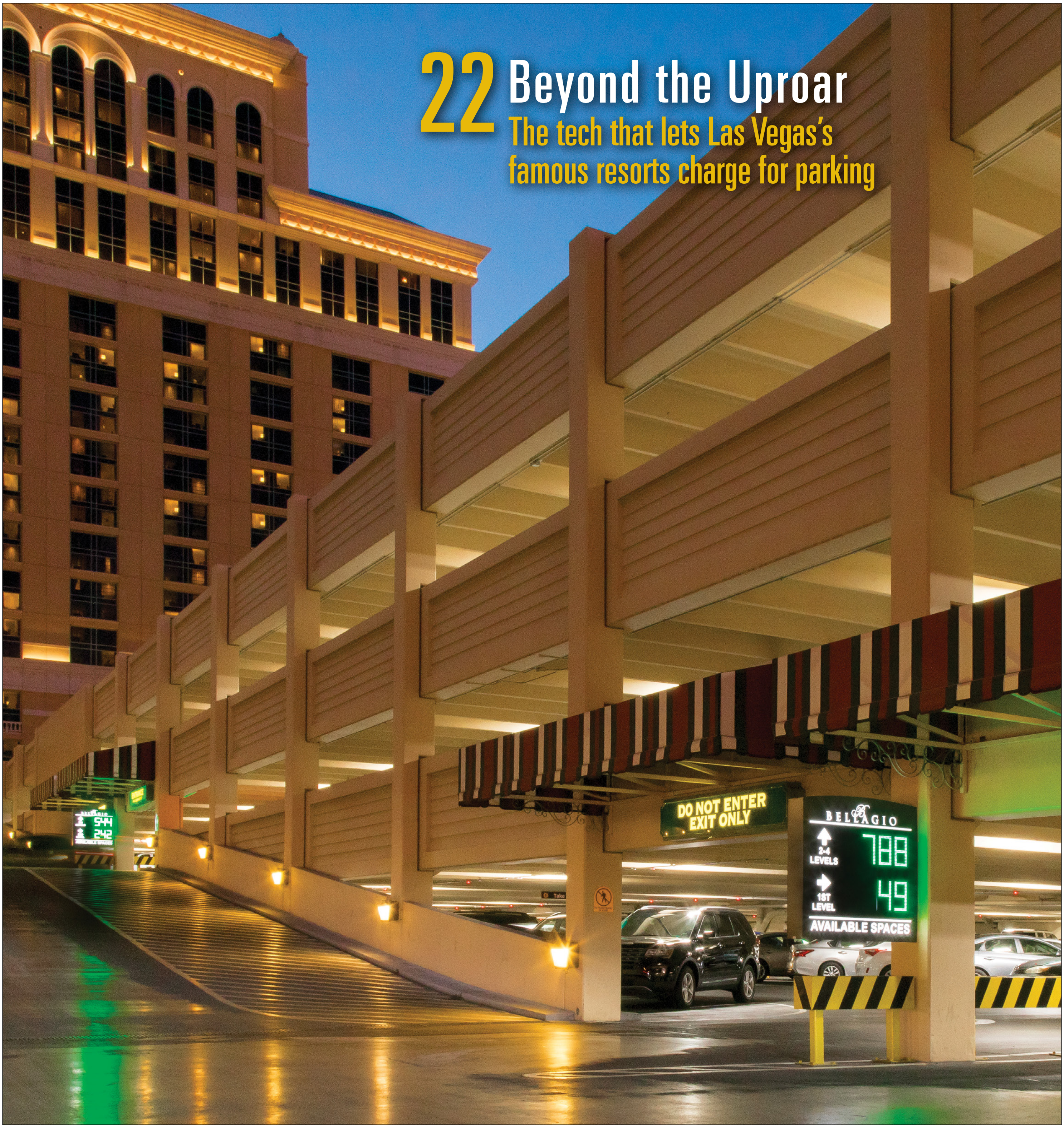
The Parking Professional

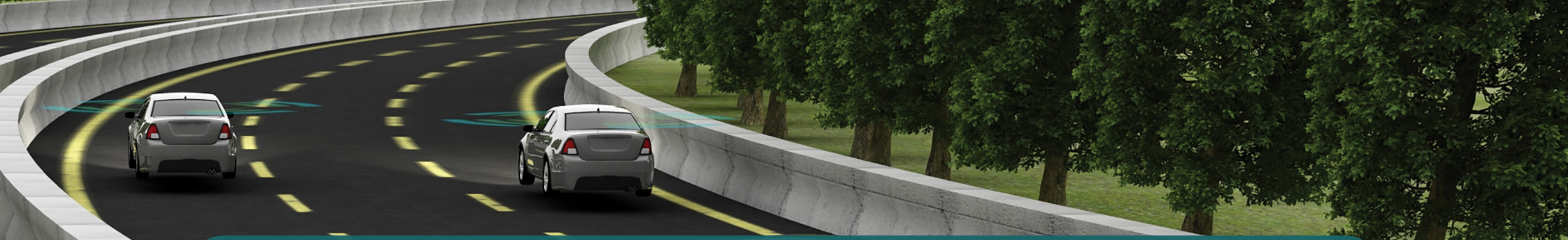
THE INTERNATIONAL PARKING INSTITUTE
MAY 2017



By Michael Drow, CAPP; Peter Lange, and Brent Paxton

SMART CONNECTIONS

Connected vehicles are already among us and big changes are ahead. What does it all mean for parking professionals?



ISTOCK / KARNEG

The connected car is coming! The connected car is coming!

When you read this, do you think of Paul Revere riding through the countryside, waking the minutemen to prepare for battle? Or do you flash back to your youth and the excitement of the ice cream truck coming down the street? Everyone has a different perspective on the effect of connected cars on parking—some excited and some concerned. While the connected car will have an impact, it also creates opportunity.

What is the connected car? When it is mentioned in literature, there are usually references to many terms and acronyms. In simplest terms, the connected car is a vehicle with internet access. This internet connectivity allows the vehicle to share and receive data. GM's OnStar, introduced in 1996, is a connected car technology, and today we see most auto manufacturers connecting their vehicles to the internet either directly with 4G LTE built into the vehicle or via the driver's mobile phone.

Typically, a connected car has an in-car entertainment unit or an in-dash system with a screen from which apps and services can be managed by the driver. All this connectivity allows the vehicle to present the driver with useful information and entertainment, such as point-of-interest information, music/audio playing from external sources or devices, built-in smartphone apps, navigation systems, roadside assistance, voice commands, and contextual help and offers from the dash. It also enables the vehicle to communicate with the roadway and other vehicles to improve efficiency and safety.

The following are common terms related to connected cars.

- V2V (vehicle to vehicle): The technology and methods that enable a vehicle to communicate directly with another vehicle without human intervention. The simplest example is a vehicle "talking" to other vehicles to inform it that it is braking. This communication alerts the other vehicles to monitor their speed and brake as necessary.
- V2I (vehicle to infrastructure): The technology and methods that enable various roadway infrastructure components to communicate with a vehicle. Examples include a stoplight alerting vehicles that the signal is about to change or a vehicle entering a parking facility and communicating its access credential information to raise the gate.
- V2C (vehicle to cloud): The technology and methods that enable a vehicle to communicate with a cloud-based system to share information. A vehicle requesting weather information or parking availability information to present to the driver are examples. Vehicles also share information with the cloud system—"I am on Interstate 10 going 20 miles per hour" (i.e., there is congestion).
- Infotainment: The variety of apps that provide information services, such as Google maps, fuel finder, parking payments, Apple Pay, or apps that provide entertainment services such as Pandora, CNN, and Facebook. The apps can be part of the vehicle's entertainment system or accessed by a vehicle via a connected mobile phone.
- MaaS (Mobility as a Service): Instead of an individual owning transportation assets, an individual purchases transportation services on an as-needed basis. This includes car sharing, ride sharing, and public transit options. MaaS typically involves the merging of several transportation and payment options to complete trips while catering to the specific needs of the user.

In addition to providing information to the driver, connected cars collect and share information about local environmental conditions and driving activity. Most new vehicles are outfitted with many types of sensors to collect data, which are used to support the vehicle's operation. Vehicles have proximity sensors to determine when they approach an object, GPS to identify location, cameras to view the roadway and identify obstacles ahead or nearby, and various forms of radar to manage speed and proximity to other objects.

These sensors support the driver assist systems found in many cars today, including dynamic cruise control, automatic braking, lane-departure alerts, and many other safety and control systems. In addition, these sensors provide data to the cloud for use in other applications. One such example being tested is the sharing of open parking spaces based on the data collected from a vehicle as it drives down the street. A vehicle's proximity sensors detect the presence of vehicles parked in on-street spaces and report that information along with GPS coordinates to create street parking occupancy.

Evolution of the Autonomous Car

Sensors and connectivity within vehicles form the basis for the evolution to the autonomous vehicle. An autonomous vehicle requires the ability to sense its environment in detail, plus receive updates to its maps and be aware of current roadway conditions to operate effectively. The evolution is best described using SAE International's Levels of Automation as shown in the table below.

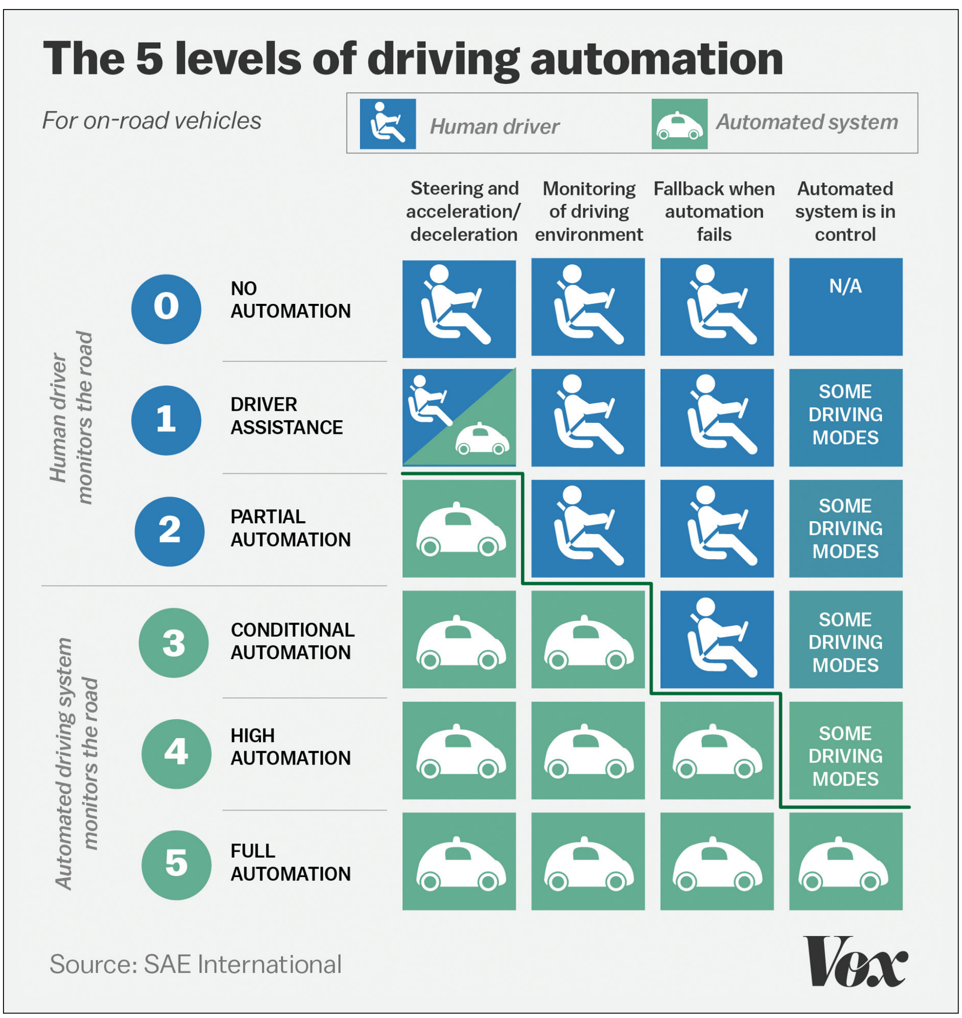
At the top of the graphic is the most basic level of automation—no automation. In the SAE Levels of Automation this is Level 0—the driver is 100 percent in control of the car 100 percent of the time and no systems control the vehicle.

At the bottom is the highest level of automation—the human driver is not required and the systems control 100 percent of the vehicle. Vehicles using Level 5 automation are being piloted on roadways today to improve and test the systems before they are mass-produced.

Between these two levels, the graphic depicts the various iterations of vehicles and automation on the road today. A significant shift occurs between Level 2 and Level 3 vehicles; this transition covers the driver's change from an active to passive role in managing the vehicle's operations and allowing the systems to take control in specific-use cases.

The following provides a short review of each level:

- **Level 0—No Automation.** Human driver is responsible for steering, accelerating, and decelerating the vehicle. Human driver is also responsible for monitoring the driving environment and conditions and making necessary adjustments. Systems on the vehicle may provide warnings to driver. Examples include blind spot monitoring and lane departure warning.
- **Level 1—Driver Assistance.** Human driver is responsible for steering, accelerating, and decelerating the vehicle. However, a single driver-assistance system managing either steering or acceleration/deceleration actions can control the vehicle when enabled by the human driver. Human driver may have hands off the wheel or feet off the pedals but not both. Human driver is still responsible for monitoring the driving environment and conditions and making necessary adjustments. Examples: cruise control, lane control, automated braking, and dynamic cruise control.



- **Level 2—Partial Automation.** Multiple driver assistance systems managing steering and acceleration/deceleration actions in a combined function are responsible for managing the vehicle in specific-use cases. Human driver can have both hands off the steering wheel and feet off the pedals simultaneously. However, the human driver must be ready to take over system control at any moment. Human driver is still responsible for monitoring the driving environment and conditions and making necessary adjustments. Example: adaptive cruise control with lane control.
- **Level 3—Conditional Automation.** Multiple driver assistance systems managing steering and acceleration/deceleration actions in a combined function are responsible for controlling the vehicle in many—but not all—use cases. In addition, the system is monitoring the driving environment and conditions and initiates adjustments as required. However, the human driver must be ready to take over control in undefined-use cases or when the system does not know how to handle a situation in the defined-use case. In these situations, the system will provide an alert that human intervention is required. Example: Tesla Autopilot.

ISTOCK / CHESKY_W

- **Level 4—High Automation.** Multiple driver assistance systems managing steering and acceleration/deceleration actions in a combined function are responsible for controlling the vehicle in most use cases. The system also monitors the driving environment and conditions and initiates adjustments as required. The human driver is not required as a backup for the defined-use cases but is required in the few undefined-use cases. Example: Audi's self-park/valet operation.
- **Level 5—Full Automation.** The system manages 100 percent of the vehicle's operation in all use cases. A human driver is not necessary even as a backup. Example: Google's autonomous car with no steering wheel.

Mobility Services, Connected Cars, and Autonomous Vehicles

As mobility services are introduced, vehicles with Level 4 and 5 automation will provide significant efficiency in moving people and goods. In addition, new operating practices using automated vehicles will undoubtedly be introduced.

There are several mobility use cases currently being tested in the marketplace with autonomous vehicles. Level 4 automated vehicles and trucks are being used to transport goods on the highway. Level 4 automated trucks can drive extremely close to each other in an operation called platooning that improves gas efficiency. Companies are also exploring the use of smaller Level 4 vehicles to perform delivery of goods in urban environments.

In addition, Uber is testing and refining the use of self-driving cars in cities to provide its ride-sharing service in urban environments. Users request a vehicle and enter a destination via the Uber app and the vehicle does the rest.

What is the timeline to see automated vehicles? Fully autonomous vehicles, ready for mass production, are projected to be ready in five to eight years. The technology to support Level 4 and 5 automated cars is quickly improving as can be seen in active production model vehicles now. Tesla currently has Level 3 autonomous vehicles in use by customers. Tesla also states that its recent cars have the technology necessary for Level 4 automation support once they receive certification to enable it. GM intends to release the Cadillac Super Cruiser—a Level 3 autonomous vehicle—in 2017. Other automotive manufacturers are also releasing Level 3 autonomous vehicles during the next two years. And as for the Level 5 autonomous vehicle, Mercedes Benz announced its intent to deliver a vehicle by 2025. So the autonomous vehicle is here—for specific-use cases.

As highlighted, the autonomous vehicle provides capabilities to support MAAS offerings. Reverting to the simpler connected car, how does it improve mobility? Here's how:

- Providing options to the driver. Many people currently use apps such as Google Maps or Waze to determine the best routes to a destination. Map apps provide real-time traffic information to provide accurate arrival times and to reroute around long delays. In addition, many map and transit-related apps show the options and travel time differences of using different modes of transportations to a destination. There are also apps that help users find the nearest parking to their destinations, pay for the parking via the app, and even pre-purchase a parking space in some cases. In addition, these apps know the user's preferences and can filter the available options to relevant ones for a specific person.

- Share information about current transportation status. Where are the traffic data used in certain map applications derived? One source is the hundreds of thousands of smartphone users driving around with a map application. Current speed, travel times, and other related activity is collected to provide near real-time traffic congestion information. In other apps, data are actively submitted by users to share with others. Waze is an example of crowdsourcing in action. Waze users report traffic accidents, roadway debris/hazards, and other important information that can help other travelers. Waze has millions of active users providing real-time updates. Vehicles are also automatically reporting data via their connections. Some insurance companies now offer lower insurance rates if customers let the insurance company app monitor their driving habits. All of us benefit from the real-time sharing of information.

Preparing a Parking Facility

You may be thinking "So the connected car is here and the autonomous car is around the corner—what does this mean for my parking facility? Should I heed Paul Revere's shouts and grab my musket or scrape up the loose change in the house and chase the ice cream truck down?"

Nothing is going to change overnight. If autonomous cars take over the roads, it will take many years to replace the current inventory of human-driven cars—and many do not believe the human-driven car is ever going to be phased out.

Thus, there is no need to prepare to shut down parking operations; rather, there is a need to think how to enable the facility to support connected and autonomous vehicles alongside their human-driven counterparts.

The first step is to consider how a connected car might change parking usage in the facility. The following are some sample scenarios to consider. It is important to remember that every facility has different types of users and will be impacted by the scenarios differently.

- Customers search for parking while driving to their destinations; in some situations, they may want to pre-purchase their parking before arriving or are interested in special services when they arrive, such as a premium parking space, a wider space, or an EV charging space. Does the facility have accurate information about its rates and parking options online? Can it accept electronic payments or pre-purchases?
- Customers use a ride-share/car-share service to get around some days but on other days, they drive themselves. Does the facility support ride-share/car-share services? Can the facility store ride-share/car-share vehicles that are not currently in use? These vehicles will need to go somewhere.
- A customer using an autonomous vehicle is dropped off at a destination (or maybe at the entrance to the parking facility) and the vehicle now needs to park itself. Is the autonomous vehicle aware that the parking facility is nearby via its map and information database? Is the facility able to support the autonomous car entering the facility? Enabling it to parking itself? Pay for itself?

After considering these and other scenarios, managers must be ready to prepare a specific plan to support connected cars and autonomous vehicles at their location. Here are four areas to prepare a facility to support connected cars:

- IT infrastructure.
- Information to share on apps.
- Technology to support credentials and payment.
- Options to reconfigure sections of a facility.

Plan for IT infrastructure

Connected cars need the ability to collect and share data, and the facilities that support them need the exact same thing—the ability to collect and share data. Many parking facilities currently use technology to manage the operation, from meters to parking access and revenue control equipment. However, not all facilities connect this technology to the outside world or allow other systems to interact with the facility's technology. Facilities need to be connected.

Implementing the proper network infrastructure to enable a facility's technology and systems to communicate with the outside world is important. This communication supports many services, including the sharing of occupancy data, ability to sell parking online, supporting electronic payments, and even providing customer support remotely. Having the proper network infrastructure also supports a facility's PCI compliance and improves protecting the facility from other data breaches such as personally identifiable information (PII), a growing concern considering the amount of PII many parking facilities manage every day.

In addition to the proper network infrastructure, a facility needs sufficient data bandwidth available to handle the data it shares. Several years ago, not much data were shared from facilities, but today they share real-time occupancy data, managers are on email, some sites use digital video to manage the facility remotely, and transaction data are being shared with various partners to provide services to customers. Old data lines may not support the amount of data being communicated today. It is worthwhile to determine if a facility's existing data lines can effectively support all these data needs. Once this is known, a facility can plan to upgrade the data lines when appropriate.

Finally, with increased network infrastructure and technology in use, a facility should have the correct people resources to manage and maintain the assets and systems. This includes access to individuals that can maintain the network infrastructure, oversee communications and system integrations, and ensure that the network is keeping up with the demands of the operation.

Information Needs for Apps

A key benefit of connected cars is that a driver or passenger has access to real-time information to understand the available options. However, for a driver to realize a certain facility is an option, the facility needs to present accurate information to the connected world. When was the last time a facility's information was reviewed for accuracy? The simplest data to confirm is the information that does not change very often. Does the parking facility show up on a map in the correct location? Is the correct name used for the facility on the map and are the phone number and website listed accurately? Are the hours of operations accurate? Potential customers use the internet to make decisions—if this information is incorrect, the use of the facility will be affected.

After a facility provides this information more accurately, it should begin to develop means to provide dynamic data. Dynamic data include data such as rate information, real-time occupancy information, availability of online parking sales, or the status of EV chargers and other amenities in the facility.

Technology to Support Credentials and Payments

Every consumer-facing business is enhancing how it interacts with customers, and electronic payment is a key part of the experience. When patrons go to Starbucks, they can pre-order a coffee via an app and pay for it by scanning a barcode on their phone. People can go to the store and pay for their goods by touching their phone to the payment terminal versus pulling out a credit card. Apple Pay, Android Pay, and similar payment technologies are now also making their way into parking operations.

In addition to electronic payments, more garages are using license plate-based credentials to authorize access for monthly parkers, eliminating the need to maintain a prox card. Other facilities are installing barcode scanners to read parking permits from mobile phones. And recently we have seen the introduction of Bluetooth-based devices installed in lanes that authorize access to a facility and collect payments from customers.

When Level 5 autonomous vehicles are more prevalent, a facility will need to be able to support the collection of payment from the vehicle, and there will not be a robotic arm rolling down the window to insert a credit card in the lane equipment. Now is the time to begin implementing this necessary technology, as a facility will be able to leverage these same technologies to enhance the user experience of entering and exiting garages in advance of Level 5 vehicles.

As a facility manager, it is wise to start implementing hands-free technologies that can support access credentials and payments. We are not suggesting to remove your existing equipment and payment tools; rather, begin to layer in the new technologies so that the facility can support the connected cars.

Physical Layout of the Facility

With the expansion of car share, ride share, and eventually autonomous vehicles, how might a facility's layout need to change?

If a facility expects to support an increase in ride-share activity, is it advantageous to convert a few parking spaces into a dropoff and loading zone for the ride-share customers?

If supporting car-share operations, where should the car-share cars be positioned in the facility to make it easier for car-share customers to access the vehicles and drop them off?

If the above activities increase pedestrian activity in the facility, how might walkways be reconfigured and identified to separate vehicle traffic from pedestrian traffic and improve signage and floor markings to alert drivers and pedestrians to each other.

Finally, when the autonomous vehicle traffic increases in a parking facility garage, they will not need the same width stalls that human drivers need. Should a facility establish an autonomous vehicle-only parking area that has narrower stalls to increase parking density?

The adoption of autonomous vehicles will occur gradually in the coming years, but the connected car is here today. The actions a manager implements now for the connected car will also support the autonomous vehicle in the future. There is no reason not to start implementing the changes to support both.

Connected cars and autonomous vehicles are unlikely to eliminate the need for parking, but they will alter how customers interact with parking facilities. While different facilities will experience different impacts based on their users, managers should expect mobility services to become a growing method that people use to transport themselves in addition to their personal vehicles.

Managers can ensure their facilities will support mobility services and connected cars by understanding their current and future customers' needs, confirming the facility information used in maps and other transportation services is accurate, and installing technology that allows a facility to interact with drivers and vehicles. Doing nothing is a sure means to being negatively impacted by the connected car.

So, who's now ready for some ice cream?

MICHAEL DROW, CAPP, is a parking consultant. He can be reached at mjdrow@gmail.com.

PETER LANGE is executive director of transportation at Texas A&M University, College Station. He can be reached at plange@tamu.edu.

BRENT PAXTON is executive vice president, sales and operations, with Parkmobile. He can be reached at brent.paxton@parkmobileglobal.com.