Stable Linear Referencing for OSM

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Mapzen Mobility

Valhalla - Open Source Routing

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start where you are...

- → Global, multi-modal routing using open source data
  - OpenStreetMap
  - Transitland (open public transit data)
- → **Dynamic, run-time costing**
  - Flexible
  - Extensible
- → **Routing graph tiles**
  - Optimize memory use/caching
  - Off-line routing capabilities
- → **Map matching**
- → Improved guidance
  - Clear and concise, with verbal prompts
  - Focus on mobile navigation applications

https://github.com/valhalla

How to Associate Data to OSM Road Network?

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- → Wish to associate data to roads to add value and create new applications
- → Data that:
  - Is not readily available to OSM mappers
  - May vary over time (traffic)
  - May be proprietary (travel counts, ratings)
- → Desire a set of stable identifiers that reference a path along roadway
  - Persistent Ids
  - Stable under small, local changes to road network
  - Ability to add new Ids as roads are added

Location Referencing

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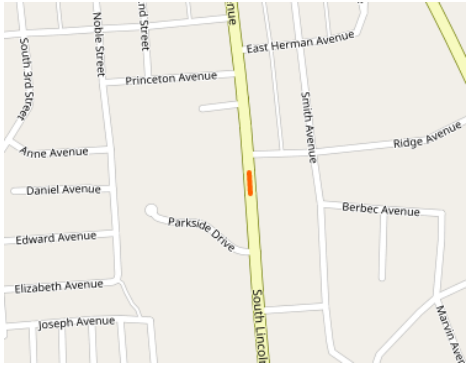
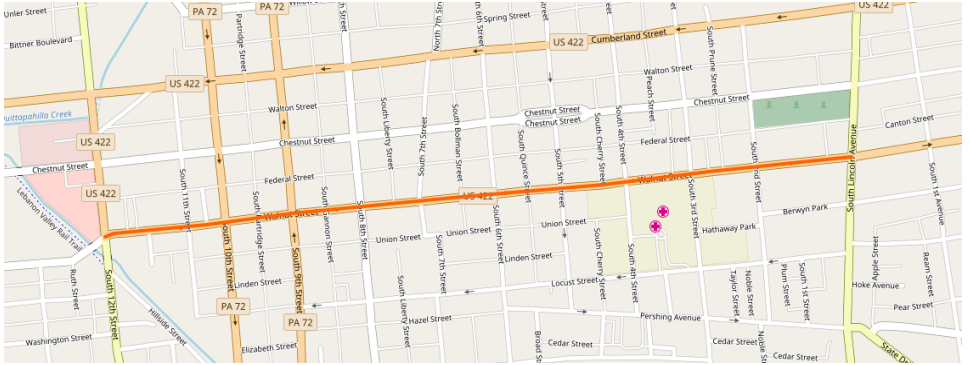
→ OSM way Ids are not feasible

- Not persistent - way Ids change as edits occur
- Inconsistent localization - ways vary greatly in extent

→ **Linear location referencing** provides a way to describe a linear path



Overpass

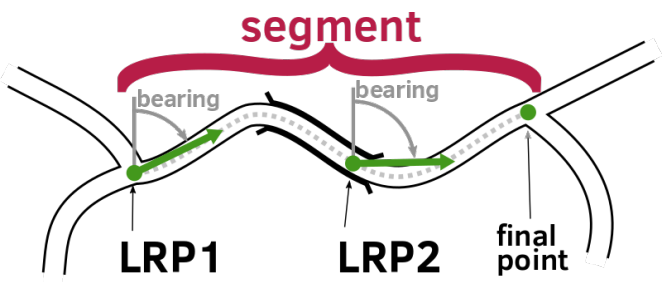


Long stretch of roadways with many intersections

OSMLR

→ **O**pen**S**treet**M**ap derived **L**ocation **R**eferencing

- Open source (part of Open Traffic organization)
  - https://github.com/opentraffic/osmlr
- Protocol buffer and GeoJSON
  - https://github.com/opentraffic/osmlr-tile-spec



→ Based on **OpenLR** – open standard developed by TomTom

- http://www.openlr.org/
- http://www.openlr.org/data/docs/OpenLR-Whitepaper_v1.5.pdf

→ OSMLR uses Location Reference Points (LRP)

- Hints to describe path in between: length, bearing, form of way, road class

→ https://mapzen.com/blog/open-traffic-osmlr-technical-preview/ https://mapzen.com/blog/osmlr-2nd-technical-preview/

Sample Use of OSMLR

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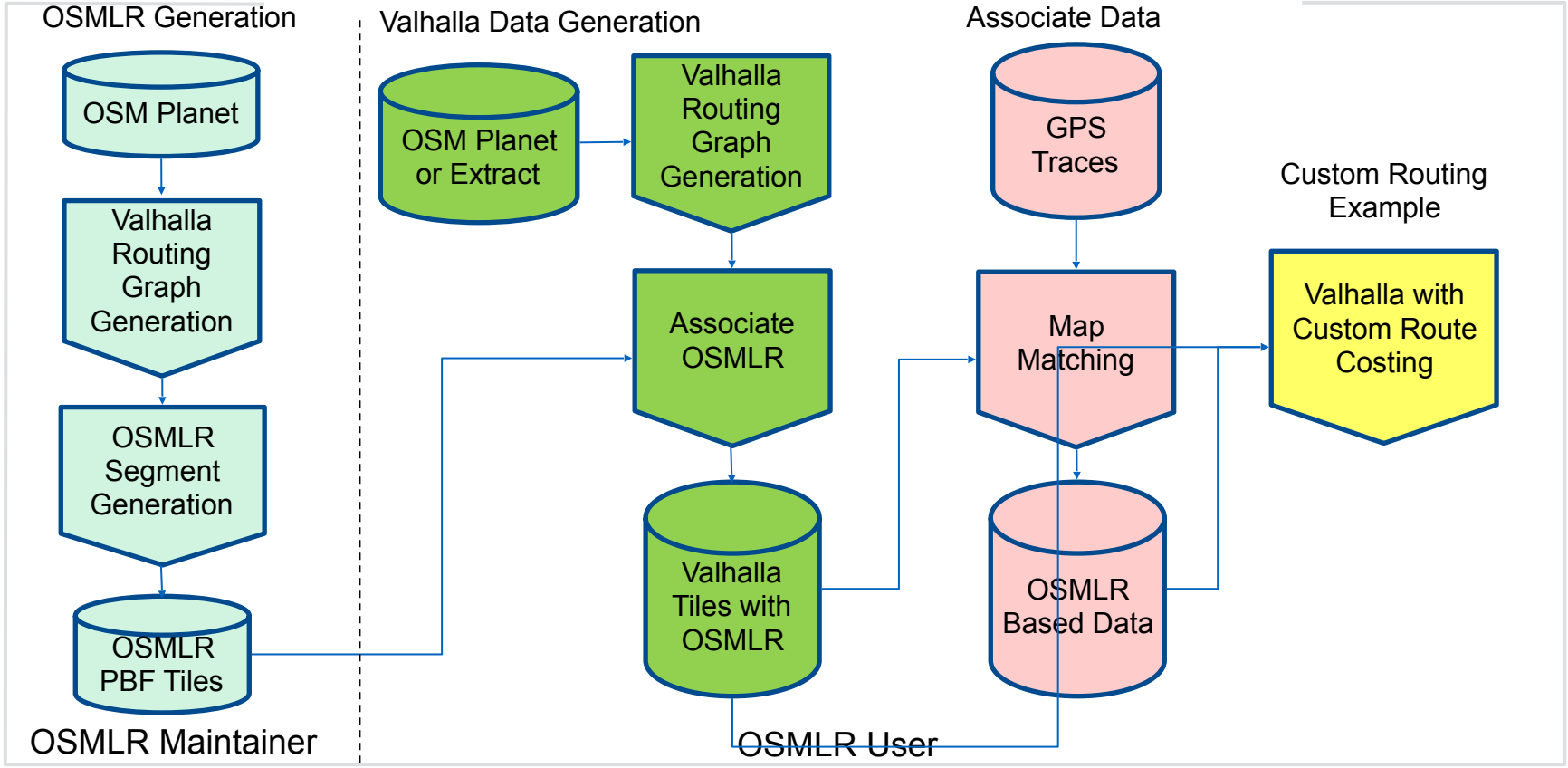

Open Traffic

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- → Open Traffic is a global platform
  - https://github.com/opentraffic
  - Import anonymous GPS positions/traces
  - Create historical traffic statistics
- → Sponsored by the World Bank
  - Import archived data from Grab
    - Southeast Asia
- → Open source software components
  - https://github.com/opentraffic/otv2-platform
- → Uses Valhalla map matching
  - GPS trace → Valhalla edges → OSMLR

Showing traffic along a route.
Also computes ETA

OSMLR Identifiers

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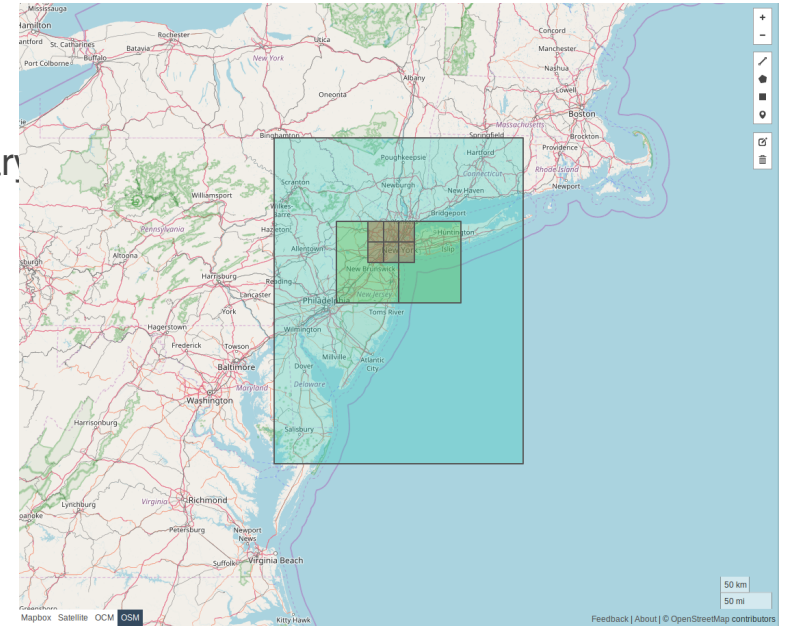
- → Unique identifiers consist of a tile Id, a hierarchy level, and a unique Id within the tile/level
- → Uses Valhalla tile definitions
- → Level 0 - highway
  - 4 degree tiles: motorway, trunk, and primary
- → Level 1 - arterial
  - 1 degree tiles: secondary and tertiary
- → Level 2, local
  - ¼ degree tiles: unclassified, residential



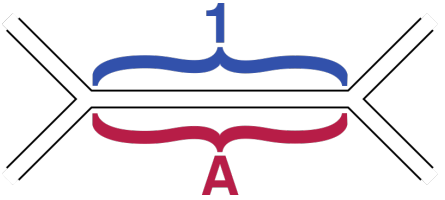
OSMLR Generation

→ OSMLR is generated using Valhalla data

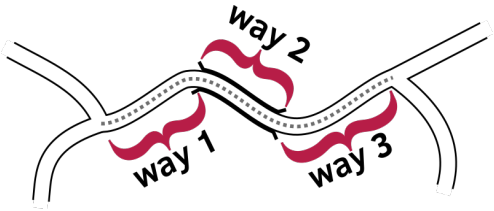
- Tiled, routing graph
- Nodes – intersections of ways or begin/end of a way
- Edges – directional portions of OSM ways between nodes

→ https://mapzen.com/blog/open-traffic-osmlr-technical-preview/

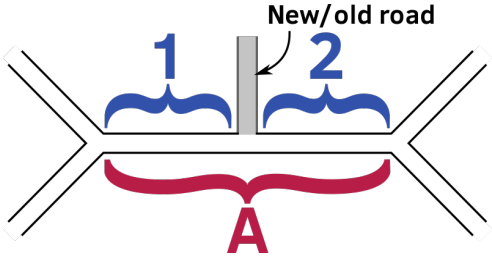
- Most edges produce 1 OSMLR segment
- Edges can be merged (many edges → 1 OSMLR)
  - Across nodes with no other intersecting edges (e.g. overpass)
  - Across intersections with local or non-driveable edges
- Edges can be split (1 edge → many OSMLR)
  - Data edits, length limit (1 km)



1 Edge → 1 OSMLR Segment



3 edges →1 OSMLR segment



1 edges → 2 OSMLR segments

“Internal” Edges

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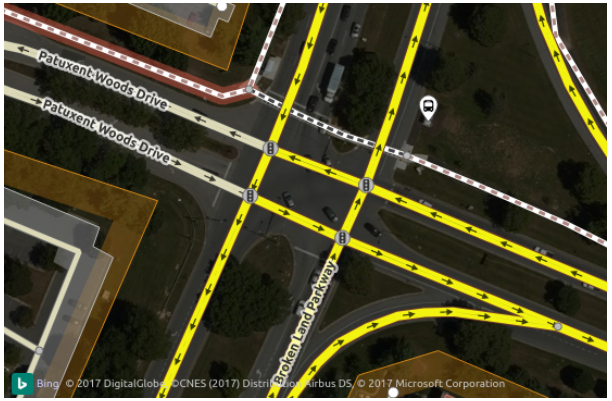
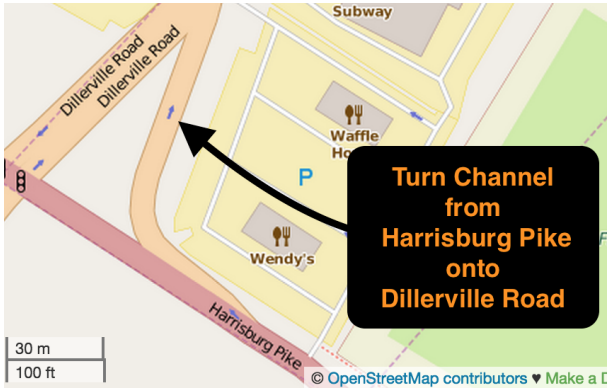
- “Internal” edges do not receive OSMLR Ids
  - Generally considered as providing “transition” between two other OSMLR Ids
- **Internal intersection** edges
  - Edges that are “internal” to intersections
- **Turn channels**
  - Short, at-grade “links”
- **Roundabouts**
  - Often have very short ways/edges





Statistics

Hierarchy	OSMLR Count	Average Length (meters)
Level 0	11,257,706	660
Level 1	26,792,704	641
Level 2	183,500,211	94

→ OSMLR version 1.1 is available in Amazon Web Service's Public Dataset program

- https://s3.amazonaws.com/osmlr/listing.html
- https://mapzen.com/blog/osmlr-released-as-public-dataset/

OSMLR Updates

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→ Strategy:

- Ids for OSMLR segments associated to Valhalla edges remain unchanged
- Deprecate Ids no longer associated to Valhalla edges
- Create new Ids
  - To replace deprecated Ids
  - For newly added OSM ways

→ Goal: stable OSMLR Ids under certain OSM edits

- Moving nodes within some tolerance
- Single to doubly digitized or double to singly digitized
- Classification changes within same hierarchy
  - E.g., primary -> trunk

OSMLR Quality Through Time

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→ How quickly do OSMLR Ids degrade under OSM editing?

→ Evaluate percentage of OSMLR Ids that fail to associate to Valhalla edges

- Due to OSM edits

Hierarchy	Success Count: Successfully Associated to Valhalla Edges	Failure Count: No Longer Associate to Valhalla Edges	Percentage
Level 0	10,779,466	351,438	96.8%
Level 1	25,646,511	642,091	97.6%
Level 2	177,147,235	2,250,141	98.7%

* Association to Valhalla after 4 months

Future

→ Experiment with update tolerances (LRP locations, bearings, length)

- When is an edit/change large enough to warrant deprecating a segment?

→ Develop methods for tracking lineage of an OSMLR segment

- Approaches and guidelines for migration of data associated to a deprecated Id.

→ Extend to other OSM ways

- Footways, cycleways, etc.
- Extend Id space to separate them from current OSMLR Ids

→ Extend OSMLR Id space to accommodate other types of linear data

→ Fix issues caused by “overlapping” ways or ways that have overlapping sections

OSMLR / Valhalla Team

MAPZEN
start where you are...

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Also, big thanks to Matt Amos!

Questions, Comments, Contributions?

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start where you are...

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