

Overview

Around the globe, new services and technologies are intersecting to create value-added convenience to customers and business owners while better utilising our available parking, mobility, and transport infrastructure. Whether related to car sharing, ride sharing, micro mobility services, prepaid parking, dynamic pricing used in parking, remote management of operations, and/or improved reporting, the sharing of data is key to enabling the adoption of these services. The Alliance for Parking Data Standards (APDS) is harnessing the expertise and experience of parking industry experts from around the world to produce common specifications to facilitate this sharing.

APDS was formed in 2018 by the International Parking & Mobility Institute (IPMI), the British Parking Association (BPA) and the European Parking Association (EPA). APDS has created consensus-built, international parking and mobility data specifications and is establishing a common language for data elements and definitions in the parking, transport, and mobility sectors.

This common language is composed of a set of data elements and definitions that public and private parking owners, operators, and service providers can use to facilitate communication between themselves and also with external stakeholders. This includes stakeholders in the automotive industry, IT developers, official national and international organizations, universities, map and app providers, highway and event operators, airport and railway operators, authorities and municipalities and the end users themselves.

Adopting APDS specifications reduces the effort required to connect technology solutions to each other and allows companies to refocus their resources on developing new innovative services and operations. With the support of the global parking industry, APDS has defined workable data specifications to share parking and mobility data for international use. Over time APDS will continue to update and maintain the data specifications as living, open specifications that will evolve and expand as the marketplace evolves. APDS is working with ISO (the International Organization for Standardization) to have the APDS specifications adopted as formal ISO standards and to develop a bridge to the disparate European standards that currently cover parking data. APDS is also liaising with an ISO drafting group of automobile manufacturers who are developing the standards for Automated Valet Parking to ensure that APDS specifications are coherent with those emerging standards.

Mission

APDS is a not-for-profit organization that is developing, promoting, managing and maintaining uniform global specifications for parking and mobility data that allow organizations to share data worldwide.

How is APDS accomplishing this mission?

By forming cross-functional working groups from within and outside the global parking industry to define an open but specified structure for communicating parking and mobility related information and enabling certain actions between systems used in the parking, transport, and mobility sectors.

The deliverables include standardized terms and definitions to allow participants to communicate in the same language and share data across platforms.

APDS provides a forum for both discussion and decision-making. APDS has released specifications and is supporting maintenance of those specifications as they develop and evolve.

APDS Governance

The APDS is a not-for-profit organization developing, promoting, and managing and maintaining uniform global specifications for parking and mobility data that allows organizations to share data worldwide. The Board of APDS ensures the Alliance has sufficient resources to meet its objectives. It defines specification development priorities, reviews specifications prior to release, and ensures that APDS specifications, including PIPS, support the needs of the industry and external stakeholders. Participation in the Alliance for Parking Data Standards working groups is open to all. We need everyone's support!

The initial preparatory work and Release of version 1 of the APDS specification was financed by the three founding associations and the UK Government's Department for Transportation. APDS Release 2.1 and future releases are funded by sponsorship from leading companies in the global parking and transportation sectors. (See APDS website for details on limited opportunities to sponsor).

Background

As early as 2016 the three founding associations (BPA, EPA, and IPMI (formerly IPI)) were each working independently to develop approaches to share and process information related to parking. In their respective geographical zones each association had established a working group with input from a variety of stakeholders including property owners, parking operators, municipalities, universities, access control system providers, enforcement system providers, marketing firms, transaction processing organizations, map suppliers, and search engines. In early 2018, the three associations agreed to merge their efforts, to establish the Alliance and work together to establish a single, common set of international specifications. Phase 1 of the APDS specifications was released in June 2018 and Phase 2.1 was released in April 2020.

This document provides a summary of the APDS specification development (known as Release 2.1). Subsequent updates will be released in late 2020.

APDS documentation includes data specifications that define how entities should share various types of data within the parking industry and, more importantly, with other industries and users of parking. As smart-city and mobility efforts continue to expand, the ability for parking facilities and operations to participate and share data efficiently will be essential to the continued success of the industry.

APDS has established a formal consultation and governance structure with representation from the across the industry to manage the data specifications and set objectives for the various working groups.

As additional specification needs are identified, APDS convenes working groups to define the relevant data elements and use cases for the addition to the specification. The working groups prepare working papers to document their discussions and initial concepts. The working papers are then presented to the APDS governance structure and industry and related stakeholders for comment. After the comment period, the working group incorporates feedback and develops the final specification. As necessary revisions are made to the documents and the APDS governance structure approves, the data specification is released.

Our Guiding Principles

The principles that guide the APDS specification efforts, in no specific order, are:

The focus is on defining a set of open global data specifications that constitute a common language for parking and mobility operations and sharing related data with other industries. As the APDS specifications develop, collaboration of participants across the globe ensures the specifications are applicable internationally. This includes a data dictionary that enables individuals to translate the meaning of specific data elements to regional terminology.

To ensure the highest probability of adoption, the efforts to create the APDS specifications focus on the needs of the industry. Industry participants define the priorities to ensure that the specifications create immediate value to the industry.

APDS focuses on the parking and mobility industries and does not duplicate efforts across other related industry segments (i.e. public transport and transit, smart city, highway operations, etc.). Where applicable, the Alliance references and takes account of existing standards when developing the APDS specifications.

The individual APDS specifications are versioned and subject to ongoing maintenance. The specifications evolve as a living set of documents that responds to market needs, priorities, and technology. In all cases, the industry, as defined by the entities that volunteer to participate in the development and maintenance of the specifications, is managing the evolution of the specifications.

Use of the APDS specifications is voluntary and adoption is driven by the marketplace.

The intent of the APDS specifications is to enable the sharing of data within the industry and reduce costs and efforts to support data sharing. Each entity that uses the APDS specifications decides the data elements it chooses to share; the specifications define how to share them. How an organisation uses or manipulates the data is not in the scope of these specifications.

The APDS specifications provide guidance on Permissions / Use of Data / Privacy of Shared Data. The specifications define common rules and permissions on how to use and share data.

The APDS specifications do not create a competitive advantage for any one entity or group and APDS does not encourage the use of one entity's services over another.

The creation and ongoing maintenance of the APDS specifications is transparent and open to solicited and structured industry feedback. Industry participants are at the core of the development and maintenance of the specifications. The APDS specifications are made available for public review and comment.

APDS' role is to convene parking and mobility industry and data standards experts, as well as related stakeholder representatives, to develop and maintain the parking data specifications. APDS does not and will not store data or act as an aggregator.

Implementation

The APDS specifications are now ready for use. The first pilot implementation was introduced in the City of Manchester, UK. With the aid of funding from the UK Government, the city authority put in place an open data platform, based on APDS specifications, which brings together dynamic real time information on availability and kerbside management into a single source (supplied by data from multiple sources owned by private operators and the city). The platform provides:

- Real time off street dynamic parking availability data on city centre NCP and Q-Park car parks in open data (APDS compliant) format through a single online portal (data feed).
- Static data on city centre parking & kerbside (loading, deliveries, etc) restrictions and spaces to be made available in open data format through a single online portal (data feed).
- As part of the initial project, the data is available to end users via the Parkopedia app resulting in a full proof of concept. The APDS compliant open data feed is available for all online consumer/publishers to connect to and provide the data to their own customers via their apps and websites.

Numerous equipment and service providers are developing APDS compliant services and products.

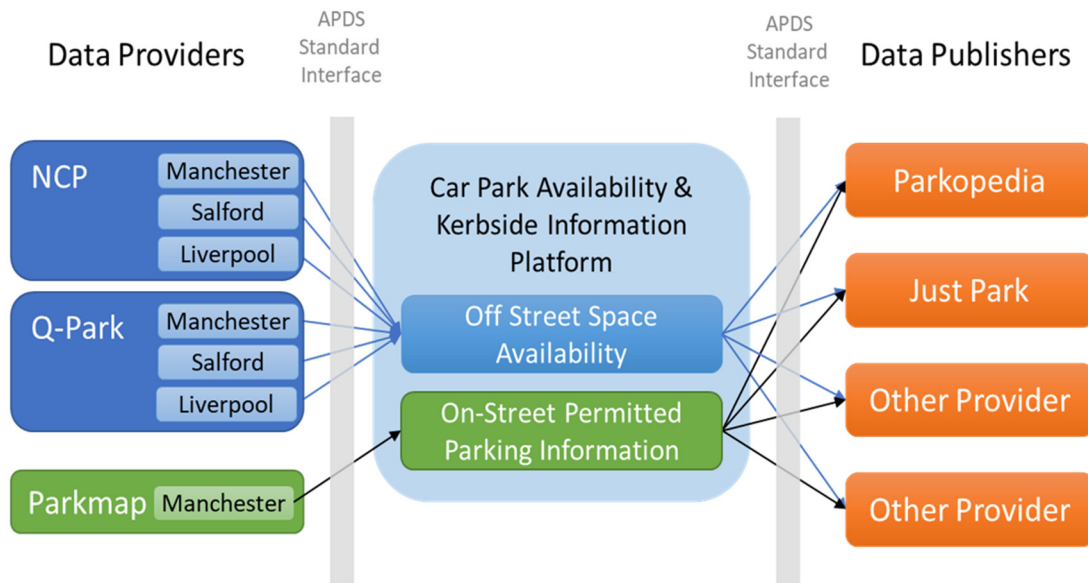


Figure 1 - Initial phase of the Manchester City Open Parking Data Platform

APDS Specification Development Program

Developing a complete set of specifications to cover every possible data element related to parking and mobility is a significant and time-consuming undertaking. APDS has established milestones and deliverables to break down the effort into achievable and meaningful steps. By grouping data elements into specific data domains, we allow the community to work on specific data domains to create additional specifications.

Figure 2: Data Domain Overview shows the phased delivery of data domains that comprise the APDS Specifications.

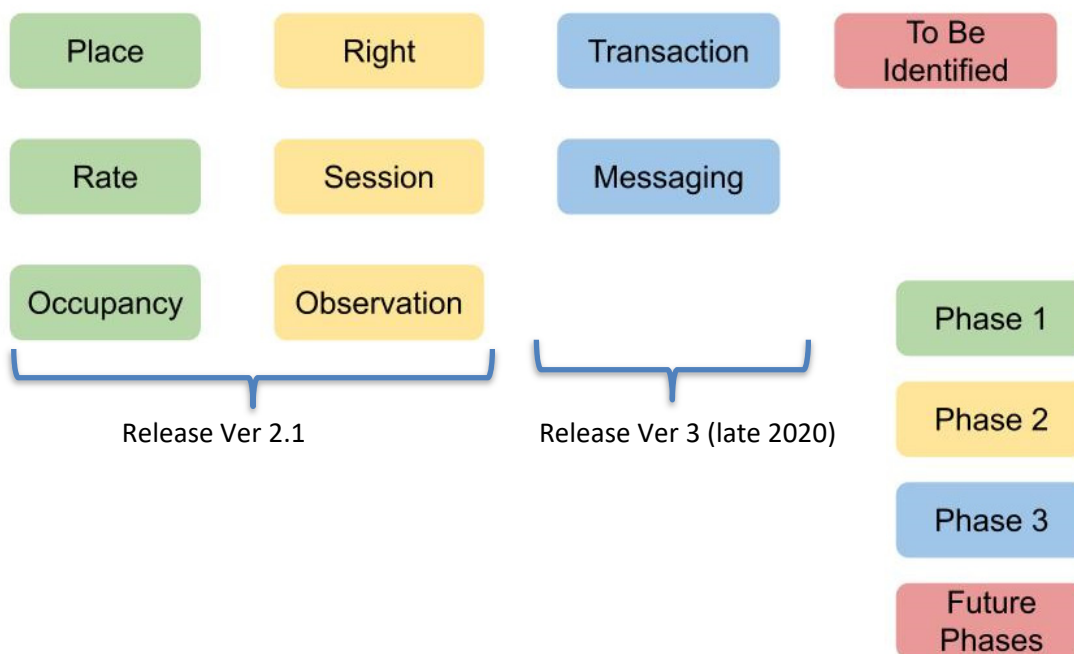


Figure 2: Data Domain Overview

While there are many data elements that require standardization, the initial effort was prioritized, per APDS *Guiding Principles*, to develop specifications for the following data domains, which were released as Phase 1 in June 2018:

- *Place Information.*
- *Rate (Pricing).*
- *Occupancy / Utilization.*

Phase 2, released in April 2020 (Release 2.1), adds the following data domains to the APDS specification:

- *Rights.*
- *Sessions.*
- *Observations.*

The APDS specifications define the data structure to share relevant *Place* (on- or off-street), operational transactions (Sessions), and other data shared between parties. The specifications define common terms and a consistent structure to share and receive data.

Figure 3: Data Domains – APDS Release 2.1 shows the content included in the current release of the APDS specifications.

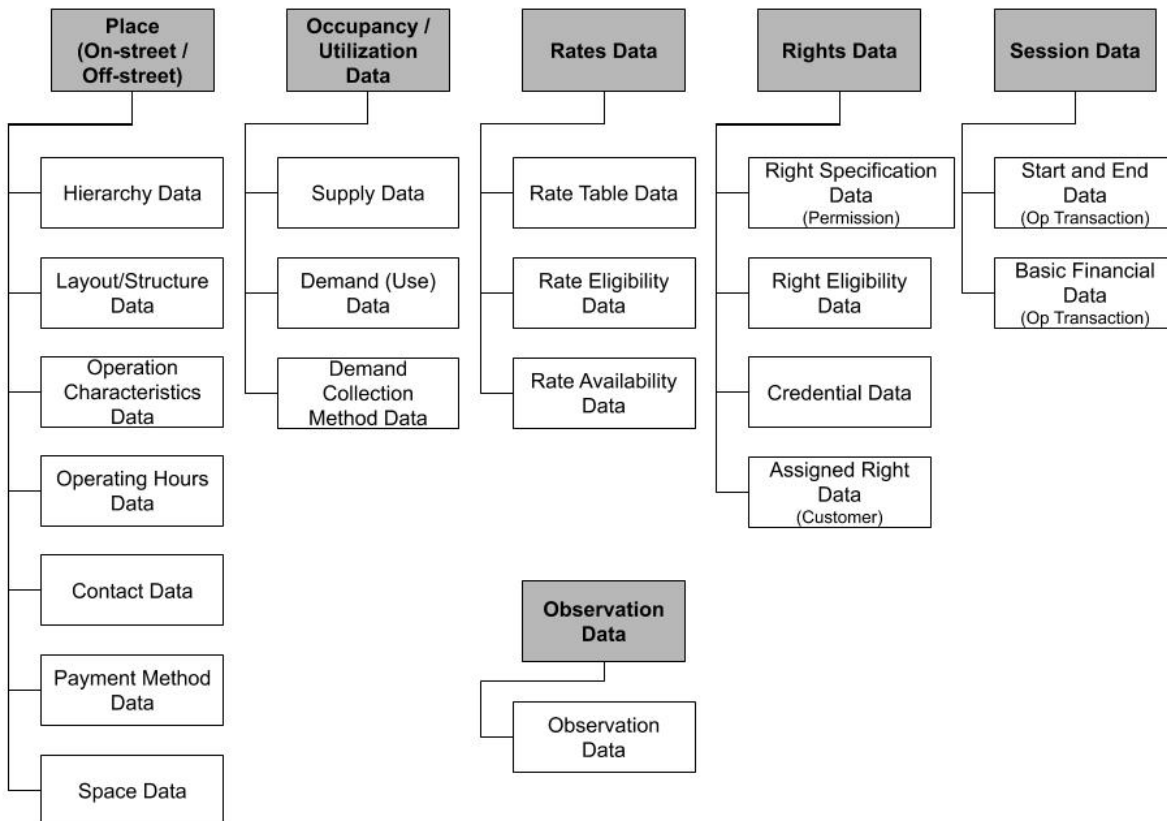


Figure 3: Data Domains – APDS Release 2.1

APDS Technical Documentation

The APDS Technical Documentation describes a set of data elements and definitions public and private parking owners, operators, service providers, and others can adopt and use as a common language to facilitate the communication of data between themselves and with the outside world.

The specifications comprise a set of documents that define the various data elements related to parking and mobility operations and show the relation of these data elements to other data elements. The documentation includes the following documents and information:

- Information Model Document.
 - List of data elements.
 - Defined lists of acceptable entries for certain data elements.
 - Identified references to other standards, as appropriate.
 - Relationship diagram showing how the data is organized.
- Use Case Document: example use cases for applying the data specification.
- Data Dictionary Document: Terminology and definitions for the data elements.

Data Specification Permission and Security

The APDS data specifications do not specifically define data security and permissions rules. It is incumbent on the party sharing its data to use common data security and data access practices with the parties it is engaged.

The following are guidelines an entity should consider:

- Access and security to data is controlled by the Distributing Party of the data.
- It is the responsibility of the Distributing Party of the data to implement a security protocol that protects access to data on the Distributing Party's network. Typically, a Distributing Party will issue an authorization token to a specific Receiving Party to validate and control access to specific data sets.
- The Distributing Party should manage the specific amount of data that a Receiving Party can access. It is customary that different Receiving Parties will receive different sets of data.

Receiving Party should confirm ownership of data when data for a Place record previously received is newly received from a different Distributing Party.

- Due to the distributed nature of data ownership in the marketplace, it is expected that a Receiving Party will eventually receive data on a specific Place record from different sources.
- The Receiving Party should have a data procedure to identify conflicting data records for the same Place record and a process to validate the appropriate data owner.

Examples of this scenario

Example 1 - Parking Operator A transfers management duties of Place 1234 to Parking Operator B. Thus, at one time, Parking Operator A was the Distributing Party for Place 1234. Parking Operator B became the new Distributing Party when it took over management duties.

A Receiving Party has Place 1234 in its database with a record update date/time of 15 June 2016 by john.doe@parkopA.com.

A Receiving Party receives a new data feed for Place 1234 in its database with a record update date/time of 31 March 2017 by jane.smith@parkB.com.

Receiving Party should have a process to contact parties to confirm which record is accurate.

Example 2 - Parking Operator A is managing Parking Place 6789 and is a Distributing Party for the place. Owner C owns Parking Place 6789 and is a Distributing Party for the parking place. In this example, there are two Distributing Parties.

Receiving Party will decide which data elements are different and which to use. Most likely, the difference will be in the logos provided and contact information. Receiving party can merge contact and logo information into a single location record or select one of the Distributing Parties as the default source as they determine is appropriate.

Place Data Specification

The *Place* specification facilitates the sharing of basic *Place* information between organisations and systems. These include map services, online marketing and aggregator services, event ticketing platforms, public transport and transit companies, and other firms, organisations or individuals that have a need to know the location of parking and mobility services and general information about their operation.

Benefits of Place Data Specification

Parking a vehicle is a geographic based activity. This means people and entities search for parking based on proximity to a destination. These searches require a person or application to know certain facts about the *Place*, such as where the *Place* is located, whether the *Place* is available to use at a certain time, how to access the *Place*, who to contact, and other relevant operating attributes.

Currently, there is not a common method to share *Place* information. How should the name of the *Place* be identified? Is it available for use by the public?

By providing a common specification for sharing this information, firms will more quickly and accurately be able to share and find *Place* data to support value added services that can be offered to businesses and consumers.

In addition, more detailed data sharing such as *Rates*, *Occupancy*, and online transactions (*Session*) all have an association to the *Place*. It is very difficult to share more detailed data if the *Place* data is not accurate.

Use Cases Supported by the Specification

The following use cases are examples of data sharing the *Place* specification is intended to support. Additional use cases will be added to the specification to ensure the specification supports them effectively.

Use cases:

- Find, reserve and pay for parking.
- Update data with a data aggregator.
- A platform to interface with a parking operator.
- Exchange data within an organization.

Place Hierarchy

The specification defines a method to build a hierarchy of *Place* records. This enables an operation to breakdown a *Place* into discrete enclosures to better communicate operating hours, space counts, operating restrictions, location, and eventually rates and utilization information in a consistent manner.

The hierarchy allows a Distributing Party to decide the appropriate level of detail to send to a Receiving Party.

The hierarchy supports the ability of lower level *Place* records to inherit data elements from higher level *Place* records because when sharing a lower level *Place* record, all *Place* data (that contains the lower level data record) will flow down and be distributed as well. Figure 4: Place Hierarchy depicts the use of these data elements.

Place is a term introduced in the specification to define where a vehicle may park, stand, rest, or briefly transit to allow a person to change modes of transport (i.e. taxi drop-off/pickup, ride share drop-off/pickup, valet stand, etc.).

The *Place* is a collection of *Hierarchy Elements*. *Hierarchy Elements* allow an operating entity to subdivide the *Place* into homogenous operating areas. The *Place* is typically identified in the physical world as a specific parking structure, surface lot, or city zone of on-street parking or delivery area.

A Hierarchy Element is a collection of Identified Areas and other Hierarchy Elements. In the APDS data specifications, the lowest data element to define a *Place* is the Identified Area. This is a required data element.

A collection of *Identified Areas* ultimately defines the lowest level *Hierarchy Element*.

A collection of *Hierarchy Elements* can create higher level *Hierarchy Elements* or a *Place*.

At the highest level, a collection of *Places* can be defined by a *Campus*. A *Campus* is not a required data element in the model.

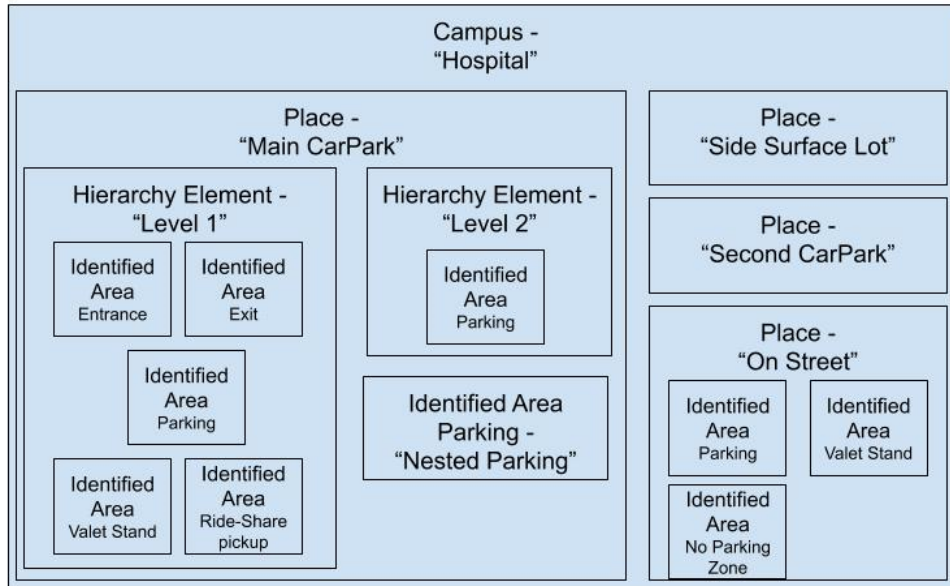


Figure 4: Place Hierarchy

The Identified Area data element can be identified as one of two types of purposes in parking, mobility, or kerbside management operations. The two types are *Vehicular Access* and *Specific Area*.

Vehicular Access class is a type of *Identified Area* data element that enables a *Place* to share relevant information about entry lane, exit lane, and similar type of access points to a *Place*. The *Vehicular Access* type enables an entity to share relevant information about points of entry to a *Place*.

Specific Area class is a type of *Identified Area* data element that enables a *Place* to denote specific geographic areas in a *Place* that have a common physical infrastructure purpose. Examples of common infrastructure purpose include parking area, electric charging infrastructure, bike storage. The *Specific Area* class describes the physical components of a *Place*. This type is NOT used to define or describe logical or virtual areas of a facility as the *Right* data element more effectively defines various uses of a *Specific Area* type of *Identified Area* (e.g. reserved parking, loading/unloading, valet, etc.)

The *Identified Area* also collects general operating information such as operating hours, operating restrictions, rate information, space information, and payment information. If the data is absent at the *Identified Area*, it is assumed the data is inherited from higher layers in the hierarchy, perhaps ultimately from the *Place* level. This allows for customization of operations at lower levels while relying on default data.

A *Place* is synonymous with where a vehicle parks or a mobility service is delivered. It can be a collection of five (5) parking *Spaces*, an entire parking structure, a curb supporting on-street parking or a collection of streets supporting on-street parking. General operating information such as operating hours, operating restrictions, rate information, space information, payment information, etc., is associated to a *Place* and any parking or operating *Places* underneath it as appropriate.

The following example demonstrates the use of the hierarchy and data domains.

A parking operation includes a surface lot and a parking garage. Collectively the parking operation is known as “Main Street Parking.” The parking garage, called “One Main Parking” contains four (4) levels and includes 500 spaces. The surface lot is 200 spaces, of which 100 are covered. The parking garage has a premium parking area on the first level for 25 cars. There is no access technology and customers purchase a prepaid parking pass and display it on the vehicle’s dashboard or provide their license plate number. The parking garage has a nested area of 50 spaces that is controlled by automatic vehicle identification (AVI) tag on the third level - 24 hours a day Monday through Friday.

The surface lot has 25 covered spaces which are reserved for tenants and not available to the public Monday – Friday 6 a.m. – 9 p.m. These spaces are otherwise open to the public.

Main Street Parking is open to the public and the hours of operation are defined below:

Parking Garage - 24 hours per day

Premium Parking area - 24 hours per day

Parking Garage - nested area for reserved parkers - 24 hours per day

Surface lot (reserved parking area) – Monday – Friday 6 a.m. – 9 p.m. not available to the public; available to the public other times

Operating Hours by Parking Place and Time

			Mon – Fri (0900 – 1800)	Mon – Fri 6 p.m. – 9 a.m. (Mon starts at 0000 and Fri ends at 2359)	Sat – Sun (0000 - 2359)
Place →	Main Street Parking Operation				
Hierarchy Element →	One Main Garage (total 500)				
Identified Area →		Normal space	425	425	475
Identified Area →		Premium	25	25	25
Identified Area →		Reserved	50	50	0
Hierarchy Element →	Surface (total 200)				
Identified Area →		Covered	75	100	100
Identified Area →		Uncovered	100	100	100
Identified Area →		Covered Reserved	25	0	0

Applying the data specification, a Distributing Party builds the *Place* records with associated hierarchy data elements as shown above. The data specification suggests that a Distributing Party provide data elements and *Place* hierarchy to the level of detail appropriate. As an example, an entity may only send the detail about Main Street Parking Operation to the One Main Garage and Surface Lot level for one integration partner. For a different integration partner, it may send all hierarchy levels. An entity controls the amount of detail they provide. However, when providing lower level details, the higher-level details must be included.

For a more in-depth review of the *Place* specification, refer to the Information Model, Use Case, and Data Dictionary documents.

Right Data Specification

The *Right* specification defines how a facility / *Place* owner or manager authorizes the use or *Rights* (e.g. park, delivery, pick up, etc) of a specific *Place* to various users or vehicles via a credential at a specific set of *Rate(s)*, if a *Rate* applies

The *RightSpecification* defines the operating parameters for parking or related mobility activities (Delivery, pick-up/drop-off, electric vehicles only, etc.). A *RightSpecification* is the combination of operating privileges, *Rate(s)*, at *Place(s)*, during a specific time period for a type of user or vehicle.

The *RightSpecification* is best described as the template of a *Right* as defined by the *Place* owner. A *RightSpecification* is granted to a specific *RightHolder* by an *AssignedRightIssuer*. The *AssignedRightIssuer* can be the *Place* owner, a reservation service, or other entities, identified as *Assigned Right Issuers*, authorized to sell or distribute the *RightSpecification* on behalf of the *Place* owner.

When a *RightSpecification* is granted to a specific *RightHolder*, an *AssignedRight* is created. The *AssignedRight* includes the information from the *RightSpecification* as well as specific information related to the *RightHolder* (expiration of the *AssignedRight*, number of uses, etc). In some cases, an *AssignedRight* can include the ability to perform a specific *RightSpecification* multiple times (example, prepay for five (5) parking events). When a specific, future use of the *AssignedRight* is initiated a *Planned Use* is generated.

RightSpecification

- 1) Has a unique identification within a *Place*.
- 2) Has a description of the *Right* granted.
- 3) Has an expiration: the date/time when the right is no longer valid for any user as defined by the *Place* owner.
- 4) Has a creator: the entity, typically the *Place* owner, that defines and authorizes the *Right*.
- 5) Has authorized credential types.

Data Associations to a *Right Specification*:

- 1) *Place*: defined earlier in the document. *Place* defines where a *RightSpecification* is valid. A *RightSpecification* can be associated to multiple *Places*. Each *Place* owner needs to authorize the *RightSpecification* and reference the proper *RightSpecification* IDs when sharing data.
- 2) *Eligibility*: This is a group of data elements that define the type of vehicle or customer that is able to access the *RightSpecification*. *Eligibility* may be associated with being a member of a group (office employee, resident, etc), a vehicle type (electric car, Truck, passenger car, etc), or use of a *Rate* in a previous session. *Eligibility* is associated to *RightSpecification* via *RateEligibility*.

Rate Table: *RateTable* is a specific *Rate* structure that defines how a *Right* is priced. A *RightSpecification* can have multiple *Rates* associated to it as long as the *Rates* all apply to the same *Eligibility* requirements and *RightSpecification* via *RateEligibility*. Actual pricing in *Rates* may vary based on time of day.

- 3) *RateEligibility*: defines the combination of *Eligibility* requirements with *RateTables* and associates this combination to a *RightSpecification*. *RateEligibility* enables a *RightSpecification* to have association to multiple *RateTable(s)* for a specific *Eligibility*. *RateEligibility* also defines if *RateTables* are *Combinable*. This is a Yes / No (Boolean) definition. Either all *RateTables* associated to a *RightSpecification* with a common *Eligibility* can be combined or they cannot.

If *RateEligibility* has the *Combinable* flagged YES, then *Rates* can be combined in a *Segment*.

- 4) *OperatingTimesValidity* defined earlier in the document. This defines when the *RightSpecification* is available for use. In association with *Right Pool*, this data element defines the specific number of *RightSpecifications* that are available for use, in use, or intended for use in specific date/time periods. A *RightSpecification* for monthly parking for a business employee may have *OperatingTimes valid* Monday through Friday from 6am to 9pm. While a resident may have a *RightSpecification* with *OperatingTimes Validity* of Sunday through Saturday 24 hours a day.
- 5) *Right Pool*: shares the number of *AssignedRights* that are available for use, are currently in use, or intended for use within a specific *RightSpecification* in specific date/time periods by a specific *AssignedRightIssuer*. A specific calendar (i.e. March 23, March 25, April 7) can be defined to represent the number of *AssignedRights* available for distribution via the *OperatingTimesValidity* or a recurring time period can be defined (Monday – Friday, Saturday-Sunday) via *RelativeValidity*.
- 6) *RightHolder*: this is a specific entity [e.g. individual, corporation, vehicle] that is issued a *RightSpecification* by either *Place* owner or an *AssignedRightIssuer* via an *AssignedRight*. The *RightSpecification*, along with additional data related to the *RightHolder*, is contained in the *AssignedRight* data element. Associated to a *RightHolder* are the individuals and/or vehicles able to access the *AssignedRight*.

- a) A *RightHolder* may have multiple vehicles associated to one or more credentials
 - i. A person that has access to more than one vehicle and uses them interchangeably.

- b) A *RightHolder* may have multiple users associated to one or more credentials
 - i. Example: a company that provides parking to its employees under one contract, or that issues validations to customers to discount their parking.
 - ii. Example: a family share a defined number of credentials

- a) *AssignedRight*: when a *Place* owner or authorized issuer grants a *RightSpecification* to a specific person or entity, an *AssignedRight* is created. The *AssignedRight* includes the key data from the *RightSpecification* as well as specific data related to the *RightHolder's* use of the *RightSpecification* which includes:
 - i. Approved credential,
 - ii. Expiration date and time of *AssignedRight*,
 - iii. *Rate(s)*
 - iv. Valid number of uses, minutes or some other value describing the quantity of use.
 - v. Data on the entity that issued the *RightSpecification* to the *RightHolder*. The issuer can be the *Place* owner, *Place* manager, or a 3rd party entity authorized by the *Place* owner, identified as an *Assigned Right Issuer*.
 - vi. Data about when the *AssignedRight* was issued to the *RightHolder*
 - vii. *AssignedRight* has one to multiple *PlannedUse(s)*

- 7) *PlannedUse*: When an *AssignedRight* is “activated” for a future use, a *PlannedUse* data element is created. The *PlannedUse* defines the proposed time to use the *AssignedRight* in the future and identifies the credential of the *AssignedRight*.

For a more in-depth review of the *Right Specification*, refer to the Information Model, Use Case, and Data Dictionary documents.

Session and Segment Data Specification

The *Session* specification documents the actual act of parking, or other use of an *AssignedRight* such as delivery, pickup, etc. A *Session* captures the ACTUAL use of an *AssignedRight* and includes start time, end time, credential, and other relevant data related to an operational transaction. A *Session* is not used for future activities.

A *Session* is broken into one or multiple *Segments*.

Segments enable a single *Session* to capture and report changes in *Rate* and *AssignedRight* during a *Session*.

A *Segment* can only have one *AssignedRight* and *Rate* associated to it.

Session

- Has a unique identification within a *Place*.
- Has a start time and end time.
- Has at least one *Segment*.
- Is associated to a *Place*.

Segment

- Is associated to a *Session*.
- Is associated to an *AssignedRight*.
- Is associated to a specific *Rate* via the *AssignedRight*.
- Has a start and end time.
- Has a credential via the *AssignedRight*.
- Is associated to basic financial data.
- Has version control on the *AssignedRight* (i.e. a *Segment* starts with one *AssignedRight* and then is updated to a new *AssignedRight* at the end of the *Segment*, replacing the original).
- Has a *Place* reference or *Space* ID.
- Can be associated to one or multiple *Observations*.

Financial transaction data will be expanded upon in future releases of the APDS specification. To allow basic sharing of financial data immediately, certain financial data is associated to the *Segment*. Each *Segment* has its own financial data defined. An entity is able to sum the financial data of each *Segment* to determine total *Session* financial data.

- a) Minimum financial data to include in a *Segment* includes:
 - i. Total value of *Segment* based on expected value to be received by *Place* owner or operator (i.e. amount of calculated rate table based on *Session* times).
 - ii. Entity name of the service provider that is responsible for selling/collecting fees associated to the *Segment*.
 - iii. Tax included in value - Yes/No (Boolean).
 - iv. Country currency.

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- b) Optional data to include in Segment:
 - i. Date segment fees collected by service provider.
 - ii. Transaction ID (reservation #, credit card transaction #, etc.) as agreed upon by the two entities sharing data.

The financial data collected under Release 2.1 of the APDS specification is the value of a transaction based on a defined *RateTable* that is associated to a *Segment* via the *AssignedRight*. The transaction value shared in the *Segment* is the amount of the transaction that is expected by the owner or operator of the *Place*.

For a more in-depth review of the *Session* specification, refer to the Information Model, Use Case, and Data Dictionary documents.

Rate and Occupancy Data Specification

The *Rate* and *Occupancy* specifications facilitates the sharing of *Rate* data- the fees an owner/operator is charging to use services or *Rights* and *Occupancy* data – the available inventory for use at a *Place* and the current usage of the *Rights* or *Spaces*.

Benefits of Rate and Occupancy Specification

Information is becoming a highly valuable resource to support customer needs. The ability for an entity to share *Place* data as well as *Rate* and *Occupancy* information helps consumers to make more informed decisions about options that best fit their mobility and parking needs.

By providing a common specification for sharing this information, firms are able to more quickly and accurately share and find *Place*, *Rate* and *Occupancy* data to support value added services that can be offered to businesses and consumers.

Defining a data specification for sharing parking and mobility data allows the industry and consumers to more effectively incorporate the data into their services.

Use Cases Supported by the Specification

The following use cases are examples of data sharing that the *Rate* and *Occupancy* Specification supports. Additional use cases will be supported and will be added to the specification to ensure the specification supports them effectively.

Use cases:

- 1) Share *Rate* and *Occupancy* information with map providers to present the information on maps.
- 2) Share *Rate* and *Occupancy* information with an aggregator.
- 3) Share updates of *Place* information with a map provider or aggregator.
- 4) Present *Rate* and *Occupancy* on a self-managed or third party hosted website or mobile application.
- 5) Configure *Rates* in PARCs, meters and other revenue and access control systems.

Rate Data

The specification defines a *Rate Table* and the critical data elements to include in a *Rate Table*. It also introduces a concept to define a collection of *Rate Tables* at a *Place* that can be updated on a collective basis.

A *Rate Table* in the data specification represents a set of charges that are applied to a single set of criteria and a single *RightSpecification* for parking or other operation (e.g. delivery permits, rideshare access, etc.) at the *Place*.

Rate Line defines how to calculate a tariff for the specific time durations and fees for specific parking or another event.

Rate Surcharges defines additional fees and taxes associated with the *Rate Table*.

Eligibility defines a singular set of criteria (*Qualification*) that enables users to access a *Rate* and a single *RightSpecification*.

Rate Name - common name used at a *Place*

Rate ID - identification to associate a specific *Rate Table* across various platforms and devices. This includes online services, PARCS, pay station, mobile payment provider, etc.

Rate Type - describes that type of the *Rate Table* define the fees for daily, contract/monthly, event, validation, etc.

Rate Expiration - when the *Rate Table* is replaced by a new *Rate Table* or permanently deactivated for use



Key concepts

- A *Place* or *Hierarchy Element* may have multiple *Rate Tables* active simultaneously during a specific time of the day.
- *Rate Tables* have effective periods -- times of day when a parker should expect to pay the *Rates* defined (i.e. active Monday to Friday 6 a.m. until 12 a.m., Friday @ 5 p.m. through to Monday @ 2 a.m., etc.).
- *Rate Tables* have expiration dates and times -- times when the *Rate Table* expires and is no longer valid for use or is replaced by a *new Rate Table*.
- *Places* can have their *Rate Matrix* replaced with a new *Rate Matrix* to allow simpler *Rate Table* revisions.

For a more in-depth review of the *Rate* specification, refer to the Information Model, Use Case and Data Dictionary documents.

Occupancy Elements

The specification defines relevant *Supply* and *Demand* data to communicate *Place* utilization. The data is associated to an *Identified Area* or *Space*.

Supply: defines the parameters of the *Supply* of parking. This is the total number of *Spaces* usable for parking. It can be defined as demarcated or non-demarcated spaces.

Space: defines the specific *Space* ID and associated information on a specific *Space*, such as *Space* characteristics, methods of *Occupancy* detection, and valid time of *space* information.

Demand: defines the parameters of reporting actual usage of parking in a hierarchy.

Demand Space: defines the *Occupancy* status of a specific *Space* and associated usage start and end times.

The document provides initial definitions for each data element, the suggested format to transfer data, and where appropriate defined lists to ensure consistency on specific data elements.

Occupancy

Occupancy has been deconstructed into two data segments: *Supply* and *Demand*.

Supply is the data that defines the number of vehicles or *Spaces* that can be parked in the defined *Place*, *Hierarchy Element* or *Identified Area*.

Demand is the data that defines the actual number of vehicles parked or *Spaces* occupied.

By separating the *Occupancy* data into a *Supply* and *Demand* (*Occupancy* domain), the intent is to improve the efficiency of communicating *Demand* data (real-time parking space usage). It is assumed that *Demand* Data will be communicated very frequently, potentially more frequently than every five (5) minutes. It is assumed that *Supply* data does not change frequently and can be communicated every day. This approach enables the *Supply* data segment to communicate a majority of the data on *Spaces* while the *Demand* data is limited to communicating critical data that changes frequently.

Supply data includes data elements that define the type of *Right* supported in the *Identified Area*, methods used to detect usage, *Space* count, and *Space* characteristics. When defining the *Supply* for a *Specific Area*, an entity can communicate if the *Space* count is based on actual demarcated spaces (i.e. there are five (5) parking spaces defined as five (5) demarked parking spaces) or if the *Supply* count is based on derived data.

As an example of a derived Supply count, consider a street curb that is not marked with specific spaces. The street curb is 100 metres long and the controlling entity assumes the average length of a vehicle parking is 5 metres. The derived available supply is 20 spaces. A different entity could use a different average length of 7 metres and report 14 spaces. It is the responsibility of the entity to determine the appropriate method to use when sharing derived space supply.

For a more in-depth review of the *Occupancy* specification, refer to the Information Model, Use Case, and Data Dictionary documents.

Observation Data Specification

The *Observation* data specification includes the data elements that document the *Observation* of an entity in a *Place* performing an action. *Observations* can be visual or electronic (e.g. ALPR read, RFID read, etc).

Observation:

- has a date/time when the Observation is made.
- has a location where the Observation is made.
- has an association to a credential Observation.

Credential Observation:

- has a reference identification of the Observation.
- has a method of Observation (ALPR, visual, ticket, RFID, etc.).
- has an observer name (who made the observation).
- has a credential type Observation (license plate, tag, hang tag).
- has the credential Identification observed.

For a more in-depth review of the *Observation* specification, refer to the Information Model, Use Case, and Data Dictionary documents.