



# ***2006 GIS-T Symposium Columbus Ohio***

## ***Accommodating Multiple Location Referencing Methods***

**Developed and Presented by  
Al Butler  
MilePost Zero**



## *The Issue of Discreteness*

- ④ Extent of linear transportation facilities may be arbitrarily defined by:
  - Name
  - Jurisdictional boundary
  - Intersection
- ④ Different actors may employ different methods
- ④ Next problem: location
  - Where are the segments?
  - Where are things on those segments?

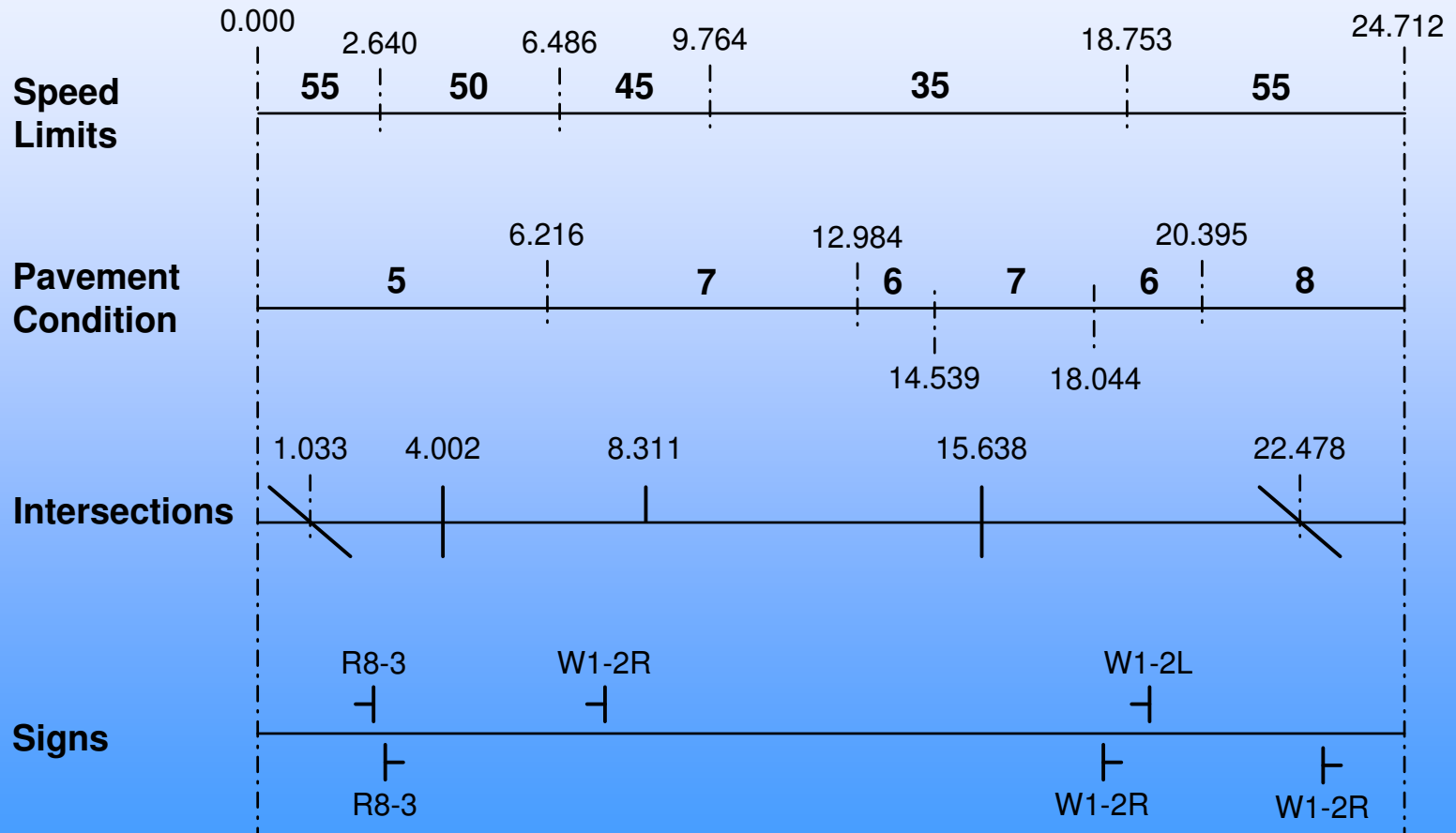


## *Common Transportation Data Structures*

- ④ Seek to create discrete linear features
- ④ Four primary types:
  - Link-node
  - Street address block
  - Fixed segmentation
  - Route-milelog



# Highway Inventories





# *Inventory Database*

## *Speed Limit Table*

| <u>roadway ID</u> | <u>begin ML</u> | <u>end ML</u> | <u>speed limit</u> |
|-------------------|-----------------|---------------|--------------------|
| 33S058            | 0.000           | 2.640         | 55                 |
| 33S058            | 2.640           | 6.486         | 50                 |
| 33S058            | 6.486           | 9.764         | 45                 |
| 33S058            | 9.764           | 18.753        | 35                 |
| 33S058            | 18.753          | 24.712        | 55                 |

## *Pavement Condition Table*

| <u>roadway ID</u> | <u>begin ML</u> | <u>end ML</u> | <u>condition</u> |
|-------------------|-----------------|---------------|------------------|
| 33S058            | 0.000           | 6.216         | 5                |
| 33S058            | 6.216           | 12.984        | 7                |
| 33S058            | 12.984          | 14.539        | 6                |
| 33S058            | 14.539          | 18.044        | 7                |
| 33S058            | 18.044          | 20.395        | 6                |
| 33S058            | 20.395          | 24.712        | 8                |



# Route-Milelog Examples

| RouteSeg           |
|--------------------|
| <u>route</u>       |
| <u>refPt</u>       |
| <u>endRefPt</u>    |
| <u>length</u>      |
| <u>updateYr</u>    |
| <u>description</u> |
| calYr              |

| FunClass           |
|--------------------|
| <u>route</u>       |
| <u>refPt</u>       |
| <u>endRefPt</u>    |
| <u>length</u>      |
| <u>updateYr</u>    |
| FIPSCity           |
| <b>FIPSCounty</b>  |
| <b>population</b>  |
| urban              |
| <b>funcClassID</b> |
| <b>fedSysID</b>    |
| <b>fedStatus</b>   |
| routeSign          |
| routeSignQual      |
| ...                |
| calYr              |

| XSection        |
|-----------------|
| <u>route</u>    |
| <u>refPt</u>    |
| <u>endRefPt</u> |
| <u>length</u>   |
| <u>updateYr</u> |
| builtYr         |
| secOutShld      |
| secOutShldWd    |
| secSurf         |
| secSurfWd       |
| median          |
| medianWd        |
| prlnShld        |
| prlnShldWd      |
| ...             |
| calYr           |

| PointEvent            |
|-----------------------|
| <u>roadwayID</u>      |
| <u>pointEventID</u>   |
| <u>pointEventDate</u> |
| enteredBy             |
| collectionDate        |
| fromDate              |
| toDate                |
| <b>atMeasure</b>      |
| <b>side</b>           |
| lateralOffset         |
| offsetDirection       |
| directionOfTravel     |
| <b>eventTypeID</b>    |
| <b>primaryValue</b>   |
| secondaryValue        |
| <b>statusID</b>       |

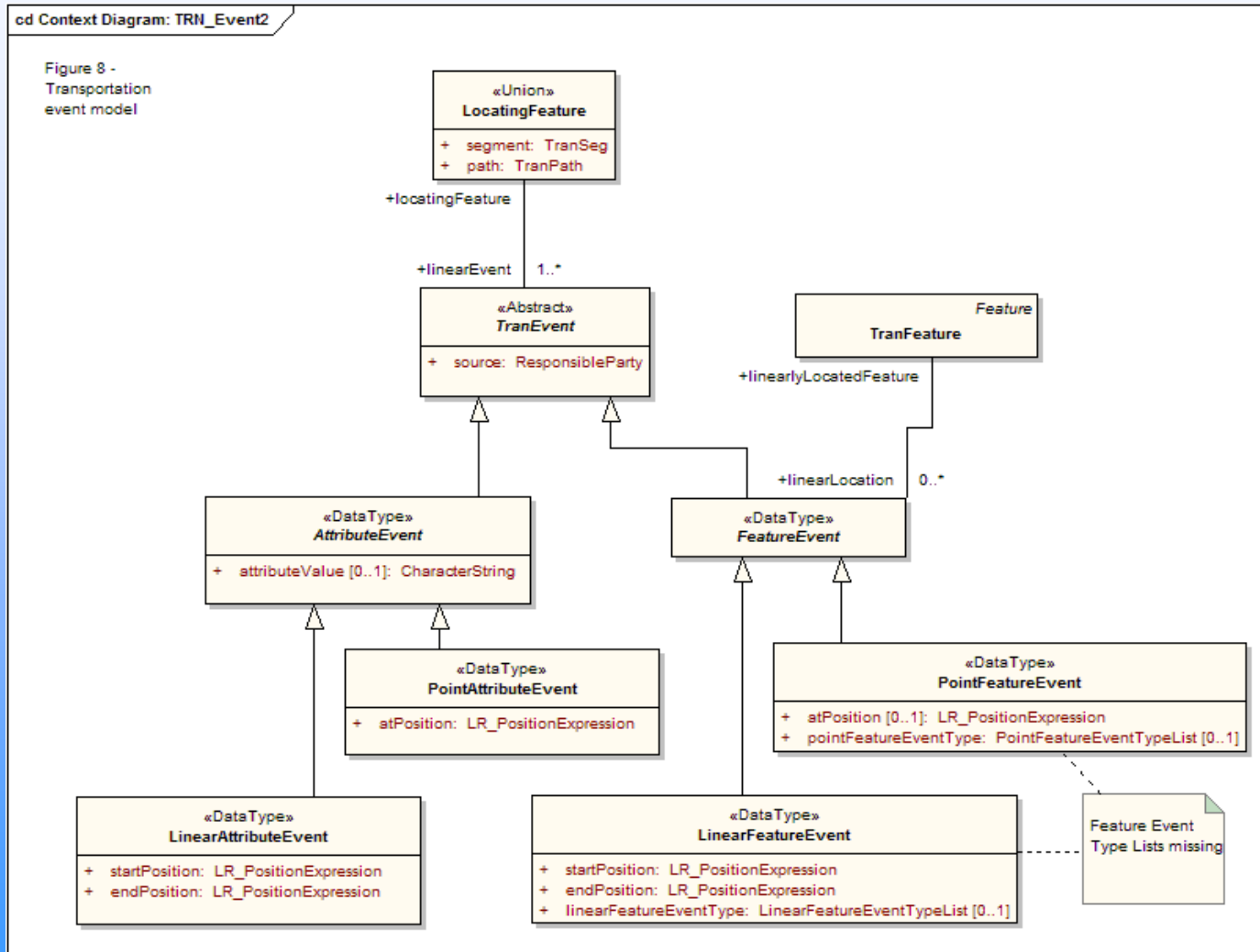
| LinearEvent            |
|------------------------|
| <u>roadwayID</u>       |
| <u>linearEventID</u>   |
| <u>linearEventDate</u> |
| enteredBy              |
| collectionDate         |
| fromDate               |
| toDate                 |
| <b>fromMeasure</b>     |
| <b>toMeasure</b>       |
| <b>side</b>            |
| lateralOffset          |
| offsetDirection        |
| directionOfTravel      |
| <b>eventTypeID</b>     |
| <b>primaryValue</b>    |
| secondaryValue         |
| <b>statusID</b>        |

*Denormalized Structure*

*Normalized Structure*



# FGDC Attribute Model





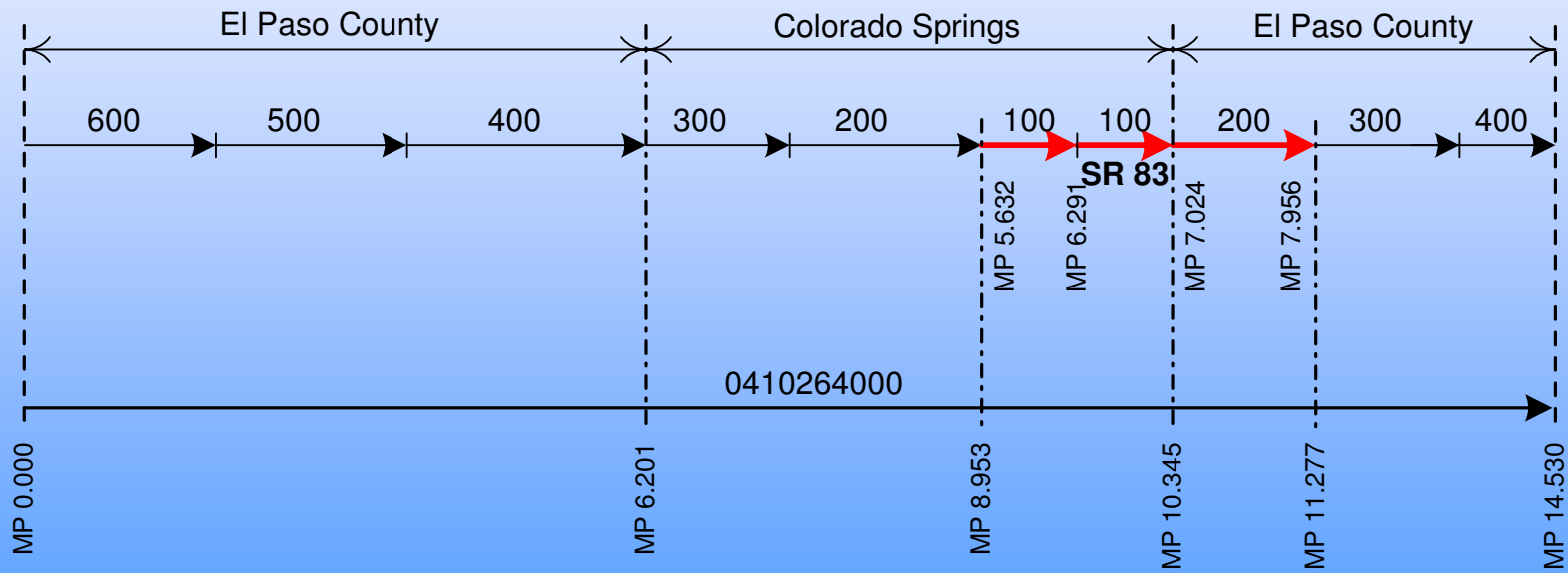
## *One Location Attribute*

- ⓐ Records tied to one route with one LRM location
- ⓐ What do you do when...
  - ...there is more than one LRM for a facility segment?
  - ...revised LRM measurements “move” a facility element or attribute?
  - ...routes are extended?
  - ...routes are realigned?
  - ...database structure is revised?
  - ...you need to construct a traversal from parts of multiple routes?



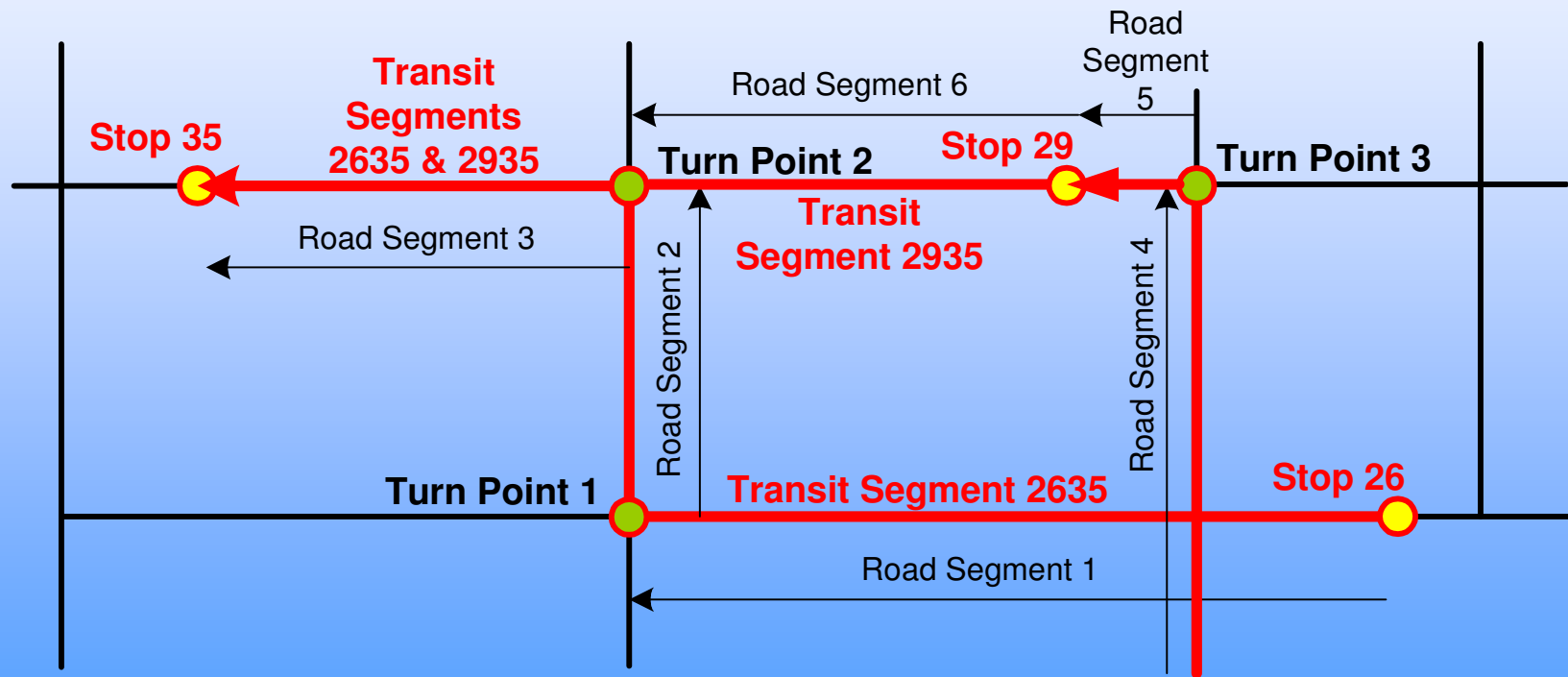


# Multiple Structures





## Road Transit Problem





## *Central Principles*

- ④ Route in database is not the facility in the real world; it is an abstraction of the facility
- ④ Many routes (abstractions) may be defined for a given segment of a real-world facility; each LRM defines its own routes (LRM datums)
- ④ Location is absolute but position is relative
- ④ Record information about a facility, event, or characteristic once; assign it many locations

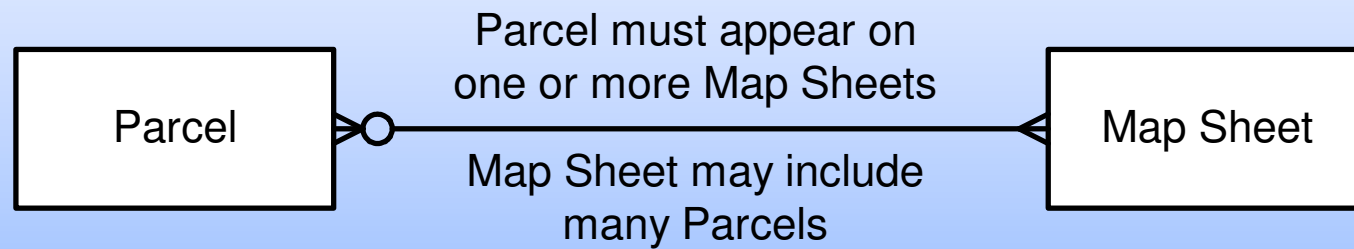


## *Normalization Is the Answer*

- ④ Normalization is the process of removing dependencies and redundancies in a database design
- ④ Applies to all relational databases
- ④ Makes it easier to maintain referential integrity
- ④ Reduces editing workload

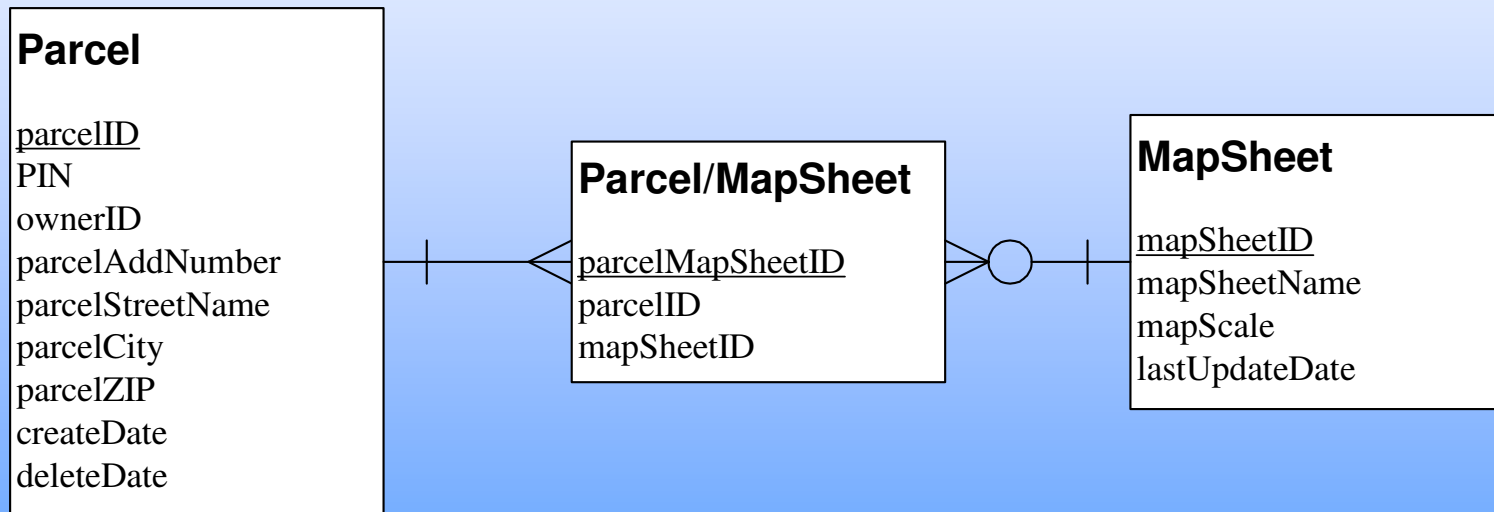


## *Many-to-many Relationship*



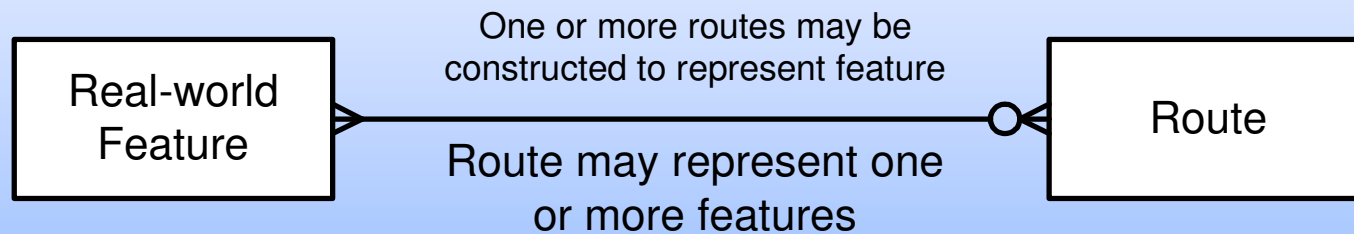


## *Add Associative Entity to Remove Redundancy*



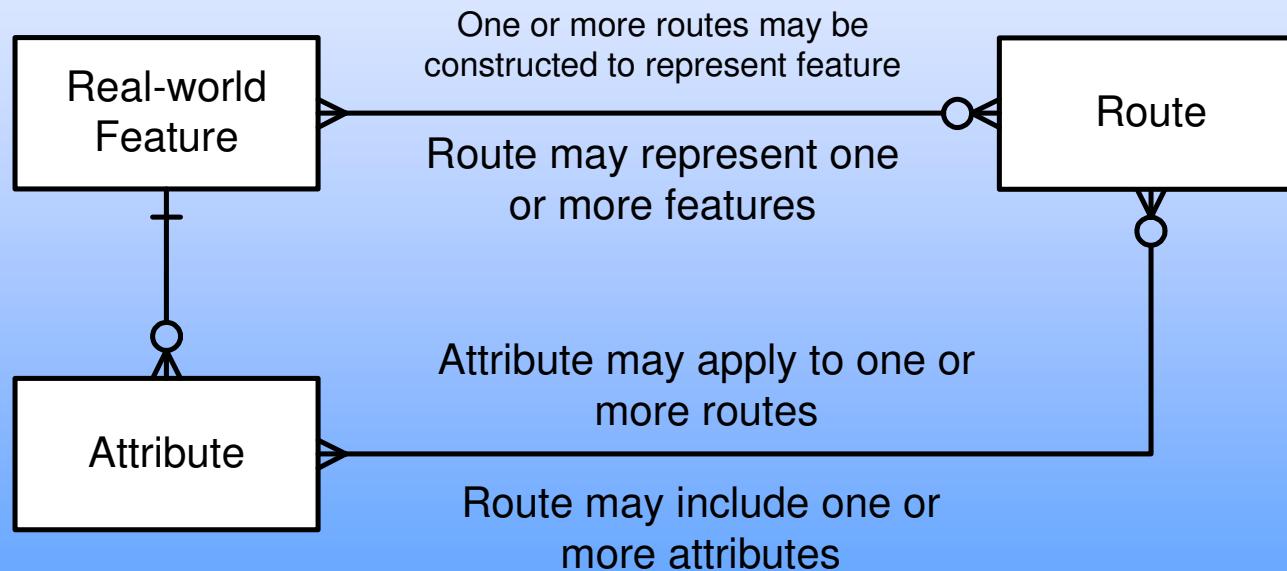


## *Database Route is an Abstraction of Real-world Feature*





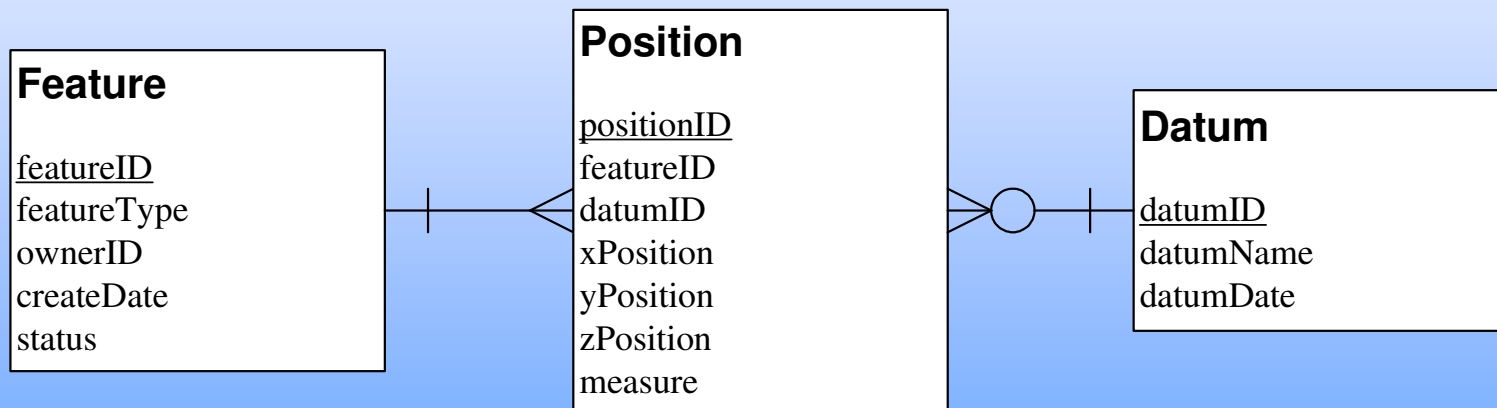
## *Multiple LRMs Impose a Many-to-many Relationship*





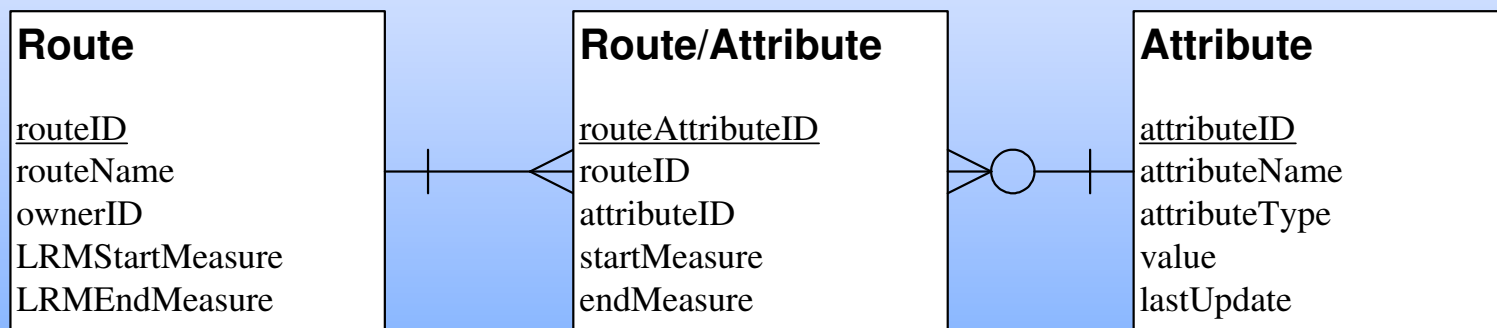


## *Remove Dependencies: One Location, Many Positions*



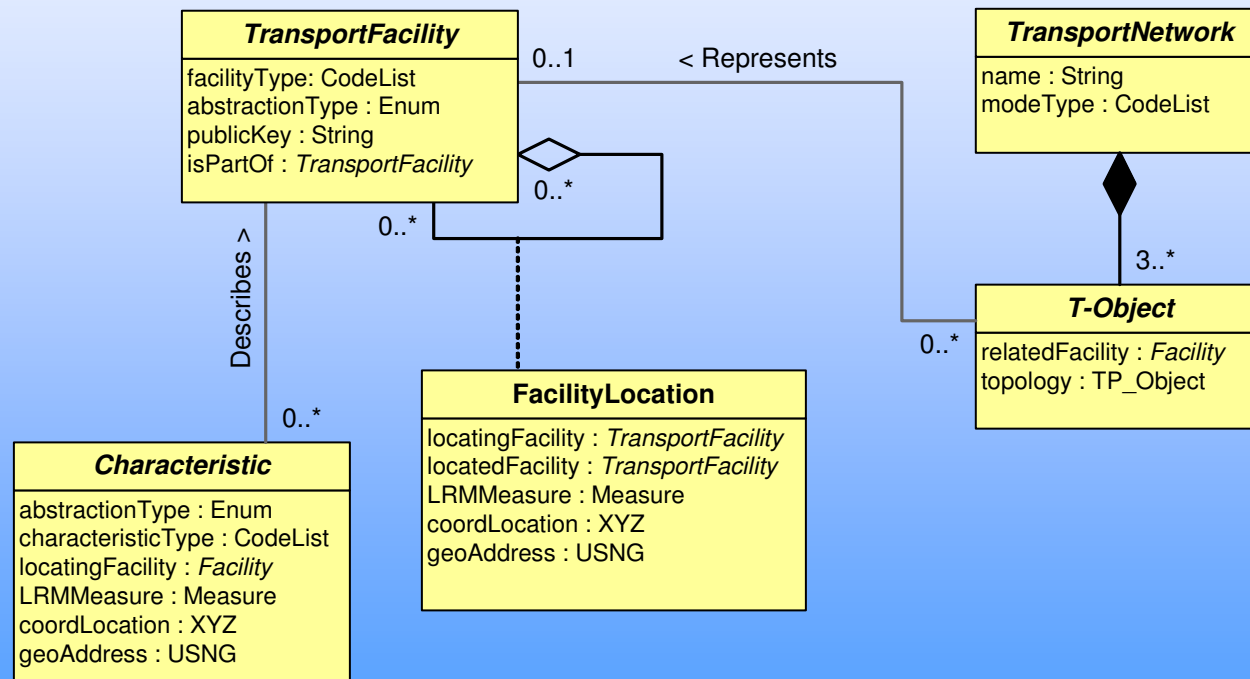


## *Associative LRM Entity*



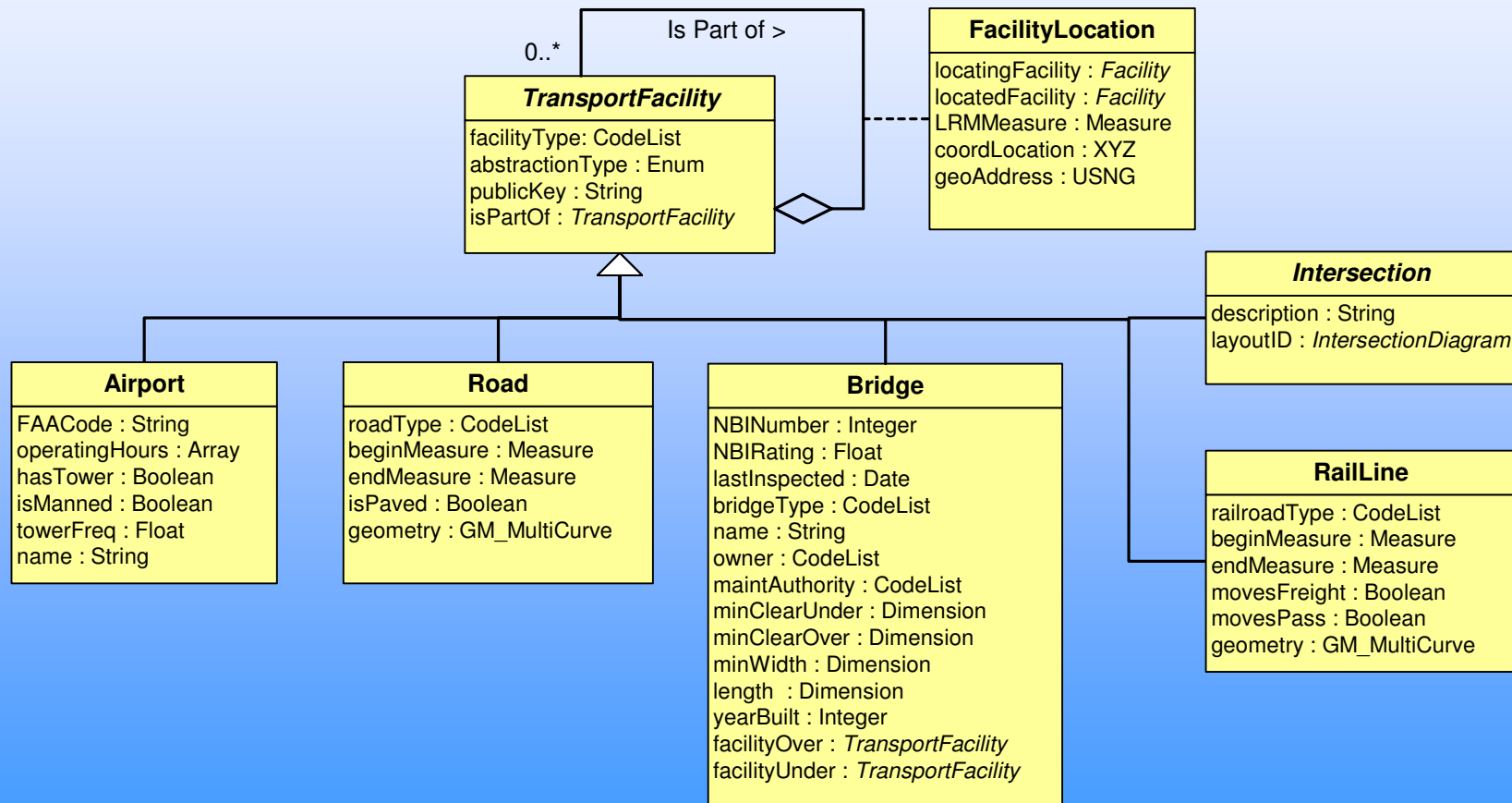


# Facility Model



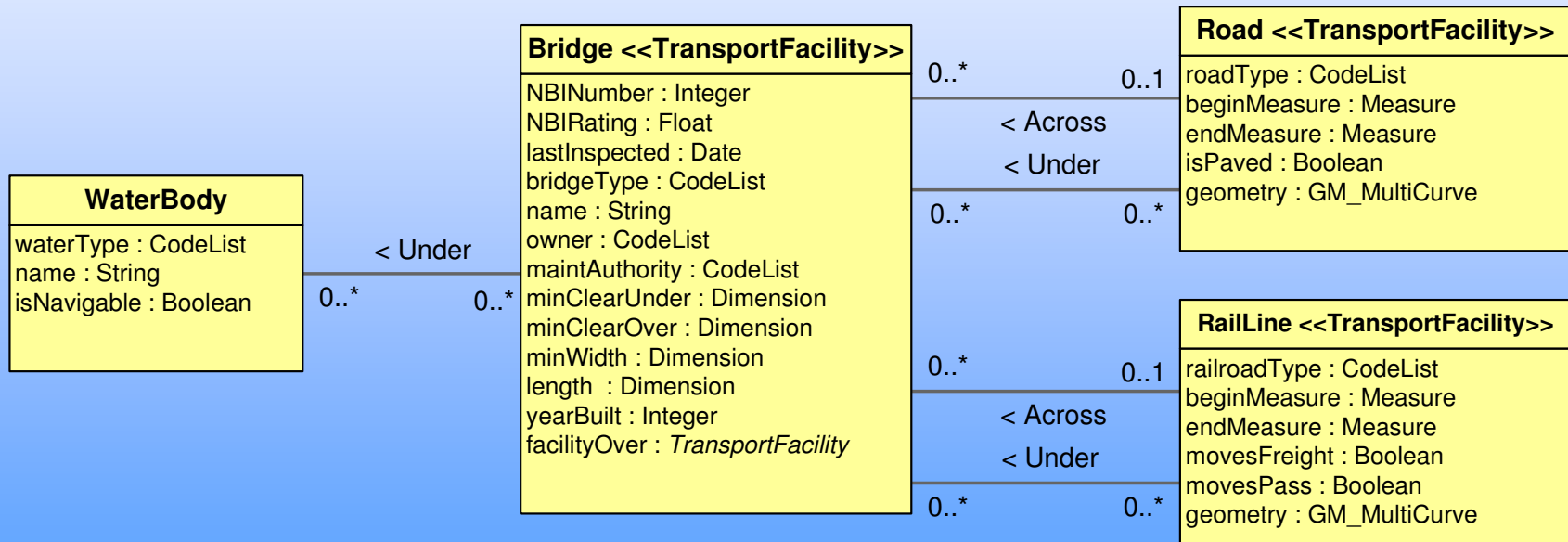


# Facility Examples



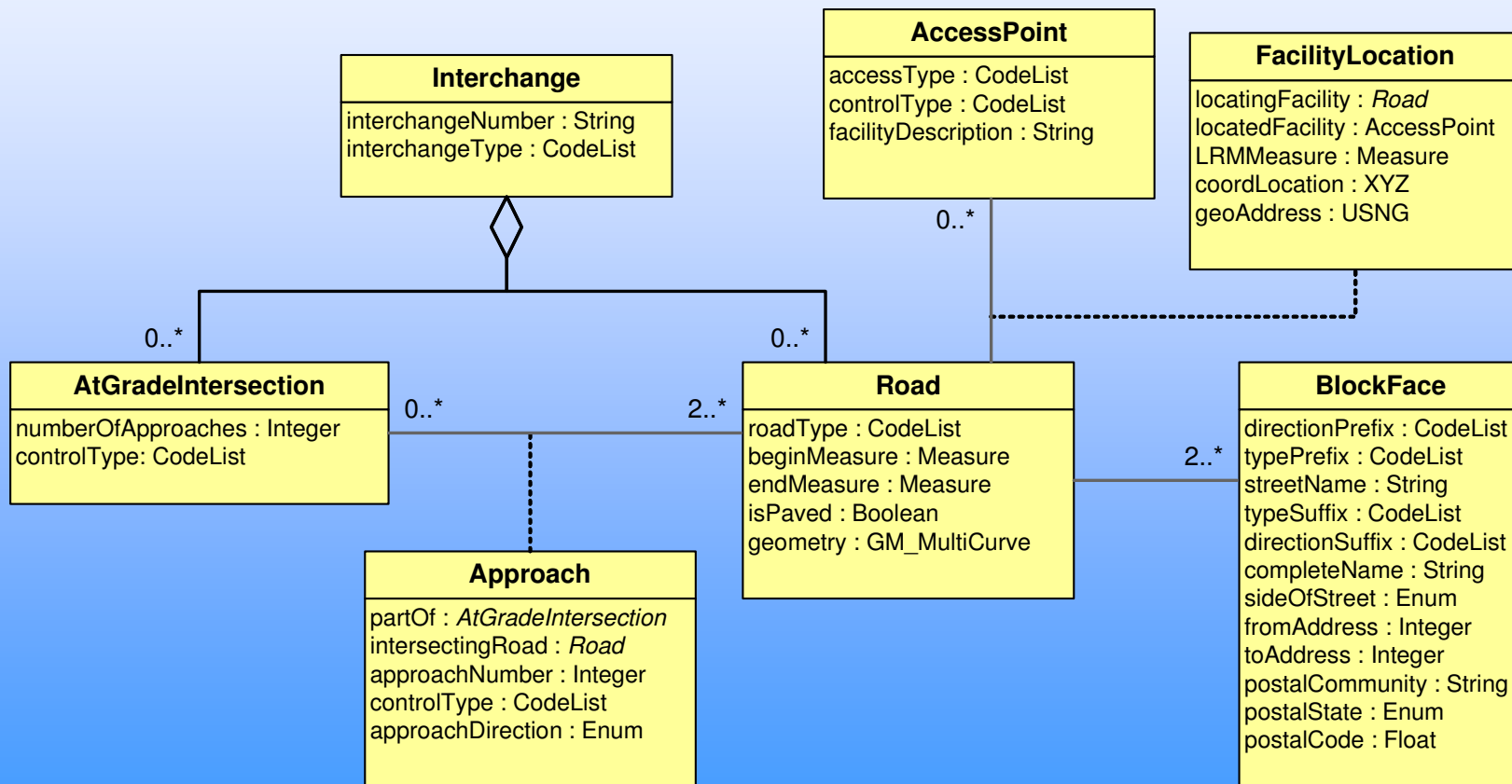


# Bridge Detail



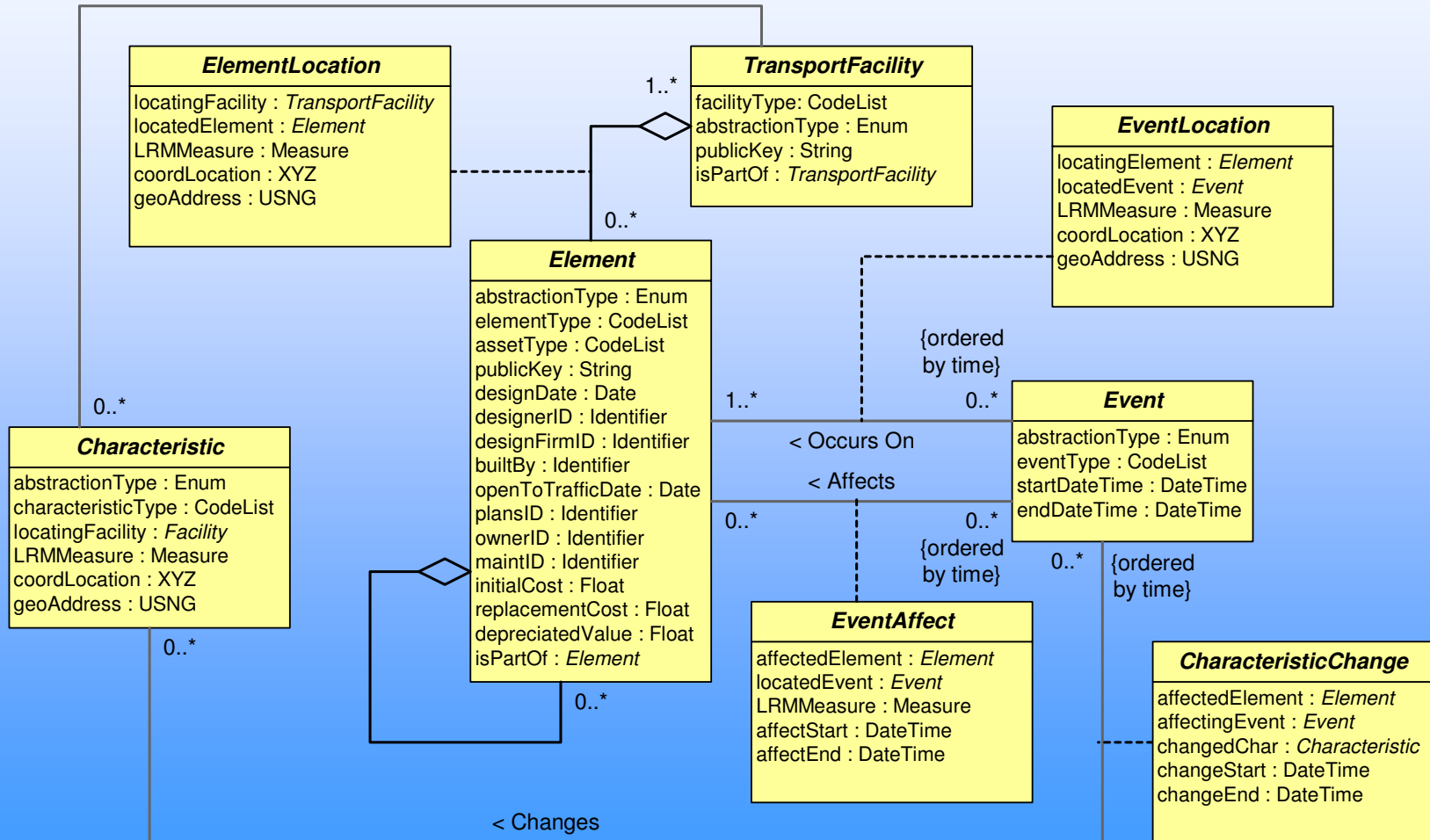


# Road-Intersection Details



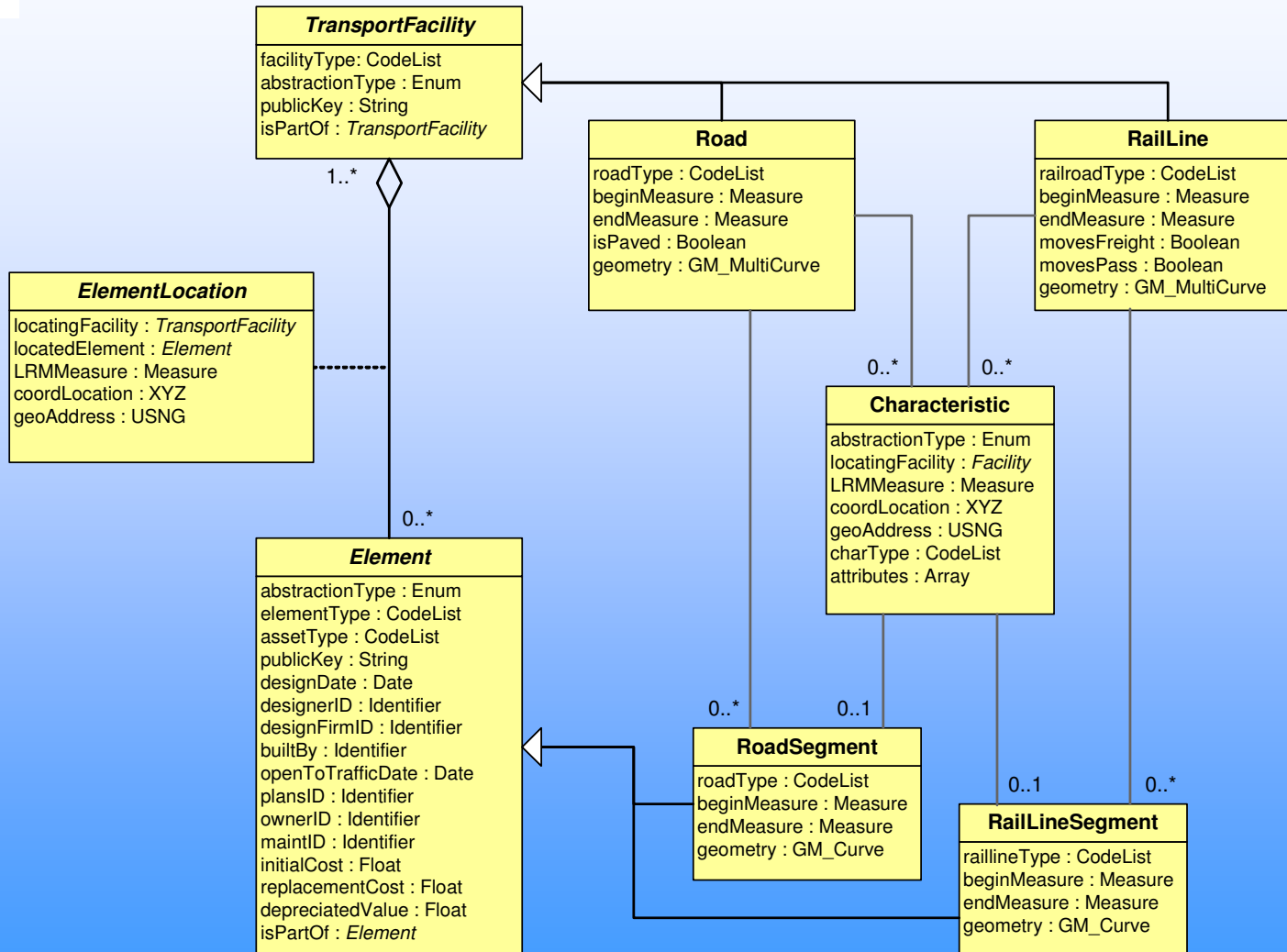


# Elements & Events





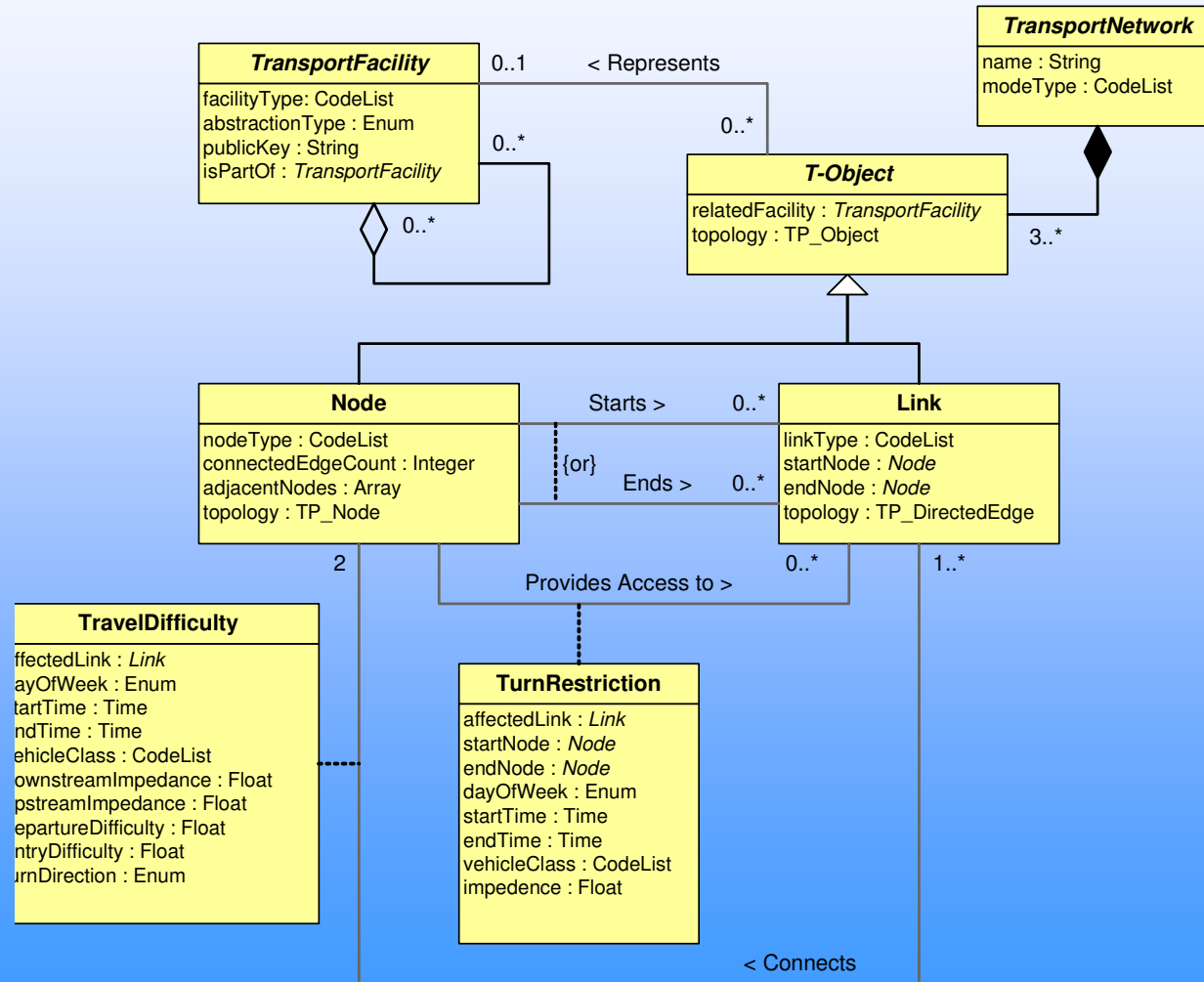
# DynSeg Example







# Basic Network Model





## *Conclusion*

- ④ Apply RDBMS normalization process to transportation datasets
- ④ Use an attributed relationship class/entity to resolve the many-to-many relationship that results from multiple LRMs
- ④ Benefits of the relative location approach:
  - Eliminate data redundancy
  - Avoid conflation and equivalency mechanisms



## *For More Information*

📧 Al Butler

MilePost Zero

407-376-3258

[abutler@mpzero.com](mailto:abutler@mpzero.com)