Overview

Version 4.1 Release

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Overview

These are exciting times – around the globe, new services and technologies are intersecting to create value-added conveniences for customers and business owners while better utilizing available parking, mobility, and transport infrastructure. Whether related to car sharing, ride sharing, micro-mobility services, prepaid parking, dynamic pricing in parking structures, remote management of operations, and/or improved reporting, the sharing of data is key to accelerating the adoption of these services.

Through the Alliance for Parking Data Standards (APDS), the parking, transport, and mobility sectors are managing consensus-built, international parking and curbside management data specifications. These data specifications define a common language based on a set of data concepts and definitions that public and private property owners, operators, and service providers can follow to facilitate communication between themselves and with other industries. The specifications facilitate seamless integration, compatibility, and communication between parking entities, mobility operators, the automotive industry, IT developers, ITS operators, services, map and app providers, as well as other stakeholders.

APDS maintains the data specifications as a set of living, open specifications that evolve and expand as the marketplace's needs adjust. Additionally, APDS works with ISO (the International Organization for Standardization), its European regional counterpart (CEN) and other bodies to incorporate the ADPS specification into other formal standards.

Mission

APDS is a not-for-profit organization developing, promoting, and maintaining uniform global specifications for parking and curbside related data that allows entities to share data worldwide.

How is APDS accomplishing this mission?

By forming cross-functional working groups from multiple sectors to define an open structure for communicating parking and curbside related information and enabling certain data actions between systems.

The deliverables include standardized terms and definitions, as well as messaging formats, which allow participants to communicate and share data across platforms.

APDS provides a forum for both discussion and decision-making on the specifications. APDS maintains its existing specifications and will release new specifications as necessary. The current release is identified as version 4.1. In addition, the APDS data specification has been published by ISO as Technical Specification ISO TS5206-1.

Background

In early 2018, the British Parking Association, European Parking Association and International Parking & Mobility Institute agreed to merge efforts to establish a single, common set of international parking and curbside data specifications. The initial phase of these specifications was released in June 2018 and additional releases have broadened the scope of the specifications. The specifications have been reviewed by industry experts from over 30 countries with over 600 contributors providing comments.

This document provides a summary of the current APDS specification. The specifications enable entities to share various types of data within the parking and curbside sectors and, more importantly, with other sectors and users of parking and curbside resources. As smart-city, curbside management and mobility efforts continue to expand, the ability for parking facilities and operations to share data efficiently is important to the continued success of the sector.

APDS established a formal consultation and governance structure, with representation from appropriate parties, to manage the data specifications and set objectives for the various working groups to develop additional data domains for the specification.

As the specifications evolve, APDS convenes working groups to define relevant data concepts and use cases. Working groups prepare working papers to document their discussions and initial concepts. Working papers are then presented to the APDS governance structure and related stakeholders for comment. After the comment period, the working group incorporates feedback and prepares the final specification for APDS governance structure approval before the data specification is released.

APDS continues to provide support. A training programme developed by APDS is designed to facilitate adoption of the standard. In addition, APDS experts are also available for specific consultations.

Adopters come from a wide variety of organisations, both public and private. In addition to associations such as EPA (European Parking Association) and BPA (British Parking Association), there are municipalities (e.g. Antwerp, Belgium), not-for-profit organisations (e.g. UK NPP National Parking Platform) and commercial players (e.g. several of the largest car park operators in Europe).

APDS Governance

The Alliance is a not-for-profit organization developing, promoting, and maintaining uniform global specifications and standards for parking and curbside management related data that allows organizations to share data worldwide. The APDS Board of Directors provides governance structure and procedures to manage the development and maintenance of the specification. Its purpose is to ensure that the Alliance has sufficient resources to meet its objectives and to define specification development priorities, review specifications prior to release, and ensure that specifications support the needs of the sectors and external stakeholders. Participation is open to all; APDS is championed by Sponsors, Affiliates, and free Supporters.

Guiding Principles

The guiding principles that direct APDS efforts, in no specific order, are:

1. **To focus on defining a set of open global data specifications that constitute a common language for parking and curbside operations and sharing related data with other**

sectors. As the APDS specifications evolve, collaboration of participants across the globe ensures the specifications are applicable internationally. This includes a data dictionary to translate the meaning of specific data concepts to regional terminology.

2. **To ensure the highest probability of adoption, the effort to create the APDS specifications focuses on the needs of the parking and curbside sectors.** Sector participants define the priorities to ensure that the specifications create immediate value.

3. **APDS maintains a focus on the parking and curbside sectors, and will not duplicate efforts across other related segments** (i.e., public transport and transit, smart city, highway operations, etc.). Where applicable, APDS references and considers existing standards when developing the specifications.

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

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

6. **The intent of the APDS specifications is to enable the sharing of data within the parking and curbside sectors, reducing costs and the effort required to support data sharing.** Each entity that uses the APDS specifications decides the data namespaces it chooses to share; the specifications define how to share them. How an organization uses or manipulates the data is not in the scope of these specifications.

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

8. **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**.

9. **The creation and ongoing maintenance of the APDS specifications are transparent and open to solicited and structured feedback**. Participants are essential to the development and maintenance of the specifications. The APDS specifications are made available for public review and comment.

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

APDS Technical Documentation

APDS Technical Documentation describes a set of data concepts and definitions that public and private facility owners, operators, service providers can adopt and use as a common language to facilitate the communication of data between themselves and other sectors.

The specifications comprise a set of documents that define various data related to parking and curbside management operations, and show the relationships of these data to each other. Documentation includes the following:

- Information Model Document.
    - List of data namespaces, classes, attributes, and relationships.
    - Defined lists of acceptable entries for certain data elements.
    - Identified references to other standards, as appropriate.
    - Relationship diagram showing how the data is organized and expected to be sent.
- Use Case Document: example use cases for applying the data specification.
- Data Dictionary Document: Terminology and definitions for the data elements.
- API Specification: version 4.1 of the standard introduces an additional component to the set of documents that comprise the APDS specification, the API specification. It is provided as a machine-readable specification file formatted in accordance with the Open API 3.1.0 standard. The APDS API forms the basis for adopters'/implementers' efforts to ensure the use of a common data language.

APDS Specification Development Priorities

Developing a complete set of specifications to cover every possible data sharing need related to parking and curbside management activities is a significant and time-consuming undertaking. APDS establishes milestones and deliverables to develop the specification into achievable and meaningful steps. Figure 1: Data Domain Overview shows the current data domains that comprise the APDS Specifications.

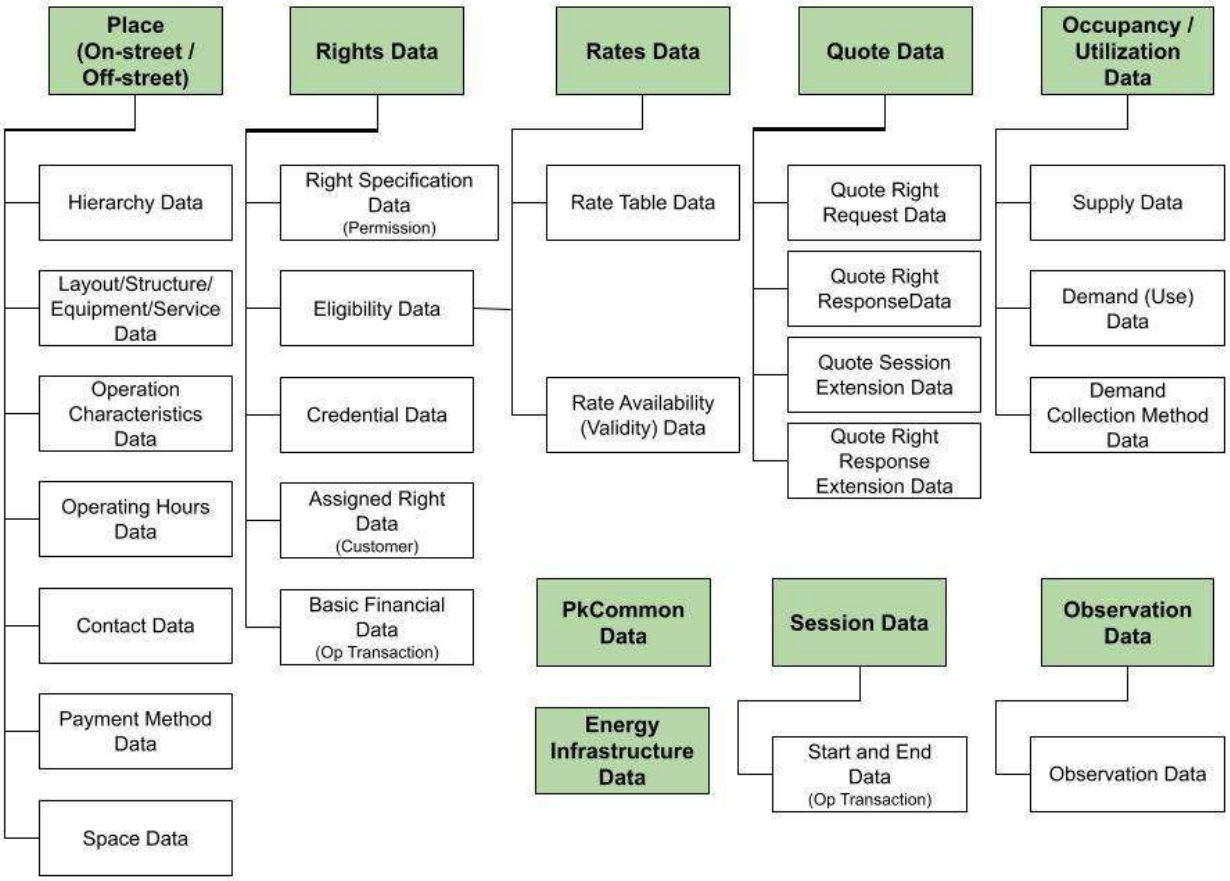

Figure 1: Data Domain Overview

APDS specifications define the data structure to share relevant on street and off-street parking and curbside management location data, rates, quotes, transactions, permissions/rights, facility infrastructure and other data between parties. Specifications define common terms and a consistent structure to share and receive data.

Overview of the Data Specification

Place Data Specification

The Place Data specification facilitates the sharing of basic place information between organizations and systems. These include, but not limited to, map services, online marketing and aggregator services, event ticketing platforms, public transport and transit companies, and other firms, organizations or individuals that need to know the location of parking, mobility and curbside services and general information about each operation.

Benefits of Place Data Specification

Parking a vehicle, delivering a good, picking up a customer or accessing a mobility service is a geographic-based activity. People and entities search for parking and other services based on proximity to a destination. Search results need to provide 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.

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

In addition, higher levels of data sharing such as pricing, occupancy, and online transactions all have an association to the *Place*. It is very difficult to share additional data if the *Place* data is not known or not accurate.

Place Hierarchy

The specification defines a hierarchy of *Place* data that is relevant to an on-street, off-street, or zone environment. A location or zone can be described in a simple manner with a single hierarchy element, or broken down into a multi-layered hierarchy that identifies discrete parking enclosures or defined areas each with its own operating hours, space counts, operating restrictions, location, rights and associated pricing and occupancy. The hierarchical structure allows a Distributing Party to decide the appropriate level of detail to send to a Receiving Party.

The specification supports the ability of lower-level *Place* hierarchy class instances (child records) to inherit specific instance data from a higher-level *Place* hierarchy class instance (a parent record) to simplify the amount of data shared. The *Place* hierarchy enables lower-level place hierarchy class instances to document variations in specific attributes from their parent instance. The specification also enables other operation types, not directly related to parking, to define discrete operating enclosures as a *Place*. This may include a defined on-street area for managing delivery services or a sidewalk area enabled for bike or e-scooter placement.

However, it is not necessary to build multi-layer hierarchies of *Place* data. Simple data needs can be represented without using all the multiple layers available in the data specification.

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, rideshare drop-off/pickup, valet stand, etc. in addition to parking).

A *Place* is synonymous with the structure or area a consumer associates with vehicle parking or where a mobility service is delivered. *Place* can also be used to define entry and exit roadways, driveways, and acceleration/deceleration zones for vehicles as well as pedestrian access points.

***Place* supports both on-street and off-street operating environments**. *Place* applies to specific areas to be defined for mobility or related uses such as bike storage, e-scooter enclosures, etc., where it is useful to share operating parameters or assign *RightSpecifications*, *Rates*, or other data domains.

The *Place* is an aggregation of *Subplace Elements*. *Subplace 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.

A *Subplace Element* is an aggregation of *IdentifiedArea* and other *Subplace Element(s)*. In the APDS data specifications, the lowest data element to define a *Place* is the *IdentifiedArea*. This is a required data element. An aggregation of *Subplace Elements* can create higher level *Subplace Elements* or a *Place*. At the highest level, an aggregation of *Places* can be defined by a *Campus*. A *Campus* is not a required data element in the model.

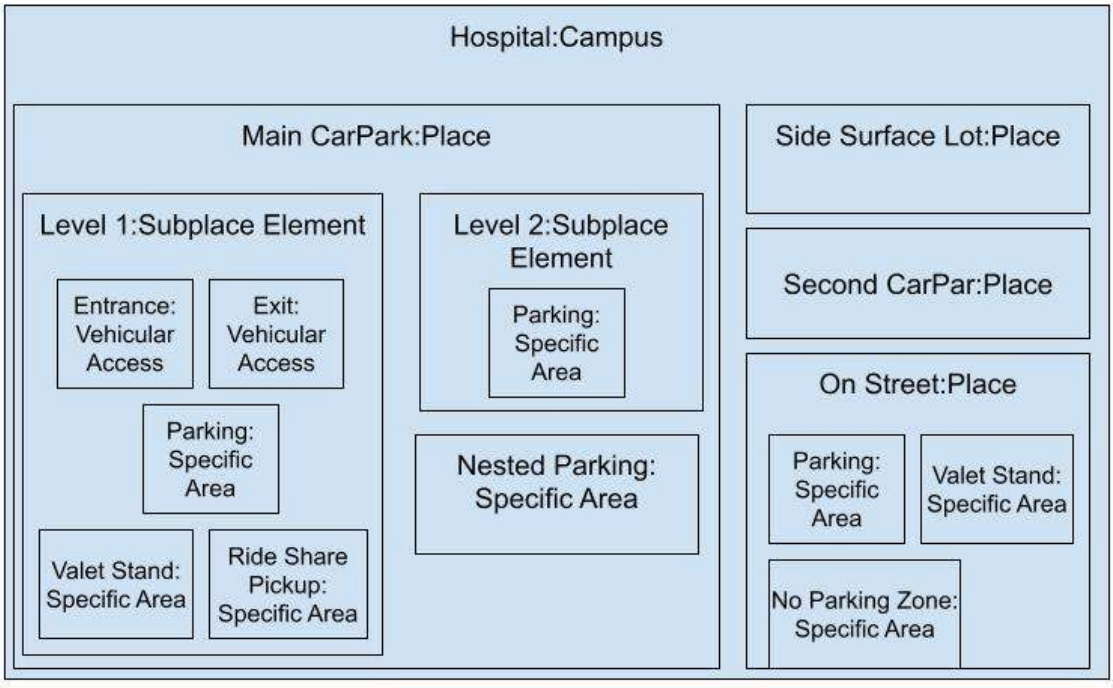

Figure 2: Place Hierarchy

To support parking, mobility or curbside management operations, the *IdentifiedArea* data class can be defined as one of four specializations: *Pedestrian Access*, *Vehicular Access*, *Supplemental Facility* or *Specific Area*. Each *Identified Area* specialization enables a specific type of data to be captured that is relevant to the *Identified Area* specialization:

- *Pedestrian Access* class is a specialization of *IdentifiedArea* that enables a *Place* to share coherent, relevant information about pedestrian entry and exit access points to a *Place*. This allows an entity to identify operating hours for the pedestrian access points and access requirements, such as credentials or restrictions for each access point.

- *Vehicular Access* class is a specialization of *IdentifiedArea* data that enables a *Place* to share coherent relevant information about entry lane, exit lane, and similar type of access points to a *Place*. *Vehicular Access* type can be used to define entry and exit to a specific facility or can be used to provide a more macro view of an entry to a facility by defining *Road* and *RoadNodes*.

    - *Road*: Allows an entity to identify the primary road a *Place* exists on and describe routes to the Place
    - *RoadNode*: Allows an entity to identify nearby major intersections of Roads

- *Specific Area* class is a specialization of *IdentifiedArea* data that denotes a specific geographic area in a *Place* that has a common operating purpose and common characteristics. Examples of common purposes include reserved parking area, electric vehicle (EV) parking, ride sharing pick up zone, delivery zone, loading zone, etc.

- *Supplemental Facility* is a specialization of *IdentifiedArea* data that enables a *Place* to identify the type and location of equipment and services available within the *Place*. The *Supplemental Facility* specialization may be used to define restroom/toilet, shower, food concession services, etc. It may also be used to identify specific equipment available in a Place, such as bike storage, EV chargers, pay stations, etc.

The *IdentifiedArea* 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 *IdentifiedArea*, 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 from higher levels of the *Place* hierarchy.

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 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 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 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.

			Mon- Fri (0900 –1800)	Mon-Fri 6 pm – 9 am (Monday starts at 0000 and Friday ends at 2359)	Sat – Sun (0000 - 2359)
Place	Main Street Parking Operation				
Subplace 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
Subplace Element	Surface (total 200)				
Identified Area		Covered	75	100	100
Identified Area		Uncovered	100	100	100
Identified Area		Covered Reserved	25	0	0

Figure 3: Operating Hours by Parking Place and Time

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 defines the *Place* hierarchy to the level of detail appropriate. As an example, the Distributing Party may only send the details about One Main Garage to one integration partner but send all Main Street Parking Operation Hierarchy levels to a different integration partner. 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* data domain includes data that define how a facility/place owner or operator authorizes the use of a specific *Place* (e.g., park, delivery, pick up, etc.) to various users or vehicles via a credential at a specific set of *RateTables(s)*, if a *RateTable* applies.

Benefits of Right Data Specification

Before a fee can be charged, it is necessary to define what the fee being charged allows an entity, vehicle or individual to do. Whether someone wants to park their vehicle, deliver a good, pick up a passenger, reserve space on a curb for a scooter corral, or rent space on a curb/sidewalk for an outdoor cafe – the specific activity being granted permission to perform needs to be defined. The *Right* data domain allows the performance of specific activities to be defined and the eligibility requirements identified to perform the activity. The *Right* also identifies the entities allowed to issue the *Right* and/or distribute the *Right* to perform the activities. By separating *Rights* from *Rates*, entities can charge different rates to perform the *Right* more effectively.

Right Data Specification

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

The *RightSpecification* is best described as a template of a Right (permission to do a specific action) as defined by the *Place* owner. A *RightSpecification* is granted to a specific *RightHolder* by an *AssignedRight.Issuer*. The *AssignedRight.Issuer* can be the *Place* owner, a reservation service, or other entities 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.

Figure 3 provides an overview of key elements in a *Right*.

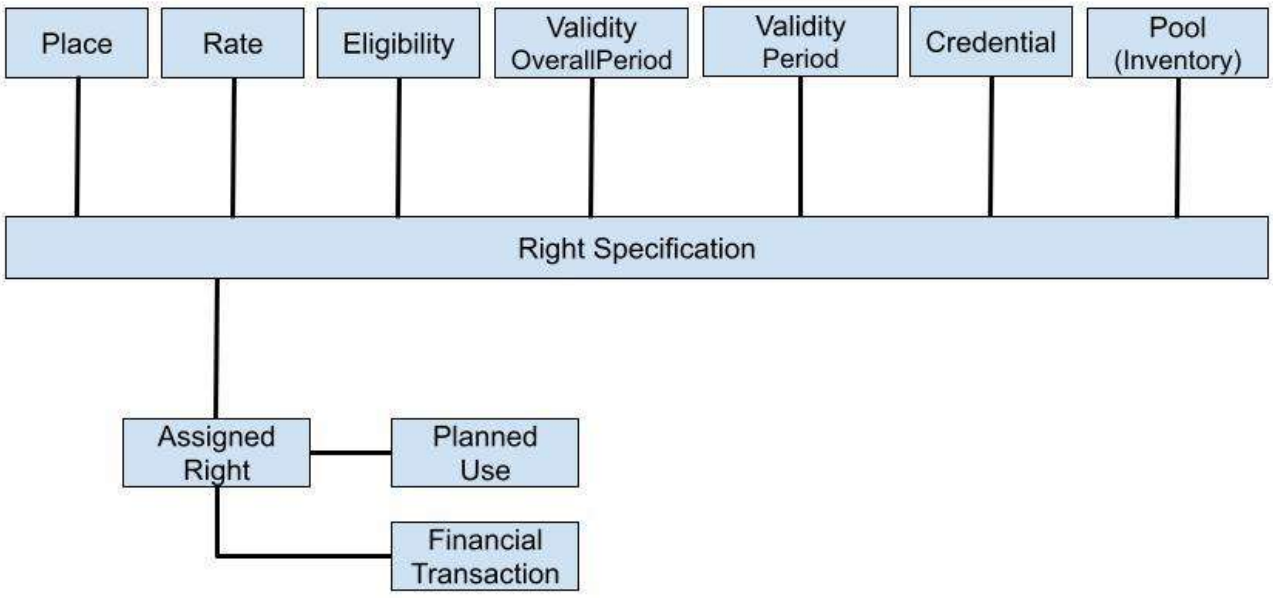

Figure 4: Right Domain

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 action multiple times (e.g., prepay for five parking events). When a specific, future use of the *AssignedRight* is initiated a *PlannedUse* is generated. The *AssignedRight* also includes data on the related financial transaction to the issuance and use of the *AssignedRight*.

RightSpecification

- Has a unique identification within a Place.
- Has a description of the permission granted.
- Has an expiration: the date/time when the permission is no longer valid for any user as defined by the Place owner.
- Has a creator: the entity, typically the Place owner, which defines and authorizes the permission.
- Has authorized credential types to identify methods of proof of holding an *AssignedRight.*

Data Associations to a Right Specification

1. **Place**: defines where a *RightSpecification* is valid. A *RightSpecification* can be associated with multiple *Places*. Each *Place* owner needs to authorize the *RightSpecification* and reference the proper *RightSpecification* IDs when sharing data.

2. **Eligibility**: defines the type of vehicle, customer, or other qualification criteria that can 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 *RightSpecification* or *RateTable* in a previous session. *Eligibility* also defines if *RateTables* are combinable via a Yes / No (Boolean) definition. Either all *RateTables* associated to a *RightSpecification* with a common *Eligibility* can be combined or they cannot. If *Eligibility* has the Combinable attribute flagged YES, then *RateTables* can be combined in a *Segment.*

3. **Rate Table**: defines a specific *RateTable* structure to apply to the use of a *RightSpecification*. A *RightSpecification* can have multiple *RateTables* associated to it if the *RateTables* all apply to the same *eligibility* requirements defined at the *RightSpecification*. Actual pricing in *RateTables* may vary based on other factors, e.g., time of day.

4. **Validity:** defines two important time periods related to a *RightSpecification*.

    a. *Overallperiod.Start* and *Overallperiod.End* identifies when the *RightSpecification* and associated attributes are valid for usage. This enables an entity to schedule the release of new *RightSpecification*(s) and communicate when current *RightSpecifications* will expire. If the *RightSpecification.Overallperiod.End* is not set, the *RightSpecification* is considered valid until it is replaced

    b. *Period.StartofPeriod* and *Period.EndofPeriod* define when the *RightSpecification* is available during a specific period to be applied to a *Session*.

    In association with *RightPool*, these attributes define the specific number of instances of *RightSpecification* available for use, in use, or intended for use in specific date/time periods.

#For example, a *RightSpecification* for monthly parking for a business employee may have *RightSpecification.Period.StartofPeriod* and *RightSpecification.Period.EndofPeriod* valid Monday through Friday from 6am to 9pm. While a resident may have a *RightSpecification* with *Rightspecification.period.startofperiod* and *RightSpecification.Period.EndofPeriod* of Sunday through Saturday 24 hours a day.

5. **Right Pool**: shares the number of *AssignedRights* available for use, are currently in use, or intended for use within a specific *RightSpecification* in specific date/time periods by a specific *AssignedRight.Issuer*. A specific calendar (e.g., March 23, March 25, April 7) can be defined to represent the number of *Assignedrights* available for distribution via the *Validity* class attributes *RightPool.ActiveStart* and *Rightpool.ActiveEnd* or a recurring time period can be defined (e.g., Monday - Friday, Saturday-Sunday) via *RelativeValidity*.

6. **RightHolder**: defines a specific entity (e.g., individual, corporation, or vehicle) that is issued a *RightSpecification* by a *Place* owner or *AssignedRight.Issuer* via an *AssignedRight*. The *RightSpecification* along with additional data related to the *RightHolder* is contained in the *AssignedRight* data class. 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. Example: 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 shares a defined number of credentials.

7. **AssignedRight**: created when a *Place* owner or authorized issuer grants a *RightSpecification* to a specific person or entity. The *AssignedRight* includes 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. *RateTable*(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*. Issuer may be the place owner, place manager, or a third-party entity authorized by the place owner.
    vi. Data about when the *AssignedRight* was issued to the *RightHolder.*
    vii. *AssignedRight* can have zero to multiple *PlannedUse*(s).
    viii. *AssignedRight* has financial data defined in two data concepts: *MonetaryValue* and *Payment.*

1. Monetary Value: the calculated total value of the *AssignedRight* based on duration, number of uses, and *RateTable* value. This is the expected total value of the *AssignedRight*.
2. Payment: the completed actual payments by an entity for the *AssignedRight*. A payment can be the transfer of funds between two entities (i.e., a payment) or a validation. A validation is a transaction where one entity has the ability to reduce or agrees to fund a portion of an *AssignedRight* for a specific entity.

The specification defines data models to share financial transaction data as defined in the *MonetaryValue* and *Payments* classes associated with a specific *AssignedRight* as described above. The specification also supports sharing financial transaction data between entities for funds disbursement related to the aggregation of multiple *AssignedRight*(s) transactions.

8. **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 Data Specification, refer to the Information Model, Use Case, and Data Dictionary documents.

Session and Segment Data Specification

The *Session* data domain 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 activity. A *Session* is not used for future activities.

Benefits of Session and Segment Data Specification

The ability to accurately document the performance of an activity is critical to supporting operational and financial activities. *Session* data allows an operation to evaluate who is currently using the services of a facility or to better understand the history of usage. *Session* data is crucial to the proper calculation of fees for services performed. As enforcement becomes more automated, accurate and complete session data ensures systems may properly identify vehicles or individuals that are operating outside of the permitted *RightSpecification,* or more specifically the *AssignedRight* issued to them.

Session and Segment Data Specification

A *Session* is broken into one or multiple *Segments*. *Segments* enable a single *Session* to capture and report changes in *RateTables* and *AssignedRight*. A *Segment* can only have one *AssignedRight* and *RateTable* 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 *RateTable* via the *AssignedRight.*
- Has a start and end time.
- Has a credential via the *AssignedRight.*
- 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.*

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

This specification facilitates the sharing of rate and tariff information and occupancy information between organizations.

Benefits of Rate and Occupancy Specification

Rate and Occupancy information is a valuable set of information 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 transportation and parking needs.

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

Rate Data Elements

This data domain describes concepts used to define *RateTables* and tariffs for a specified *Place* element. *RateTables* can be associated with a variety of activities including parking, delivery, loading, unloading, crossing an access point, etc.

A *RateTable* represents a set of fees applied to a single set of criteria and a *RightSpecification* for parking or other operations (e.g., delivery permits, rideshare access, etc.) at the *Place*.

Examples of a *RateTable* are a weekday rate scale in a public multi-story car park. Other *related RateTables* might be evening rates and weekend rates. The *Validity* class associated to the *RateTable* defines two important time periods related to a *RateTable*:

- *OverallPeriod.Start* and *OverallPeriod.End* identifies when the *RateTable* and associated attributes are valid for usage. This enables an entity to schedule the release of new *RateTables* and communicate when current *RateTables* will expire. If the *OverallPeriod*.End is not set, the *RateTable* is considered to be valid until it is replaced.

- *Period.StartofPeriod* and *Period.EndofPeriod* define when the fees and tariffs defined in the *RateTable* are available during a specific period to be applied to a *Session*.

To support the transmission of *RateTable* data that may contain multiple charging elements, a *RateTable* contains one to many *RateLineCollection*(s). An example could be a *RateTable* which contains a flat rate fee (e.g., a reservation), plus a tiered time-based rate structure for charging during the *Session*. Each *RateLineCollection* represents one of those charging elements. A *RateLineCollection* is constructed using one-to-many *RateLines*.

The *RateLine* concept is flexible and supports a range of different characterizations, which include:

- Flat rate – where the rate line defines a fee that is a flat rate and is unrelated to the duration or timing of the activity. An example is a flat rate reservation fee for a *Session*. Flat rate RateLines are defined by defining a value for the rate line, but do not use the *DurationStart*, *DurationEnd* or *IncrementingPeriod* attributes.

- Flat rate tier – where the fee is applied in full if the activity for a specific *RateLine* is active.

  Example: in the second hour of a *Session* the fee is $1.00 (USD) – for any part of that hour. For a flat rate within a tier, the *RateLine* defines the time boundary of the tier by use of the *DurationStart* and *DurationEnd* attributes and the value attribute to define the fee amount. Alternatively, an *IncrementingPeriod* attribute will share the same result if the period between the *DurationStart* and *DurationEnd* (i.e., there is one increment) is equal to the *RateLine* using a Flat Rate tier. Calculation of the fee is assumed to occur at the start of each increment.

- IncrementingRate – where the fee applied is related to the duration of the specific tier that is activated by the activity. This fee type supports *RateTables* that apply for short incrementing periods or time-based small increments.

  Example: in the second hour of a *Session*, the fee calculation is applied at a rate of 0.05€ every 3 minutes. For an incrementing rate within a tier, the *RateLine* defines the time boundary of the tier by use of the *DurationStart* and *DurationEnd* attributes. The *IncrementingPeriod* and the value attribute indicate the fee amount of each increment (e.g., 0.05€ each 3 minutes. Calculation of the fee is assumed to occur at the start of each increment.

- Per Unit – where the applied fee charged is based on a per unit of measure where the unit of measure is user defined. The user defined unit must be specific and explicit in definition. This user-defined unit of measure could be kWh to collect fees for electric vehicle charging or it could be a passenger count to support a fee structure similar to $5 per passenger in a car.

Under most circumstances, the start and end of fee calculation periods are fixed and relative to local time (e.g., between 8 am and 5 pm weekdays). In some instances, the charging period and related tiers may be relevant to a specific event. The reference of a charging period to another event is indicated by the use of *RelativeTimes* set to TRUE in the *RateLineCollection* and the use of the *RelativeTimeRates* class. All times are defined relative to the *ReferenceTimeStart*, which is the start time of the reference event.

The applicable currency is defined in the *RateLineCollection*.

Individual *RateLine* supports the identification of whether tax is applicable within the defined *RateTable*. The value of tax, if included, can be specified as either a monetary amount or a percentage

rate. Taxes may also be applied to a *RateLineCollection* in a similar manner. It is common practice for taxes to be applied at the *RateLine* level – for example the application of Value Added Tax (VAT) in Europe which is added to a basic parking fee and declared in the cost of the parking to the end user.

A *RateLineCollection* indicates whether the child *RateLine* are a chargeable tariff or represent a surcharge, which may be partially or fully refundable.

A *RightSpecification* is linked to *Eligibility* without reference to a *RateTable* when no *RateTable* is applicable (i.e., the *RightSpecification* has eligibility constraints, but no cost is associated).

Key Concepts

- A *Place* or *Subplace Element* may have multiple *RateTables* active simultaneously during a specific time of the day. *Ratetables* have two important time periods:
    - *OverallPeriod.Start* and O*verallPeriod.End* identifies when the *RateTable* and associated attributes are valid for usage. The times when the *RateTable* expires and is no longer valid for use or is replaced by a new *RateTable*.
    - *Period.StartofPeriod* and *Period.EndofPeriod* define when the fees and tariffs defined in the *RateTable* are available during a specific period to be applied to a *Session*. The times of day when a parker should expect to pay the rates defined.

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

Occupancy Data Specification

This data domain defines supply and demand of spaces or other activities available in a *Place*. *Occupancy* has been deconstructed into two data segments: *Supply* and *Demand*. Entities can calculate utilization and/or make predictions of future occupancy based on this data.

Supply: defines the parameters of the supply of space or area allocated for use. As an example, it may be the total number of spaces usable for parking or the number of occurrences available for delivery or loading/unloading activity. 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 length, width, weight restrictions, other characteristics, methods of occupancy detection, and valid time of space information.

Demand: defines the parameters of reporting actual usage of allocated areas in a *Subplace Element*.

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

Occupancy

Supply is the data that defines the number of vehicles or spaces, or the amount of area that can be used in the defined *Place, Subplace Element* or *IdentifiedArea*.

Demand is the data that defines the actual number of vehicles parked or spaces occupied, or usage of *AssignedRights*.

By separating the Occupancy data into a *Supply* and *Demand* segment, the intent is to improve the efficiency of communicating demand data (e.g., 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 should not change frequently and could be communicated for example, every day or only when the data changes.

This approach enables the Supply data segment to communicate most of the data on parking spaces and area availability while the demand data is limited to communicating critical data that changes frequently.

Supply data includes data elements that define the type of activity supported in the area (parking, delivery, loading zones, etc.), methods used to detect usage, space count, and space characteristics. When defining the supply for an operating 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) demarcated 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 meters long and the controlling entity assumes the average length of a vehicle parking is 5 meters. The derived available supply is 20 spaces. A different entity could use a different average length of 7 meters 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.

Quote Data Specification

The Quote data domain describes the concepts used to define a *Quote,* which enables an entity to request pricing for services from another entity, which then responds with a specific offer. *Quote* then supports a transaction that represents the formal acceptance of the offer. There are two data structures to support the use of *Quotes*:

- A *Quote Request* – a request for quote prices on *RightSpecification* where *Eligibility* requirements are met for a specific time range. In some cases a specific *Place* may be defined.
- A *Quote Response* – a response to a *Quote Request* which provides the Option(s) available to a *Quote Request* that meets *Eligibility* requirements. Each *Option* in a *Quote Response* is versionable.

Benefits of Quote Data Specification

As digital marketplaces continue to grow in popularity and more entities collaborate to sell and combine services (e.g., a restaurant selling parking), it will become more common for an entity to control their inventory of available *RightSpecifications* and then calculate the appropriate fees to the requesting

parties. The *Quote* data specification allows an operating entity to receive requests to use provided services from a variety of sources and to issue *quotes* with expiration times to each entity. The operating entity can then better manage the distribution of *RightSpecifications* to end users at the proper *RateTable*(s) to maximize the value of their operation assets.

Quote Data Specification

A *Quote* is a request for a firm price and confirmation of availability of a specific *RightSpecification*, at a specific time, by a specific user. A specific *Place* may also be specified. A *Quote Request* should initiate a *Quote Response* which includes relevant *Option*(s) that meet the criteria of the *Quote Request* and typically includes an expiration date/time on the *Quote Response* for the recipient to act (i.e., purchase) to obtain an *AssignedRight*.

A *Quote Response* confirms the requester meets *Eligibility* requirements and provides the requester with a price for use of a requested *RightSpecificatIon*. *Quote Requests* and *Quote Responses* are used between systems to allow users to evaluate a purchase of a *RightSpecification*. *Quote Responses* are not authorizations to use a *RightSpecification* and do not create an *AssignedRight* or assign *Credentials*. A *Quote Response* needs to be converted into an *AssignedRight* by the issuer to provide the acquiring user the right or permission to perform a specific action, as defined in the *RightSpecification* in a specific *Place*.

A *Quote Request* is not the proper means to request general *RateTable* or *RightSpecification* details about a *Place*. Other data structures exist to support messaging to retrieve these details. The purpose of a *Quote Request* is to enable a user to purchase or acquire a specific *RightSpecification* at a specific time for a specific *Place*.

Observation Data Specification

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

Benefits of Observation Data Specification

In a connected world, being able to share data that describes an event is important and supports the ability to act on the event. Reading a license plate, scanning a QR code, manually viewing an event are all examples of observations that support other actions in an operation and system.

Observation Data Specification

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 (e.g., ALPR, visual, ticket, RFID).

- has an observer name (who made the observation).
- has a credential type observed (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.

Data Specification Permission and Security

The data specifications created by APDS 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.
- A Receiving Party should confirm ownership of data when data for a parking 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 parking place record from different sources.
    - The Receiving Party should have a data procedure to identify conflicting data records for the same parking place record and a process to validate the appropriate data owner.

Scenario Examples

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 johndoe@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 janesmith@parkB.com.
- Receiving Party should have a process to contact parties to confirm which record is accurate.

Example 2: Parking Operator A manages 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.

Visit the APDS website to request the complete package of documents and specifications.