (PBS) is a newer parking model that combines multi-space pay stations with numbered parking spaces (shown above, center), either on- or off-street. Consumers note the space number corresponding to the location of their vehicle, purchase time at the pay station, and keep the receipt with them. This model is favored by consumers as they do not have to return to their vehicle to display a permit; however, they must remember to note their space number before paying. Pass-back and associated revenue shrinkage are also eliminated, since there are no displayed parking permits to pass. Since there is no walking back and forth, pay stations can be distributed in a sparser fashion, as each can serve a larger area. Also, having numbered spaces makes it possible to implement reservation schemes. On the other hand, parking operators incur the cost of marking and numbering spaces, as well as maintaining and cleaning (for example, clearing snow) the space markings. Enforcement is both more efficient and more complex than PND: a report showing paid spaces must be obtained from the pay station or via a wireless handheld device; however, once this report is in-hand, enforcement is more streamlined than PND as the officer does not need to inspect each dashboard for a valid permit.

Pay-by-License Plate

Pay-by-License Plate (PBL) is an emerging multi-space parking model in North America and widely adopted model in Europe. In a PBL deployment, consumers simply go to the pay station, enter their license plate number, and purchase time. There is no need to remember a space number, nor do consumers need to return to their vehicle to display a permit. Operators benefit from reduced expenses because there is no need to mark parking spaces and no need to maintain or clean such markings. Another advantage of PBL not relying on marked spaces is that more vehicles can park in the same street space: 16 Smart cars or 32 motorcycles instead of eight trucks, for example. PBL eliminates pass-back, as there are no permits to pass.

There are many intrinsic benefits to PBL that are superficially evident, but upon further inspection, it becomes clear that the greatest value PBL delivers is that it is a gateway to a much broader concept: License Plate-Enabled Parking.
License Plate-Enabled Parking

License Plate-Enabled Parking (LEP) is an ecosystem of technologies using the license plate as the key identifier to access an enhanced parking experience. The figure below shows the different elements of LEP.

Together, these components work in synergy to benefit consumers and parking operators. The central element of parking is the vehicle. Other elements such as the parking meter, space markings, permits, and gates, are specific to particular parking implementations rather than core to the concept of parking. Because license plates uniquely identify a vehicle, they are more naturally suited to parking technologies and services. The following subsections discuss the facets of LEP.

Pay-by-License Plate Pay Stations

The consumers’ first contact with LEP is typically through a pay station when they enter a PBL environment. Advanced PBL pay stations interface with a central management system through wired or wireless communication to transfer transaction information, including license plate details. This communication is the key to unlocking the LEP experience. Other ecosystem elements such as Pay-by-Phone services or License Plate Recognition (LPR) systems can interface with the central management system to discover information or inject parking transactions, all based on the license plate number. This seamless integration enhances the parking experience and facilitates parking administration for the operator.

Pay-by-Phone and Extend-by-Phone Services

Many municipalities, universities, and private operators offer the option to pay for parking using a mobile phone. Such systems rely on an interactive voice response (IVR) system or Smartphone application to complete the transaction. As part of the registration process, consumers enter their license plate and credit card number. This, together with the phone number, forms the basis for an account on the system. Using the license plate number as the key, Extend-by-Phone systems can interface with other ecosystem components in order to, for example, add time to a parking transaction initiated at a LEP-enabled pay station. Through LEP, consumers can conveniently add time to their paid parking transaction as they discover that their meeting is running longer than expected, for example, without having to excuse themselves to feed the meter. Some Pay-by-Phone implementations allow a start/stop parking model where the consumer pays only for the time they actually parked. For operators, LEP means that all parking transaction records can be consolidated into a single repository, making it easy to produce reports or perform enforcement.

License Plate Recognition Systems

LPR is arguably the single largest productivity enhancement for parking operators in the last 20 years. LPR uses a handheld, vehicle-mounted or fixed camera to scan license plates, and has a number of applications.
Enforcement

During I-PR enforcement, plate numbers are compared to a list of plates for which a valid parking session exists. This list is populated by LEP-enabled payment channels such as pay stations or Pay-by-Phone. When an unpaid vehicle is detected, a citation can be issued via the citation and adjudication system used by municipality or parking operator. When compared to an officer on foot in a PND or PBS environment, LPR can increase productivity 10- or 20-fold: as many as 2,500 vehicles can be automatically inspected per work shift. This productivity gain results in significant and ongoing labor savings. LPR also allows for automatic detection of scofflaws and stolen vehicles.

Gateless Parking

Some operators are deploying gateless parking facilities using LPR and PBL pay stations. As vehicles enter, I-PR cameras scan their license plate and record the time of entry. Consumers proceed to a pay station and purchase time keying in their license plate details. When they exit the facility, LPR cameras again record their license plate number and time of departure. LEP back-end systems reconcile the payment information from the pay stations with the LPR data, and citations are automatically issued for vehicles that did not pay or did not purchase enough time. This system is very efficient because it avoids congestion at exit gates. It also eliminates the need for a cashier, saving overhead costs and limiting the potential for theft.

Parking Management Systems

License plates are unique in that they unambiguously identify the parked vehicle. As such, they can be used to facilitate the management of a number of parking applications.

Digital Parking Permits

Older systems and methods for issuing weekly, monthly or annual parking permits relied on using hang tags or decals to enable visual enforcement and had a high cost associated with the printing and mailing of hang tags and decals. New digital permit systems leverage the license plate as the key identifier for digital permits that can be easily administered and managed using a Web browser and eliminate the need for tags or decals. Thus unifying parking management and enforcement via the license plate.

Reserved Parking

Reservation or advance purchase of parking via phone or through a Web site is a convenient and easy service, particularly for special event parking. Such systems use the vehicle’s license plate as an identifier, and through LEP, they interwork with systems at the parking location. Advance payments can be consolidated with information from on-site PBL pay stations and presented to handheld enforcement devices or LPR systems. This type of collaboration between systems is the essence of License Plate-Enabled Parking.

Valet Systems

Valet companies pride themselves on offering superior customer service. Using LEP technologies such as LPR, known vehicles can be recognized as they enter a facility offering valet services so that the customer can be greeted by name. The license plate can also be associated with an account in order to streamline payment. Finally, when the consumer wishes to retrieve their vehicle, they can enter their license plate number and payment at a retrieval kiosk to expedite the process.

Space Sensors

Space sensors, complementary components to LEP, allow parking operators to see how their resources are being used in real-time. The sensors monitor the occupancy status of each parking space in real-time, enabling operators to track occupancy and turnover levels, plan more efficient enforcement patrol routes, and deliver parking availability information to consumers via parking guidance systems.

Guidance Systems

Another complementary component to LEP, guidance systems...
display real-time parking availability information to consumers using electronic signage or through Smartphone applications. Guidance systems assist consumers in locating the nearest available parking space, reducing congestion and pollution, and increasing consumer satisfaction.

Citation Management Systems

Some advanced parking installations allow consumers to pay citations directly at a PBL pay station by entering their license plate. The license plate is the key to accessing outstanding citation information from a central repository. This method of payment offers significant benefits to consumers, as it avoids them having to mail a check, visit a Web site or use the phone to make their payment. In some cases, the operator may even offer a discount in order to encourage participation. Payment at the pay station reduces the amount of manual work involved in processing citation payments for the operator. Also, because of the added convenience, operators using this technique generally enjoy a higher collection rate on citations.

Central Management System

Communication among ecosystem components is the key to unlocking the LEP experience. The central management system exchanges, stores, and integrates data from every facet of the LEP ecosystem, facilitating parking administration with a wealth of real-time information.

Data Synchronization

Using real-time data from LEP components, the central management system allows synchronized management of the parking operation. From providing enforcement systems with payment data from pay stations and Pay-by-Phone services, to allowing consumers to pay parking citations directly at the pay station.

Business Intelligence

Using real-time data from LEP components municipalities can view levels of parking activity throughout the city. The ability to visually monitor parking occupancy, turnover, and demand enables managers to make informed adjustments.

Performance-Based Pricing

Using real-time data from LEP components, municipalities can develop performance-based pricing programs. This enables municipalities to dynamically adjust parking pricing to ensure better parking availability, reduce congestion and lower pollution.

Resource Management

Municipalities can better manage their parking resources from monitoring which areas have high and low parking demand and the ability to direct consumers to areas where parking is available, to the development of more efficient staffing levels, enforcement patrols, and maintenance routes.
LEP Compared to Other Multi-Space Models

The following tables summarize the salient differences between LEP and other parking models.

<table>
<thead>
<tr>
<th>Pay-and-Display</th>
<th>License Plate-Enabled Parking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enforcement officer must visually inspect each vehicle dashboard</td>
<td>Enforcement officer scans license plates using I-PR (10 times faster)</td>
</tr>
<tr>
<td>Consumer must return to vehicle to display permit on dashboard</td>
<td>Consumer does not need to return to vehicle</td>
</tr>
<tr>
<td>Revenue lost through occurrences of pass-back</td>
<td>Eliminates occurrences of pass-back</td>
</tr>
<tr>
<td>Cannot integrate with Pay-by-Phone</td>
<td>Can add time with Pay-by-Phone</td>
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<tr>
<th>Pay-by-Space</th>
<th>License Plate-Enabled Parking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enforcement officer must generate a report and visually inspect each space</td>
<td>Enforcement officer scans license plates using I-PR (much faster)</td>
</tr>
<tr>
<td>Costs associated with installing and maintaining space numbers</td>
<td>Eliminates the use of space numbers</td>
</tr>
<tr>
<td>Standardized space sizes = limited vehicles</td>
<td>Eliminates the need for marked spaces</td>
</tr>
<tr>
<td>Accommodated = lower revenue</td>
<td></td>
</tr>
<tr>
<td>Consumer must remember a space number, changes each time they park</td>
<td>Consumer only needs to remember their license plate number</td>
</tr>
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</table>
LEP Pay Stations in North America

T2 Systems is a manufacturer of multi-space pay stations and online management systems, and a pioneer of License Plate-Enabled Parking in North America. T2’s LUKE II multi-space pay station (shown below) offers multiple payment options from coins, bills, and credit cards, to smart cards, coupons, and Pay-by-Phone. LUKE II is also equipped with a large, full-color screen that’s easy to read. The pay station supports multilingual features, network capabilities, real-time credit card authorization, and remote rate configuration. LUKE II is available in AC or solar power configurations.

LUKE II pay stations support Pay-by-License Plate — in addition to PND and PBS — and work with a variety of LEP components, enhancing the parking experience for the consumer and the operator. LUKE II is equipped with an alphanumeric keypad for license plate transaction entry. Previous LUKE pay station generations can be easily upgraded in the field to support LEP with a simple keypad change and a software update.

The pay stations interface with T2’s Digital Iris, a sophisticated LEP-enabled backend that processes transactions and interfaces with LEP components such as Pay-by-Phone, LPR, and citation management systems. T2’s LEP technology partners include:

**Pay-by-Phone**
- Parkmobile
- Pay-By-Phone (Verrus)

**License Plate Recognition**
- Genetec
- Tannery Creek

**Enforcement**
- Complus Data Innovations (CDI)
- ParkTrak
- T2 Systems

In addition to existing partners, the LEP environment works in cohesion with T2’s open architecture Digital API platform. Using T2’s API, partners and T2 clients can build additional modules to analyze or add information, thus broadening the LEP ecosystem.