DATABASES FOR HIGHWAY INVENTORIES

PROPOSAL FOR A NEW MODEL

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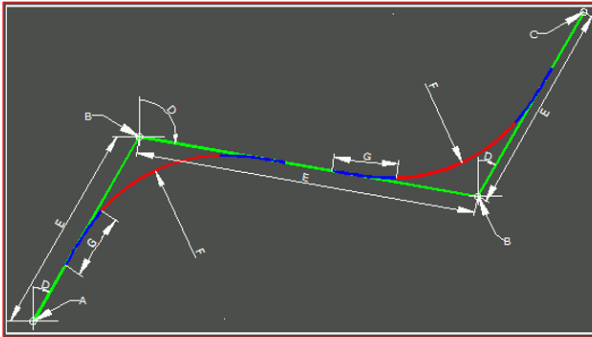
Universidad Politécnica de Madrid
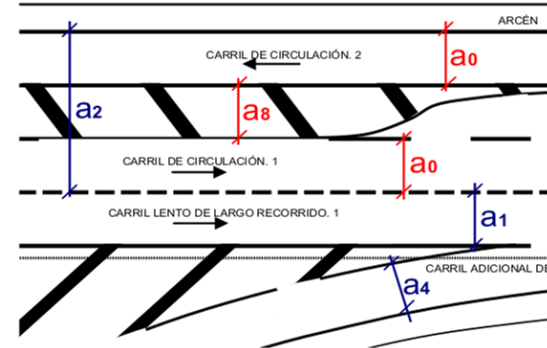
http://shiguera.github.io/cit2016

INFORMATION LEVELS

Levels of information considered in highway physical inventories

Geometry and Topology

Roadway Characteristics

Highway Elements

TWO KIND OF DATA MODELS

- **Information exchange**
  - LandXML
  - GML
  - EuroRoadS
  - Inspire Specification on Transport Networks
- **Proprietary software**
  - Commercial Inventory Software
 - Spanish Highway Inventory

STATEMENT OF THE PROBLEM

- **Different agents** are interested in highway inventories and each one has different needs (Administration authorities, design and construction companies, maintenance companies, emergency services)
- **Different kinds of roads** or paths (classic highways for cars, cycling or pedestrian pathways, forestry roads, tourism uses)
- **Long and specialized training and design period** in current inventory software. This is a handicap in disaster response
- **Centered in one country** language and regulations

PROPOSAL OF THIS PAPER

- Non-SQL database
- It does not require previous design
- It starts with straightforward model
- Users build it in an incremental way
- Adaptable to any highway and any user
- Multilanguage
- Inspired in OpenStreetMap
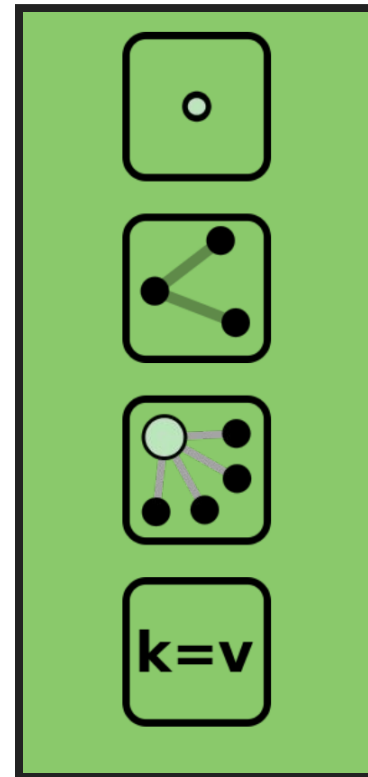
GEOGRAPHIC INFORMATION COMPONENTS
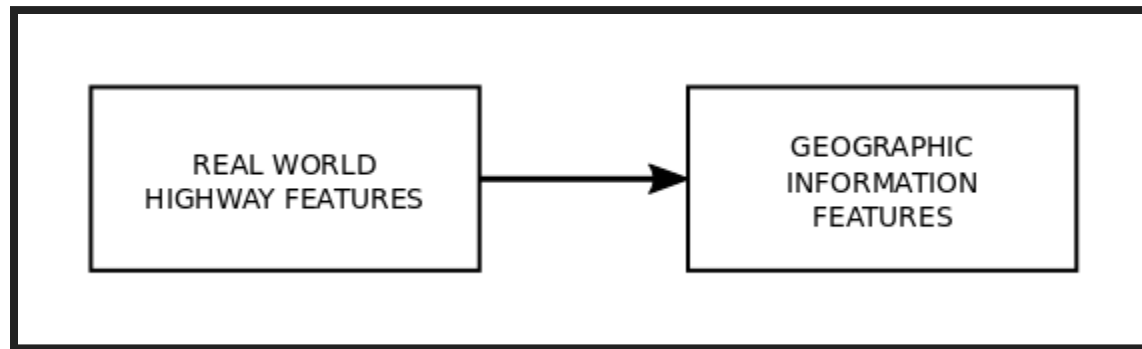
- **Spatial Component**: Location and Geometry
- **Thematic Component**: Nature and Characteristics
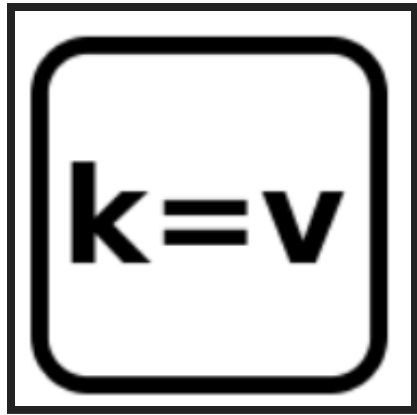

AND WHAT ABOUT TIME AS THIRD COMPONENT?

BASIC DATA TYPES

- Node
- Line
- Relation
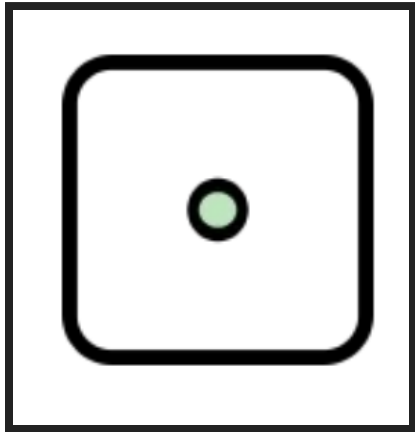- Tag

TAG: UNIT OF THEMATIC INFORMATION

- Key - Value Pair

Examples:

- highway = primary
- name = E-98
- slope = 0.04

NODES

- Attributes
  - Id
  - Longitude, Latitude
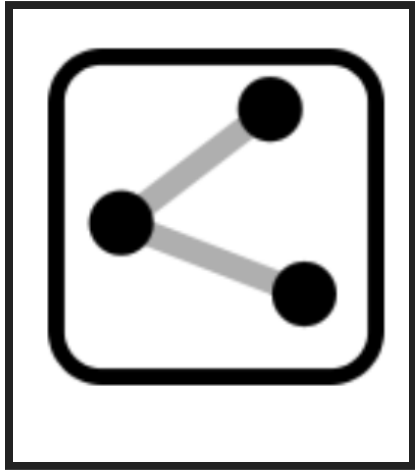- Content
  - Tag's list

Example:

```
<node id="25496583" lat="51.5173639" lon="-0.140043">
  <tag k="highway" v="traffic_signals"/>
  <tag k="group" v="warning"/>
  <tag k="code" v="es:P1"/>
</node>
```

LINES - WAYS

- Attributes
  - Id
- Content
  - Node's list: referenced by Id
  - Tag's list

Example:

```
<Line id="5090250">
  <nd ref="822403"/>
  <nd ref="21533912"/>
  <nd ref="821601"/>
  <tag k="highway" v="residential"/>
  <tag k="name" v="Clipstone Street"/>
  <tag k="oneway" v="yes"/>
</Line>
```

CLOSED LINES - AREAS
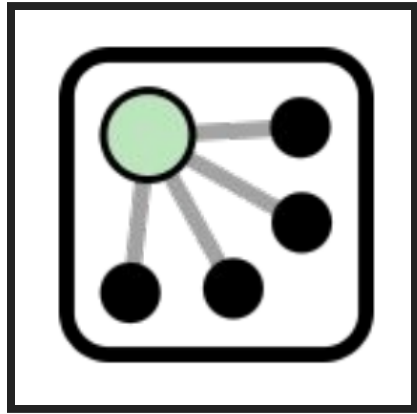
If the first and last Node of a Line are the same node

- Closed Line
- Area

Tagging establishes the type of feature

RELATIONS

Modeling complex elements

- Attributes
  - Id
- Content
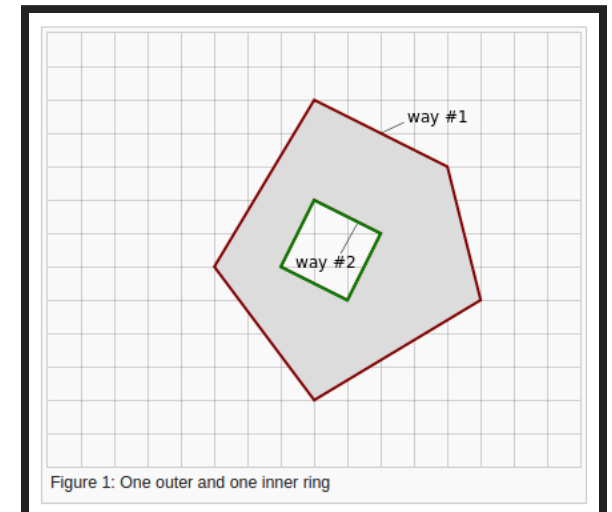 - Member's list: type, id, role
  - Tag's list

Example:

```
<relation id="1">
    <tag k="type" v="multipolygon" />
    <member type="way" id="1" role="outer" />
    <member type="way" id="2" role="inner" />
</relation>
```


way #1

way #2

Figure 1: One outer and one inner ring

ALTITUDE
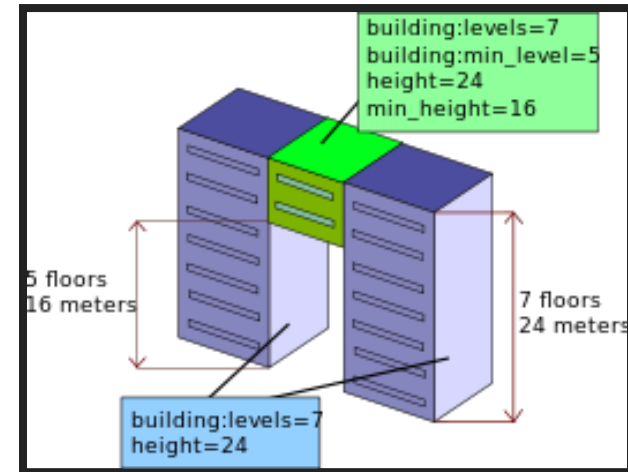
- Altitude as thematic component
- Altitude is a tag
- Complex altitude models

Example:

```
<node id="25496583" lat="51.5173639" lon="-0.140043">
  <tag k="altitude" v="960.0"/>
  <tag k="levels" v="2"/>
  <tag k="height" v="32.0"/>
  <tag k="min-height" v="12.0"/>
  <tag k="max-height" v="32.0"/>
</node>
```

LINEAR REFERENCING

ISO 19148: Geographic information — Linear referencing

- Locating feature: Route
- Located features: Tagging
- Dynamic segmentation
- Time located: Tagging

```xml
<relation id="500">
  <tag k="route" v="A-3"/>
  <member type="line" id="123" role="1"/>
  <member type="line" id="124" role="2"/>
  <member type="line" id="125" role="2"/>
</relation>
<node id="200" lon="-3.4356725" lat="40.9878652">
  <tag k="highway" v="pointEvent" />
  <tag k="route" v="A-3" />
  <tag k="station" v="5+0230" />
  <tag k="name" v="traffic-sign" />
  <tag k="description" v="crossing road" />
  <tag k="code:es" v="P1" />
</node>
<relation id="201">
  <tag k="highway" v="lineEvent" />
  <tag k="route" v="A-3" />
  <tag k="starting-station" v="5+0080" />
  <tag k='ending-station' v='5+00170' />
  <tag k='name' v='guard-rail' />
</relation>
<relation id="202">
  <tag k="highway" v="lineAttribute" />
  <tag k="route" v="A-3" />
  <tag k="starting-station" v="5+0090" />
  <tag k="ending-station" v="5+0190" />
  <tag k='name' v='pavementState' />
  <tag k='state' v='good' />
</relation>
```

DATABASE SCHEMA IMPLEMENTATION

- Node, Line and Relation tables
- NodeLine table
- RelationMember table
- NodeTag,LineTag and RelationTag tables

Any relational database can store this schema

SQLITE for straightforward inventories and mobile solutions

XML AS EXCHANGE FORMAT BETWEEN APPS

- World Wide Web Consortium Standard
- Easy to export to GIS formats (shp, GPX, KML)
- Easy to edit and modify
- Existing free tools: JOSM, QGIS, GDAL
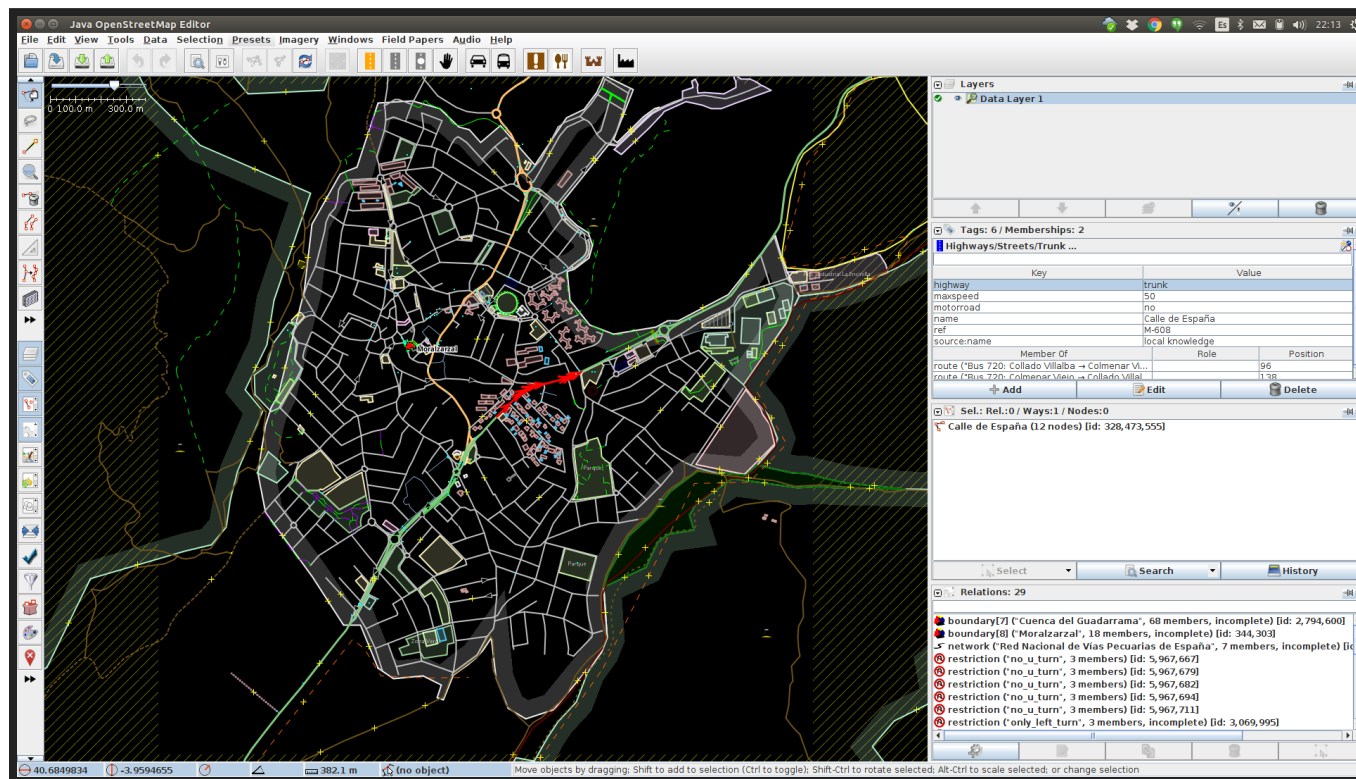
CONCLUSIONS

- Open and known schema
- Easy to develop software tools
- Customizable for any interested agent
- Customizable for any kind of highway
- Incremental process
- Information is reusable
- XML enables information exchange
- Existing free tools

THE END

BY SANTIAGO HIGUERA AND MARÍA CASTRO

If you need more information about this project or you are interested in funding its development, email to:

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