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Chapter 7: Transit Gazetteer and Related Data Concepts

In This Chapter

- Explore the Transit Gazetteer Branch of the SDP Model and its Location Table.
- Discover how transit network and related data concepts are used.
- Learn how to apply Pattern and Transit Point Event.
- Learn how to convert route segments to transit point events.

Transit Gazetteer Definition

A transit gazetteer is a geographical dictionary and reference for information about places and place-names associated with a specified data set such as the SDP document or TSDEA registered schedules, landmarks or other places of interest related to the transit network.

Elements include:

- Location
- Timepoint
- Transfer Cluster

One of the key elements of the SDP's gazetteer is a Location Table, which facilitates access to location data and simplifies maintenance.

Purpose of a Transit Gazetteer Model

Location related information is critical component of an effective transit schedule, hence its inclusion in the SDP. Generally, a schedule describes when transit service will be provided at a specific location. Time and place are important information for schedule users. The schedule includes locations where time is measured, such as where transit vehicles embark or debark, where to transfer from one service/mode to another, as well as, the locations of transit facilities.

The gazetteer concept is used by many industries to describe the location of places that are used by their services. The SDP uses this concept as a geographic dictionary and reference for information about transit places and place-names. Using a transit gazetteer with a Location Table mitigates several location referencing management issues facing most transit agencies. Among its benefits, the transit gazetteer:

- Creates a single location to find and use various types of transit features;
- Provides an extensible, single location to associate, update and propagate changes to several types of location reference methods;
- Isolates the geographic reference maintenance from the domain data maintenance schedule;
- Eliminates ambiguity inherent in the location measurement by indexing “location” using a unique, sequential number; and
- Enables an accurately measured position to be linked to a more generalized location.

Specifically, a Gazetteer with a Location Table supports the management of spatial information necessary for defining the transit network. It supports flexible, more efficient, long-term data management, and the ability to define other transit features types “on the fly” that may be needed to further describe the transit network.

Typically, all transit places are included in a Gazetteer. The Location Table, which is a key element in the Gazetteer Branch, serves to link “transit places” such as timepoints, stops and other facilities, to the transportation network. The Transit Gazetteer includes the Timepoint and Transfer Cluster (a place where transfers between transit service is recommended). Since the transit facilities model is particularly complex, it was given its own branch outside the Gazetteer in which to describe places related to facilities (see Chapter 8: Transit Facilities Branch). Discussion on the Transfer Cluster is included in Chapter 10: Advanced Topics and covered in Section 10.4: Transfers.

Issues Affecting the Design of the Gazetteer

Past practices and existing systems at transit agencies have led to a variety of ways of representing location data, and have exposed a variety of problems, which have challenged the implementations and operations of ITS and Geographic Information Systems (GIS). The design of the Gazetteer is intended to avoid or minimize these challenges.

The issues are discussed here to give the reader a better understanding of how certain approaches to creating and organizing location data can cause transit agencies problems, why the SDP is designed as it is, and to provide insight for the data conversion effort.

Issues With Location Referencing

The ability to locate the transit network upon which transit service is scheduled and to use the location information for transit features is an important need for most downstream applications. Four commonly encountered issues with location referencing will be discussed.

Often, location is handled as an attribute of an entity. This approach is not sufficient to handle the existing range of location referencing methods that transit operators need and that downstream applications use. Similarly, this approach will not support existing and future requirements for locating places of transit-based “events” and maintaining the connections among transit and transportation network data.

Many transit data models merge the transit and spatial feature concepts into a single *entity*. So features such as transit stops that may only need address and intersection may not include a reference compatible with a Cartesian coordinate used by a timepoint, and those events along a pattern used by the on-board navigation system may only use the spherical coordinates (e.g., WGS 84). As such, these equivalent locations may be dispersed throughout a data set and are incompatible. The consequence is that location may not be used as an integrating characteristic.

Further, different data sets may require different, yet equivalent, location referencing methods. For example, the same place, New York Penn Station, may be described by a variety of location referencing methods by different transit agencies:

- 25th stop (out of 33) in an express route from Staten Island through NJ (the S22X).
- 50 feet west on the south side from the corner on 34th Street intersecting with 8th Ave
- near side on 34th Street/at 8th Avenue
- about 5% along the 34th Street block between 8th and 9th Avenues
- 310 W 34th St, New York, NY 10001
- Trip123 lat/long -73.993559, 40.752190
- NY Box-id lat/long -73.993680, 40.752193

The logical location may appear as different locations, although they are equivalent.

The SDP approach provides a single place (the Transit Gazetteer) to access, share and store equivalent locations. Downstream applications may select the most appropriate location referencing method to meet its needs. These reference methods are grouped into a single instance so that the equivalence is obvious. Furthermore, information is stored in a single table to manage changes to the data.

Negotiating the Differences Between the Transit and Geospatial Domains

A number of issues may arise for transit when describing the spatial attributes of a transit feature. From a spatial location perspective, transit service may be viewed as operating on a changing and scalable environment. As a result of this complicated spatial operating environment and other data-related factors, the following categories of issues, which could affect the SDP data, will be discussed:

- Location Reference Method Equivalences
- Generalized Versus Accurate Location References
- Heterogeneity of Transit Features and Their Use as a Transit Network Building Block
- Coordination of Data Set Maintenance Schedules

These issues may arise within a single transit agency and can pose even greater challenges and barriers in a multi-agency environment.

Location Reference Method Equivalences

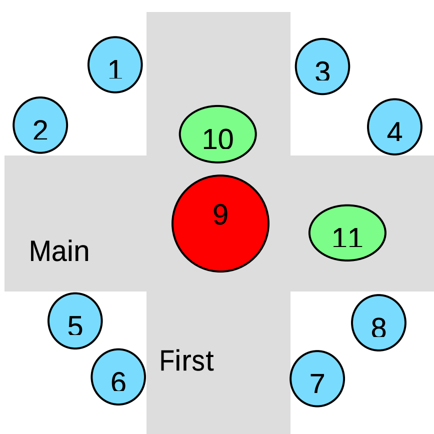
A number of challenges may arise when trying to determine if the location of transit features and events are the same. Transit applications may require the integration of multiple data sources that have very little in common other than proximity. In an operating environment that includes multiple transit agencies, an example would be bus stops that are used by more than one agency, but have different identifiers and different ways of measuring location. Moreover, the location references may be derived from heterogeneous sources, which vary in accuracy, scale, resolution and precision, sometimes significantly.

The *equivalence* of two location reference methods may exist (that is, the location may be the same but expressed in different formats), but the association may not be made even by spatial analysis tools. Sometimes painstaking human analysis is the only means of associating "equivalent location references." These relationships must then be documented in an "association" or "lookup" table. This will be the case for the SDP and Transit Schedule Data Exchange Architecture, where collocated stops will be represented by different agencies using heterogeneous location referencing methods, and each time the source data is updated, the lookup table will require a readjustment.

The human intervention may occur even within an agency that standardizes on a single base map. For example, when a change occurs to a frame of reference such as a base map, all the location references that rely on that frame of reference must also be changed. Often, these attributes are dispersed throughout the agency's data model. Because other location references are dependent on the frame of reference, a significant number of other records will need to be updated.

Generalized Versus Accurate Location References

Along with the varied types of location references and the heterogeneous sources from which the attributes are generated, the levels of accuracy for location references can vary greatly between geographic areas, agencies and applications. Some agencies provide precise and accurate locations while others provide "generalized," low resolution or approximate locations.
Figure 7-1 shows a variety of different ways that transit agencies locate bus stops near an intersection. For example, point 9 may represent locations designated as points 1 through 8; point 10 may represent points 1, 3, 6 and 7, which could be stops for a route that provides service along 1st Street; and point 11 may represent points 2, 4, 5 and 8, which could be stops for a route that provides service along Main Street. One agency may collect data by performing a field survey of bus stop locations, measured to an accuracy of 20 centimeters (e.g., points 1 through 8), another may select the location from an orthophoto with 20 meter accuracy (e.g., points 10 and 11), while yet another may select the nearest intersection as the location of the stop (e.g., point 9). For some applications, an intersection reference may be sufficient, while other applications require sub-meter accuracy.



Intersection Designated Points

1. 1st & Main nearside (NS) NW
2. Main & 1st farside (FS) NW
3. 1st & Main FS NE
4. Main & 1st NS NE
5. 1st & Main NS SW
6. 1st & Main FS SW
7. Main & 1st NS SE
8. Main & 1st FS SE
9. Main & 1st (represents 1-8)
10. First & Main (rep. 1,3,6,7)
11. Main & First (rep 2,4,5,8)

Figure 7-1: Intersection with Generalized and Accurate Point References

This problem shares similar challenges to the "equivalence" discussion above. A generalized location, like the centroid of Jamaica Station will need another generalized location to identify the AirTrain, NYCT subway and LIRR terminals, and additional location references to identify the platforms within each station area, and so on. A mechanism is needed to qualify the measurement, not to identify the accuracy, but rather to indicate whether the location approximates or pinpoints the physical object.

The SDP and the Gazetteer provide a solution to these problems. The SDP includes a Boolean element called "isGeneralized." When a place is equivalent to points 9, 10 or 11, then the field is assigned a value of "true." When a place is equivalent to points 1 through 8, then "isGeneralized" is assigned a value of "false."

Generalized and Accurate Location Data Approach

The SDP has developed an approach for dealing with the challenge of identifying and organizing location references that are associated with other locations. For example, multiple stops can be associated to a timepoint or facility, and multiple stops can be part of a larger facility (e.g., Jamaica Station bus stops, platforms and AirTrain platforms). This issue is exacerbated when the data originates from multiple sources, which occurs when there are multi-agency facilities such as those in the downstate NY region.

The recommended approach associates specific or accurate locations with a generalized location. A transit feature should only reference at most one locationID at a time. Incorporating a generalized location may cause several accurate location instances to diverge with respect to the generalized location. As such, the general location should become a managed instance to which the accurate location instances may be associated with, as depicted in Figure 7-2.

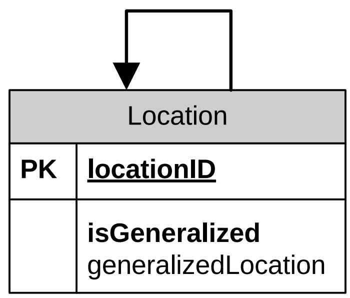


Figure 7-2: Partial Location Table Where an Associated Location May Be Associated With a Generalized Location

Figure 7-3 is an example of how to implement an instance of a self-referencing Location Table, that is how generalized locations and isGeneralized elements may be applied.

For a self-referencing set of locations as shown in Figure 7-3, the following definitions apply:

- locationID is a unique, sequential, unambiguous integer.
- isGeneralized is a Boolean (true/false); when true the value indicates that this field is approximate, centroid or generalized, and that another Location record points to this locationID as a generalized location.
- generalizedLocation is a (foreign key) locationID of a generalized location to which an associated locationID is inserted.

Figure 7-3 uses the diagram in Figure 7-1 as a reference. The scenario describes location 9 as a generalized location with associated locations 1, 2 and 3.

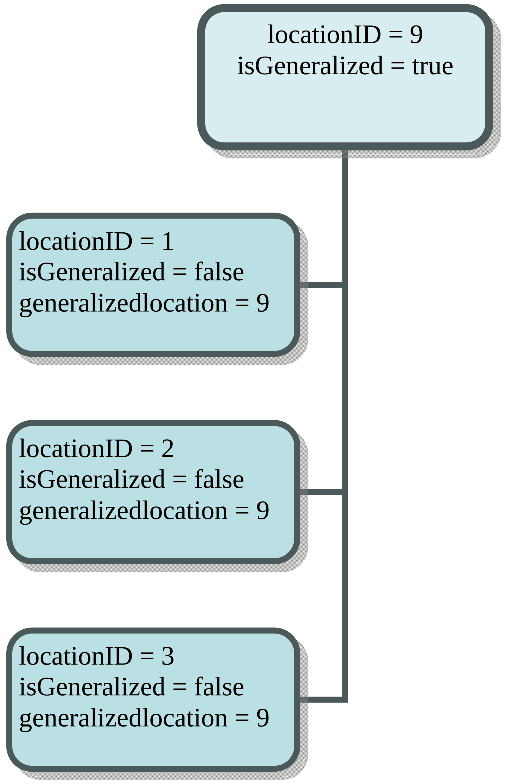


Figure 7-3: Example Instance of a Self Referencing Location Table

Location 9 is assigned a value of "true" for isGeneralized; generalizedLocation is not relevant, so it is not included in the partial list of elements. In the other instances of Location, each box depicts a record for the remaining locations. They are not generalized (rather they are specific), and they reference locationID = 9.

Heterogeneity of Transit Features and Their Use as a Transit Network Building-Block

The transit feature is the building block of a transit network. The industry uses different models for describing the transit network (i.e., patterns and route segments), however, they all encounter the issue of heterogeneous feature types, challenging the ability to integrate these features in a single, ordered list. The pattern event, as described in Section 6.1 may be comprised of one or more transit features such as transit stop, timepoint, physical path location along a route, or other trigger that supports service operations. The variety of types of transit features and the potential need to integrate new event types necessitates a single method for describing and ordering these features into a list of common data types.

Feature Type
Transit Features are objects that represent real world public transport phenomena. [GOS 7d] Transit Stop, Timepoint, Transit Facilities, Track, Transit Path are examples of a feature type.

Relative Location
Relative location is the linear relationship of a transit place such as a Transit Stop to the transportation network.

In the SDP, the Location table serves as a parent type, while all event types inherit location attributes stored in the Location element. Figure 7-4 helps illustrate a problem that transit agencies face when they want to integrate different features in a single ordered list of locations (e.g., they want to know the order of appearance along a path of timepoints, trigger points and bus stops). In the example, a pattern, described as a "unique, non-branching, ordered sequence of transit paths, timepoints, [events] or transit stops to be followed by a transit vehicle in scheduled service," incorporates a single point that may be specialized to reference one of many different types of events (timepoints, bus stops, fare set change locations, headsign change locations, and transit signal priority trigger locations).

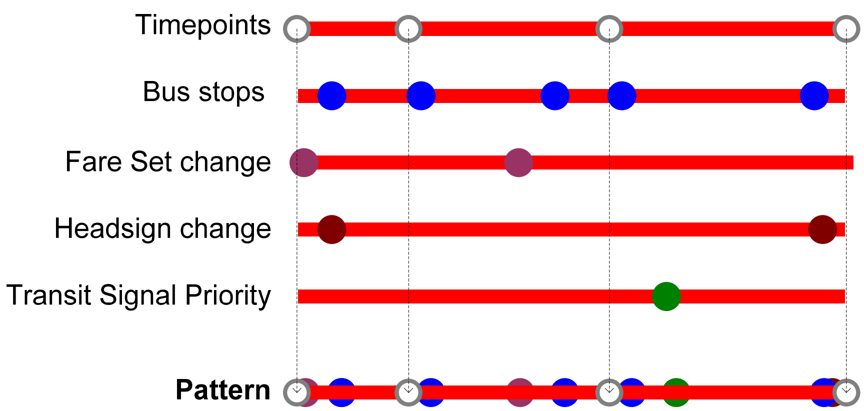


Figure 7-4: Pattern Overlaid with Various Feature Type Locations

Coordination of Data Set Maintenance Schedules

Downstream applications require different location reference methods, which, in turn, require different kinds of data fields in an entity. Some of the data fields come from data sets with different maintenance schedules. The *spatial data* maintenance plan, which may be driven by an external organization, may be different from the *transit domain* data maintenance plan, complicating the maintenance of an **entity** record.

For example, an update to the base map, upon which the location reference is based, may impact the accuracy of the location of a bus stop. The base map update may occur semi-annually. The bus stop inventory which is geo-located to the base map may be updated on a quarterly basis. The specific dates may not correspond, requiring an update of the bus stop inventory at least six times per year (while the schedule version may only be updated quarterly). In addition, all downstream applications that use the bus stop inventory also need to update their base map to correspond to the updated inventory; they do not always correspond to the base map update either. The maintenance and update procedures become complex as the number of data sets and applications that support entities with location references grows.

The design of the SDP minimizes these problems related to maintenance schedules by separating location references from the transit domain entity. As a result, the update of the location reference is modularized; a spatial data maintenance update is of no great impact to the bus stop inventory and the downstream applications that use older or updated information.

Feature Types Supported by the SDP

The primary purpose of the SDP Gazetteer is to clearly define location-related key features that support the construction of the transit network. In the current SDP model, several features are defined by entities, including the following: transit facility, timepoint, transfer cluster, and transit stop. Other supported feature types include: event locations, shape or trace points, as well as points of interest (POS). Landmark or point of interest information is supported, but not necessarily included as a feature. The SDP enables the user to define additional feature types that may be necessary for downstream applications or to support their internal requirements. The model is extensible through the mandatory featureType field. (Note: a specific inventory is not included in the agency SDP document, the landmark inventory should be available from the Web Data Maintenance System–WDMS).

Regional discussions identified other important features that will likely be needed in the future. For example, some ITS applications require different types of event trigger indicators such as for fare-set changes, and interior annunciator/sign triggers. In the discussion on “Heterogeneity of Transit Features and Their Use as a Transit Network Building Block,” the discussion identified “physical path locations” to ensure that the physical path of the pattern is unambiguously defined (particularly when a vehicle loops and backtracks through parking lots, one way streets and highway ramps). The Gazetteer approach supports location information for existing and future transit features through an expanded list of values for the feature type.

Requirements for Location Table Data Concept

The requirements that drive the Location Table data concept are included in Table 7-1. These requirements are derived based on the needs of the downstream applications that use schedule and related data concepts.

Table 7-1: Requirements for Location Table and Related Data

#	Category	Requirements
1	Unique identification, naming conventions, and references	• A place or transit feature is any location within the transit network or service area that may be described by a physical location. • A place or location is indexed by a unique, unambiguous identifier such as a sequentially assigned integer. (A location reference method may be ambiguous due to inherent measuring and instrumentation errors).
2	Geometry and spatial characteristics	• A place may be represented by a point. Its shape may be represented by Geometry (as described by the Geographic Markup Language–GML standard) which is a variable data type that may be used to describe different type geometries (e.g., one, two and three dimensional shapes). • All features should include Latitude and Longitude in NAD ’83. • Features may include other types of location references including: - Linear (relativeLocation) - Intersection - Planar (x-coordinate; y-coordinate) UTM Zone 18 for the downstate NY region. • *Non-Generalized* location: a specific location is one that is identified for the precise place for which the feature is located. It is not used to summarize a place where multiple features may be represented.

Table 7-1: Requirements for Location Table and Related Data

#	Category	Requirements
		• *Generalized* location: often a location may be based on a low resolution digital base map or is assigned a point associated with the intersection centerline (for example, when a transit stop is associated with a timepoint). These are referred to as "generalized" points. There are several downstream applications that prefer generalized locations, for example, scheduling, macro planning tools, etc. • A non-generalized location may point to the generalized location to which it is referred. (This may be a manual process or require a tool to correlate the applicable fields.)
3	Feature Types	• The SDP includes several feature types or place categories. These include: - Transit Facility - Transit Stop - Timepoint - Transfer Cluster - Amenity, portal, passenger access component - Physical Point used in by an event or trip time Other feature types may be included by local agencies as extended attributes.
4	Configuration Management of Location versus "Place" type	• A transit place may change location (and consequently locationID), although it may not change functionality, for example, a transit stop may be moved from the near side to the far side of the intersection. If the locationID is generalized, then the relativeLocation may change, and the effectiveDate and endDate are modified. However, it the location is non-generalized, a new locationID should be defined for the stop or facility.
5	Associations	• Several entities make use of the Transit Gazetteer to build the transit physical and service networks. These include: - Trip Time - Transfer Cluster (and by association Connection Segment) - Transit Path - Transit Path Event - Transit Point Event - Block Event Time - Pattern - Trip - Transit Facility, Amenity, Portal, Passenger Access Component, Transit Stop, Depot - Timetable Header

Conceptual Data Reference Model (CDRM) Description for Transit Gazetteer

The Gazetteer Branch describes the location and places used to build the transit network. The CDRM for the Transit Gazetteer branch is shown in Figure 7-5.

The Transit Gazetteer's Location Table serves to extend and centralize transit feature location references for transit point features: Transfer Cluster, Transit Facility, Timepoint and Transit

Stop, Connection Segment. These features, once aggregated, may provide a single look up table or definition to build the transit network and locate transit facilities.

The Location Table is composed of several types of location references, spherical (latitude/longitude), planar, linear and attribute (relativeLocation). In addition, a generalized Location may be associated with several (non-generalized) Locations.

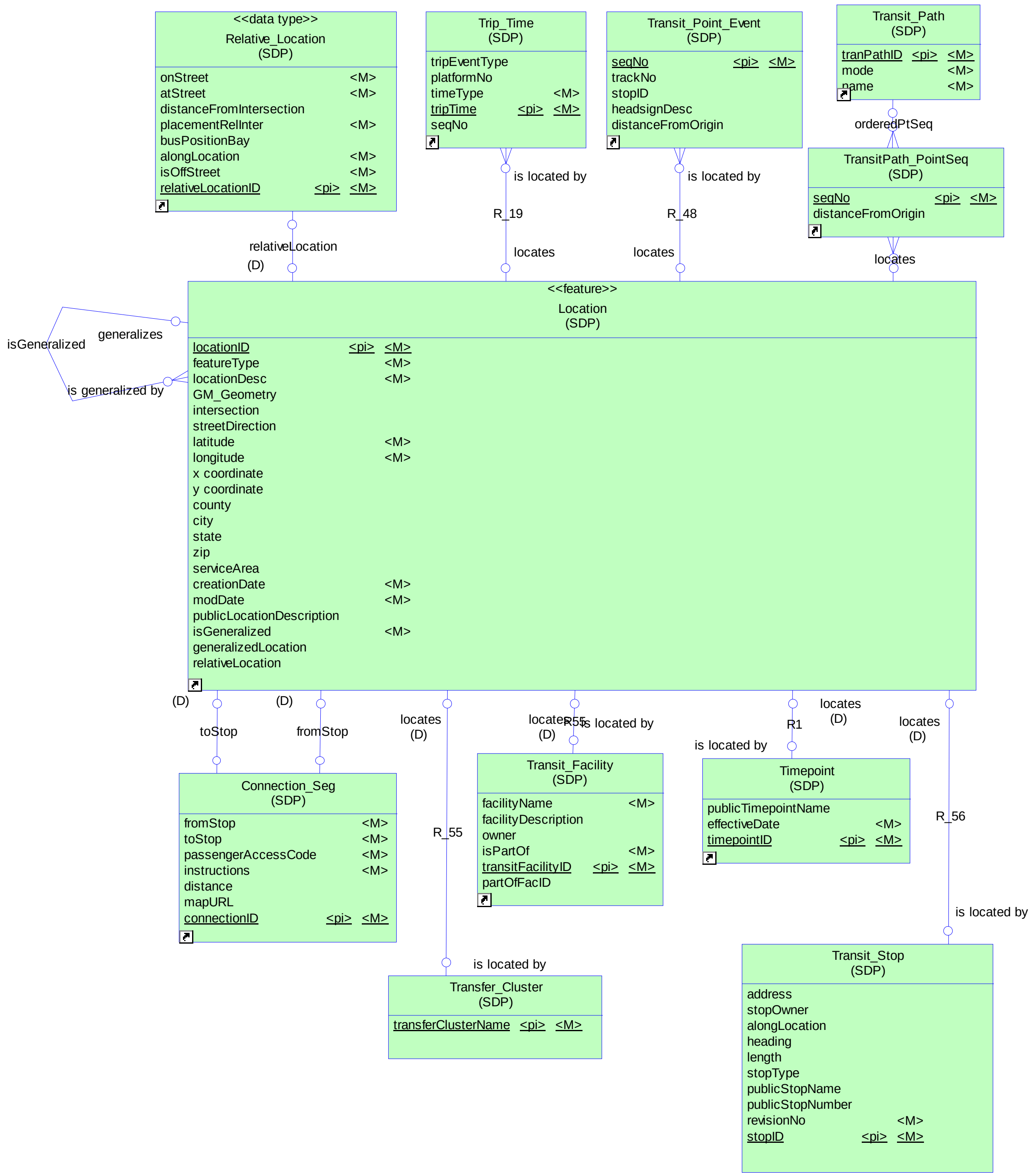


Figure 7-5: Transit Gazetteer CDRM

SDP XML Schema Description for Transit Gazetteer

In applying the CDRM to generate the XML Schema a number of rules were applied to the Gazetteer model to generate the XML Transit Gazetteer Branch.

The high level XML Schema for the Transit Gazetteer is shown in Figure 7-6. The rules associated with the Transit Gazetteer element include:

- The Location is a mandatory element that describes all the geographic places used by elements in the Transit Facilities, Transit Network, Service and Agency Registration branches.
- Related identifiers or keys are declared using the schema related key constraint: keyref; the keyref constraint was referenced to the Location element's locationID (declared as schema "key" constraint). These constraints ensure that when a locationID is used by another element, it checks to ensure the locationID exists as a record in the Location Element.

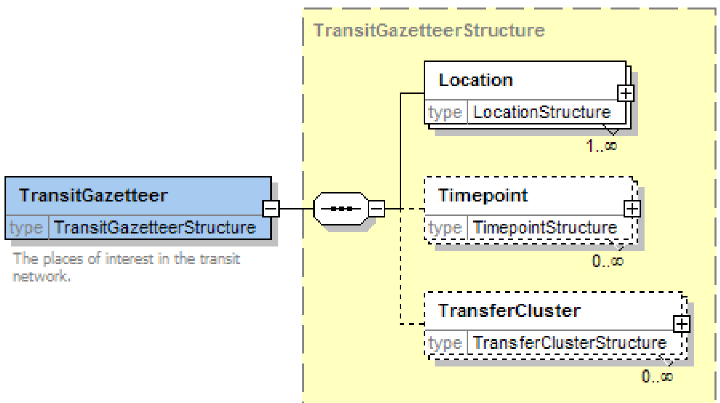


Figure 7-6: SDP XML Excerpt for Transit Gazetteer

The XML Schema for a Location element is shown in Figure 7-7. The rules applied to the Location element include:

- Seven elements are mandatory including: locationID, featureType, locationDesc, longitude, latitude, publicLocationDescription and isGeneralized
- In most cases the isGeneralized element will be "false"; use it only if there is another locationID which is pointed to it. The feature was developed to generalize multi-use facilities such as Battery Park, Grand Central Terminal and Pennsylvania Station in NYC.
- Intersection should include a "@" symbol between the "at" and "on" streets. This is used to parse the data if necessary.
- Avoid using "&" and other html type characters in the descriptions. The XML validator will declare an error.
- Geometry uses the GML description to describe the physical polygon. See Section 4.4 for an example of the polygon type.
- State, street direction and feature type are enumerated types. Currently, state only includes values NY, CT and NJ. The list should be extended as additional agencies in other States use the schema.
- Relative location references another complex element called RelativeLocationStructure
- communityName is any name which may be recognized by local users.

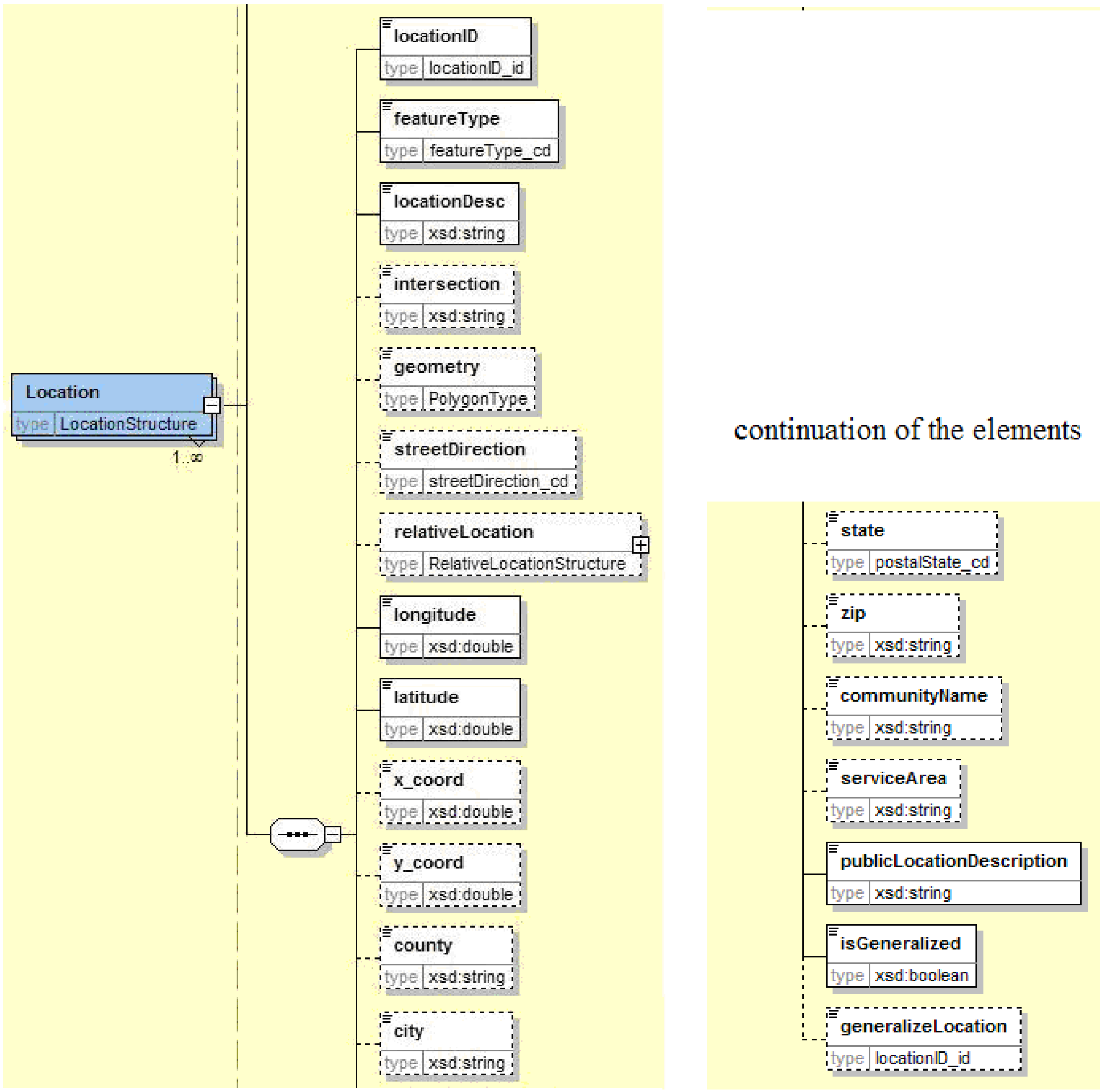


Figure 7-7: XML Schema Excerpt for Location (in two columns)

- The XML Schema for the relativeLocation element is shown in Figure 7-8. There are no additional rules applied to the relativeLocation element beyond the normal XML Schema constraints identified in the CDRM.

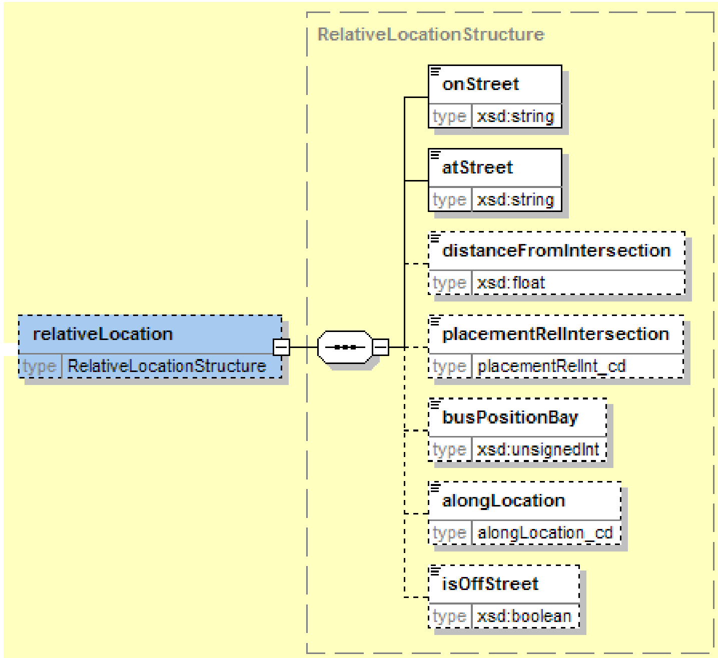


Figure 7-8: SDP XML Schema Excerpt for Relative Location

- The XML schema for the Timepoint element is shown in Figure 7-9. There are no additional rules applied to the Timepoint element beyond the normal XML Schema constraints identified in the CDRM.

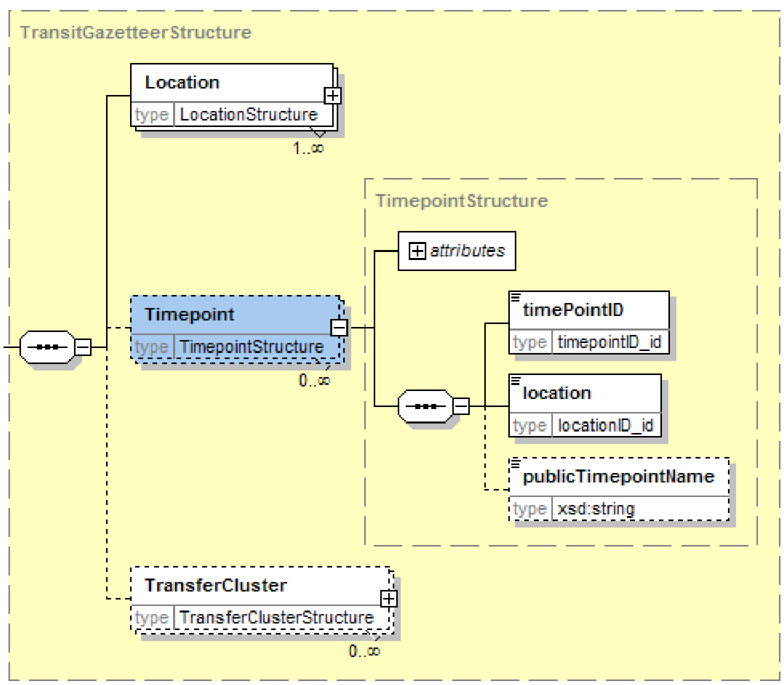


Figure 7-9: SDP XML Schema Excerpt for Timepoint

Transfer Cluster is described in more detail in Chapter 10: Advanced Topics. The details of creating transfer clusters, connections and coordinated transfers are discussed in Section 10.4.

Detailed Data Descriptions and Guidance

This section describes the best practices and guidance associated with the complex elements associated with the Transit Gazetteer, Location, RelativeLocation (embedded in Location) and Timepoint.[1] The guidance for each element is consolidated into a table with the following column headings: Requirement status (M for mandatory and O for optional), the element name, the data type and guidance related to the element. The guidance attempts to bring additional clarity to the data definition. The first column of each table identifies the baseline requirements as driven by the SDP XML Schema version 1.0. A downstream application may further restrict these requirements in order for the data set to meet the application's data needs. The XML Schema element name corresponds to the related CDRM entities and attributes descriptions (although the capitalization and spacing may differ slightly). The type may refer to a native XML type, or a declared type in the XML schema. The Guidance column is called "Questions to Ask." These questions direct the analyst to a similar or equivalent concept in their own schedule data set. In addition, some comments describe the impact of the data structures on the SDP XML Document deployment.

Table 7-2: Location Formats and Guidance

Req	Element Name	Type	Questions to Ask
M	locationID	locationID_id UNIQUE	Does your data source use a location identifier like geography identifier or AVL Physical Point to designate location referencing information for a stop, timepoint or other spatial feature?
M	featureType	featureType_cd	Is there a way to tell the difference among the following transit features (other than special tables)? (e.g., stops features are alphanumeric while timepoints are only numeric). Also, transitStop value takes precedence over collocated a timepoint value.
M	locationDesc	string	You may use any description or concatenated description in this field.
O	intersection	string	The full name of an intersection. For easier parsing, the accepted convention is "on street" @ "at street." Avoid using "&" symbol.
O	geometry	gml:GM_Polygon	The geometry of the point. A point that designates a station, for example New York Penn Station, may be instantiated as a point or polygon using different map resolutions. See Section 4.4 for guidance on how to use this element.
O	streetDirection	streetDirection_cd	The general orientation of the street, north/south, east/west, north, south, east, west. North/south and east/west may be used for either direction.

[1] TransferCluster, also included in the Transit Gazetteer branch is discussed in Chapter 10.

Table 7-2: Location Formats and Guidance

Req	Element Name	Type	Questions to Ask
O	relativeLocation	RelativeLocation	If linear referencing methods are used to describe location (e.g., nearside, off street, distance from intersection) then the relativeLocation field should be completed. See Table 7-3: Relative Location and Guidance below.
M	longitude	double	This field is a floating point. You may need to convert your data from an integer. WGS 84 is the default datum. If you use another, then record datum in metadata.
M	latitude	double	This field is a floating point. You may need to convert your data from an integer. Record datum in metadata.
O	x_coord	double	Do you use Easting/Northing (UTM Zone 18) for x and y coordinates? If you do, and do not use UTM Zone 18, then record projection and zone in metadata.
O	y_coord	double	Do you use Easting/Northing (UTM Zone 18) for x and y coordinates? If you do, and do not use UTM Zone 18, then record projection and zone in metadata.
O	county	string	Standard name for county.
O	city	string	Standard name for a city.
O	state	state_cd	Populated from ANSI/FIPS codes.
O	zip	string	May be zip +4.
O	communityName	string	Local community name in which the location is known.
O	serviceArea	string	A description of the service area. May be defined as a fare zone.
M	publicLocationDescription	string	This is the field that is used to describe the location to the public. The field should not contain abbreviations or codes, and it should use proper punctuation and capitalization.
M	isGeneralized	boolean	If this location is contained in, is part of, or has a "many-to-many" relationship to another location, then isGeneralized is 'false.' For example, a timepoint location may be associated with one or more bus stop locations. In the timepoint/bus stop case, the timepoint is true and the bus stops are false.
O	generalizeLocation	locationID_id	When isGeneralized is false, and the feature points to another location, then the specific record index (locationID) to which it points is included in this field. For example, WWM01 and WWM02 point to the "WWM" locationID.
O	effectiveDate	date	[attribute]
O	endDate	date	[attribute]

Table 7-3: Relative Location Format and Guidance

	Element Name	Type	Questions to Ask
M	onStreet	string	The name of the street on which the feature is located; if the relative location is not on the street, then this is the nearest street location.
M	atStreet	string	The name of the cross street nearest the location.
O	distanceFromIntersection	float	The distance of the feature from the intersection. An attribute may be designated for either feet or meters. The default is assumed to be feet when no attribute is present.
O	placementRelIntersection	placementRelIntersection_cd	Codes include: nearside; farside; midBlock; at; between; farsideMidBlock; nearsideMidBlock; opposite.
O	busPositionBay	integer	This is a number that designates the platform, bus bay, ferry berth or other access area that may not be defined in the TransitStop element.
O	alongLocation	alongLocation_cd	The location along a boarding area where passengers board or alight a transit vehicle. Valid fields refer to the position based on the direction of travel: right, left, both.
O	isOffStreet	boolean	If the location is off the street, then this field is true; otherwise it is assumed the location is considered on the street.

Table 7-4: Timepoint Format and Guidance

	Element Name	Type	Questions to Ask
M	timepointID	timepointID_id UNIQUE	Insert the native field that designates the timepoint.
M	location	locationID_id	Insert an index, locationID, that refers to the Location element.
O	publicTimepointName	string	Is there a timepoint name or description known to the public?
O	effectiveDate	date	[attribute]
O	endDate	date	[attribute]

Usage and Examples of Transit Gazetteer

Example 1: Location Table—Need for process/data checks

The Location Table is fairly straightforward to implement. The innovative feature is the publicLocationDescription. This element is used to support key downstream applications such as timetables and trip planning applications. The NYC Bus data set includes a public location reference of intersecting street/landmark names or a landmark. Intersections are described by the "on" street (or landmark) joined to the "at" street with a "@" symbol. Typically, the publicLocationDescription is the intersection name. Sometimes the name used by the public is a landmark name like Port Authority Bus Terminal, Walt Whitman Mall or Kingsbridge Depot.

Care should be taken to check whether the native data is referencing an **intersection** like GRAND CONCOURSE @ E 170 ST or a **landmark** like KINGSBRIDGE DEPOT so that the publicLocationDescription does not read like "the landmark at the landmark," such as: KINGSBRIDGE DEPOT @ KINGSBRIDGE DEPOT.

Description for an Intersection

```xml
<Location>
  <locationID>10ca</locationID>
  <featureType>transitStop</featureType>
  <locationDesc>GRAND CONCOURSE</locationDesc>
  <intersection>GRAND CONCOURSE @ E 170 ST</intersection>
  <longitude>-73.913296</longitude>
  <latitude>40.838995</latitude>
  <publicLocationDescription>GRAND CONCOURSE at E 170 ST</publicLocationDescription>
  <isGeneralized>false</isGeneralized>
</Location>
```

Description for a Landmark

```xml
<Location>
  <locationID>3eac</locationID>
  <featureType>transitFacility</featureType>
  <locationDesc>KINGSBRIDGE DEPOT</locationDesc>
  <intersection>KINGSBRIDGE DEPOT </intersection>
  <longitude>0</longitude>
  <latitude>0</latitude>
  <publicLocationDescription>KINGSBRIDGE DEPOT </publicLocationDescription>
  <isGeneralized>false</isGeneralized>
</Location>
```

Example 2: Representing Places with Relative Location Information

The Long Island Bus data set includes relative location information in the form of on and at streets to describe a place. In addition, the location description tag (e.g., <locationDesc>) includes references to the physical point identifier and bus stop identifier used in the native data set. Notice how the fields embedded in the relativeLocation element are indented slightly. This format is needed to provide a "well formed" SDP XML Document.

```xml
<Location>
  <locationID>234</locationID>
  <featureType>transitStop</featureType>
  <locationDesc>HILLSIDE AVE nearest bus stop J179 and Phys Pt J1791</locationDesc>
  <relativeLocation>
    <onStreet>HILLSIDE AVE</onStreet>
    <atStreet>179TH PL</atStreet>
  </relativeLocation>
  <longitude>-73.783251</longitude>
  <latitude>40.712695</latitude>
  <publicLocationDescription>HILLSIDE AVE at 179TH PL</publicLocationDescription>
  <isGeneralized>false</isGeneralized>
</Location>
```

Example 3: Timepoint Example

In addition to using “street names at an intersection” as a location referencing method, the NYC Bus data set also contains timepoint and bus stop identifiers. In the data conversion process, this location information may be inserted in the Location (locationID = 173f), TransitStop (stopID=300200 where locationID=173f) and Timepoint (timepointID= CIAAU where locationID=173f) elements.

```
<Location>
  <locationID>173f</locationID>
   <featureType>transitStop</featureType>
  <locationDesc>AV U at CONEY ISLAND AV</locationDesc>
  <intersection>AV U @ CONEY ISLAND AV</intersection>
  <longitude>-73.960717</longitude>
  <latitude>40.598289</latitude>
  <publicLocationDescription> AV U at CONEY ISLAND AV </publicLocationDescription>
  <isGeneralized>false</isGeneralized>
</Location>
….
<Timepoint>
  <timePointID>CIAAU</timePointID>
  <location>173f </location>
  <publicTimepointName> AV U at CONEY ISLAND AV </publicTimepointName>
</Timepoint>

<TransitStop>
  <stopID> 300200</stopID>
  <locationID>173f</locationID>
  …
  </TransitStop>
```