

# A Framework of Feature-Level Transportation Geospatial Data Sharing Systems

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# Motivations of the Study

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- Real time access to geospatial data that are located in different departments and organizations in different formats.
- Real time access to feature level data.
- Real time data exchange over the Web.
- Applications for emergency response.
- Applications of Homeland Security.



# Current Means of Data Sharing

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- Data Clearinghouse;
- Geography Network or G.Net;
- FTP or Web sites.



# Problems of Current Data Sharing Approaches

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- They provide only information about the availability of data,
  - Users have to integrate data from different sources and in different formats.
- They provide data sharing at the file level;
  - They do not provide spontaneous data access and data exchange at the feature level.
  - Data update at one source cannot be instantly made available to the data users.



# A New Framework of Data Sharing and Data Exchange

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- Use Geography Markup Language (GML) to code and transport geospatial data;
- Use the Web Feature Server (WFS) to extract and manipulate data at the feature level; and
- Use the Scalable Vector Graphics (SVG) to display GML data on the Web browser as vector maps.



# Geography Markup Language (GML)

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- An OGC Standard to model, encode, transport and store geographic objects.
- GML offers standard ways to describe spatial features and their corresponding properties in terms of GML Schemata, including
- schema to describe features, coordinate reference systems, geometry, topology, time, units of measure and generalized values.



# Scalable Vector Graphic (SVG)

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- A W3C standard format (XML-based).
- Works directly with the Web browser.
- A vector graphic, NOT raster image formats like GIF, JPEG and PNG.
- Vector graphic is scalable.
  - SVG can be displayed in any devices with any size and any resolution without changing clarity.
  - SVG works with other XML technologies.



# Web Feature Service (WFS)

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- An OpenGIS implementation specification,
- Can extract data from data sources in their original formats.
- Transform extracted data to GML.
- Transport the extracted data to the Web client.



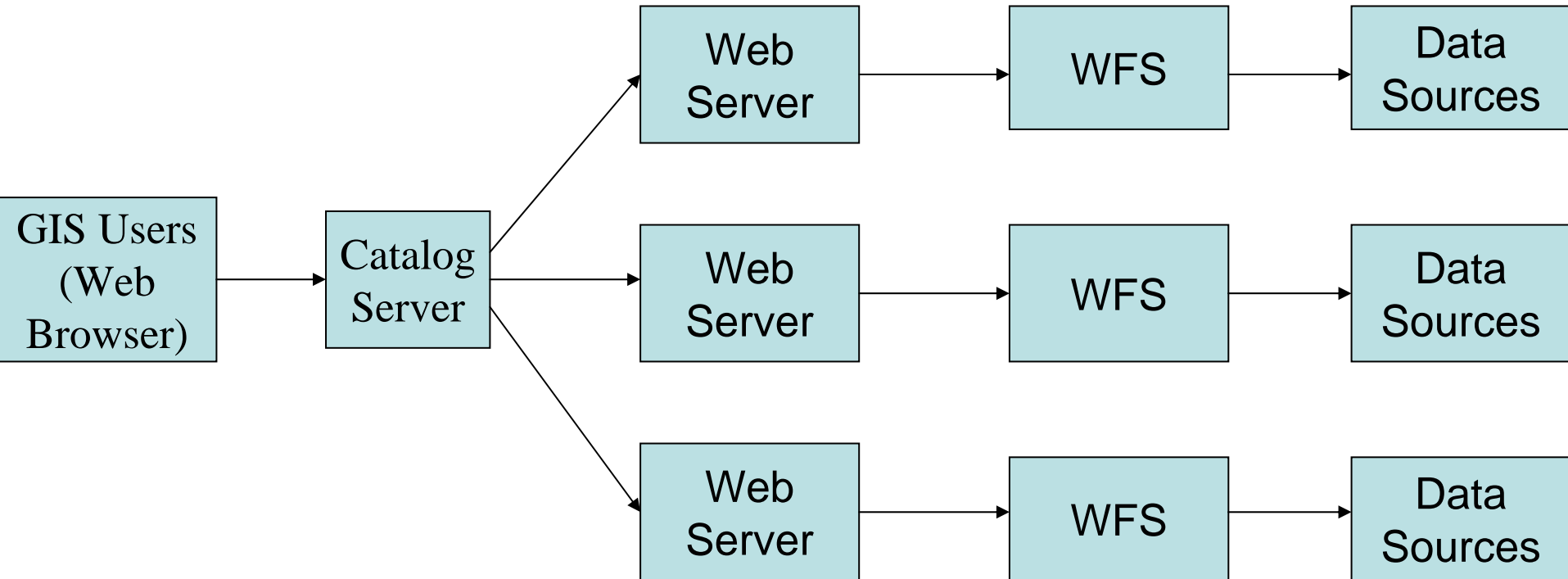


# Required Components

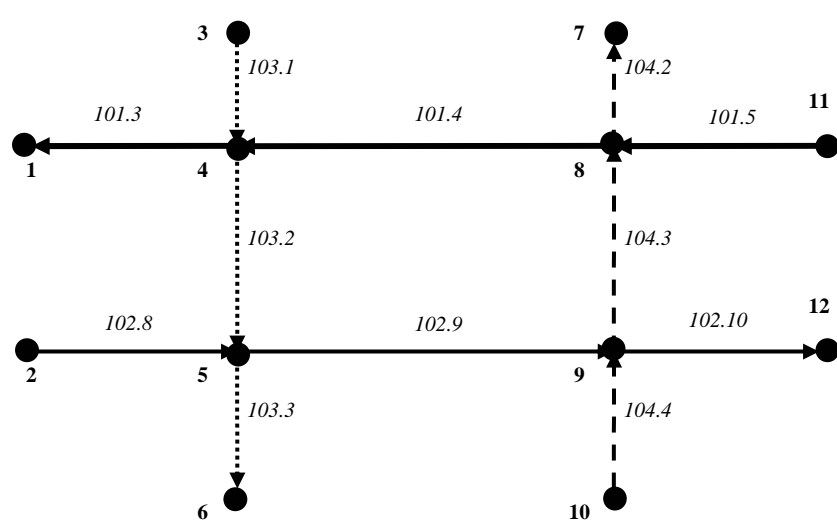
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- Common Feature Identification and Descriptions,
- Standard Data Extracting and Serving,
- Standard Data Presentation on the Web Browser.

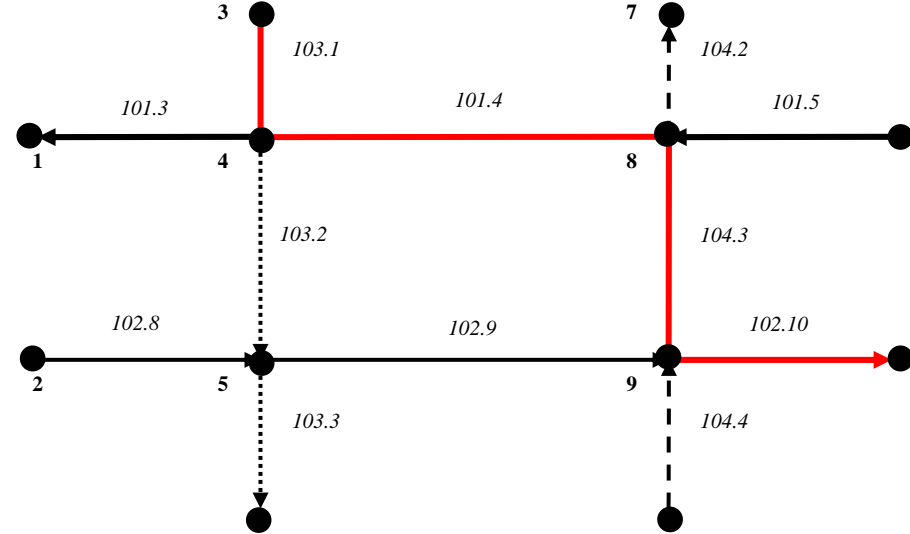
# An Architecture Model



# Data used in the case study

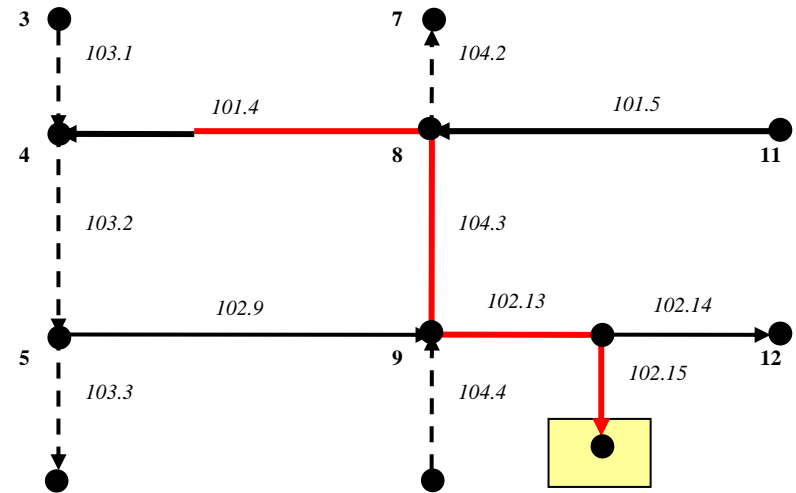
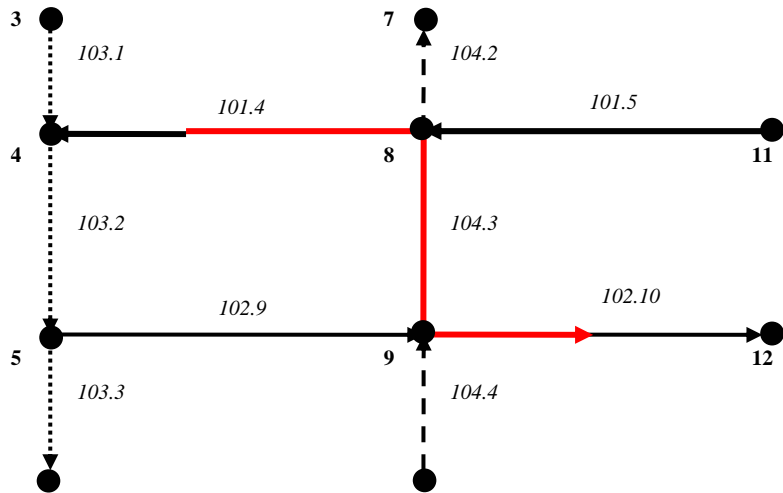


A Street network



A Bus Route (in red)

# Variations of the bus route





# GML Coding of the Data

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- Using XLink to Model Feature Relationships as Feature Members,
- Using XLink to Model Feature Temporal Changes,
- Using XLink to Encode Feature Associations.

# Using XLink to Model Feature Relationships

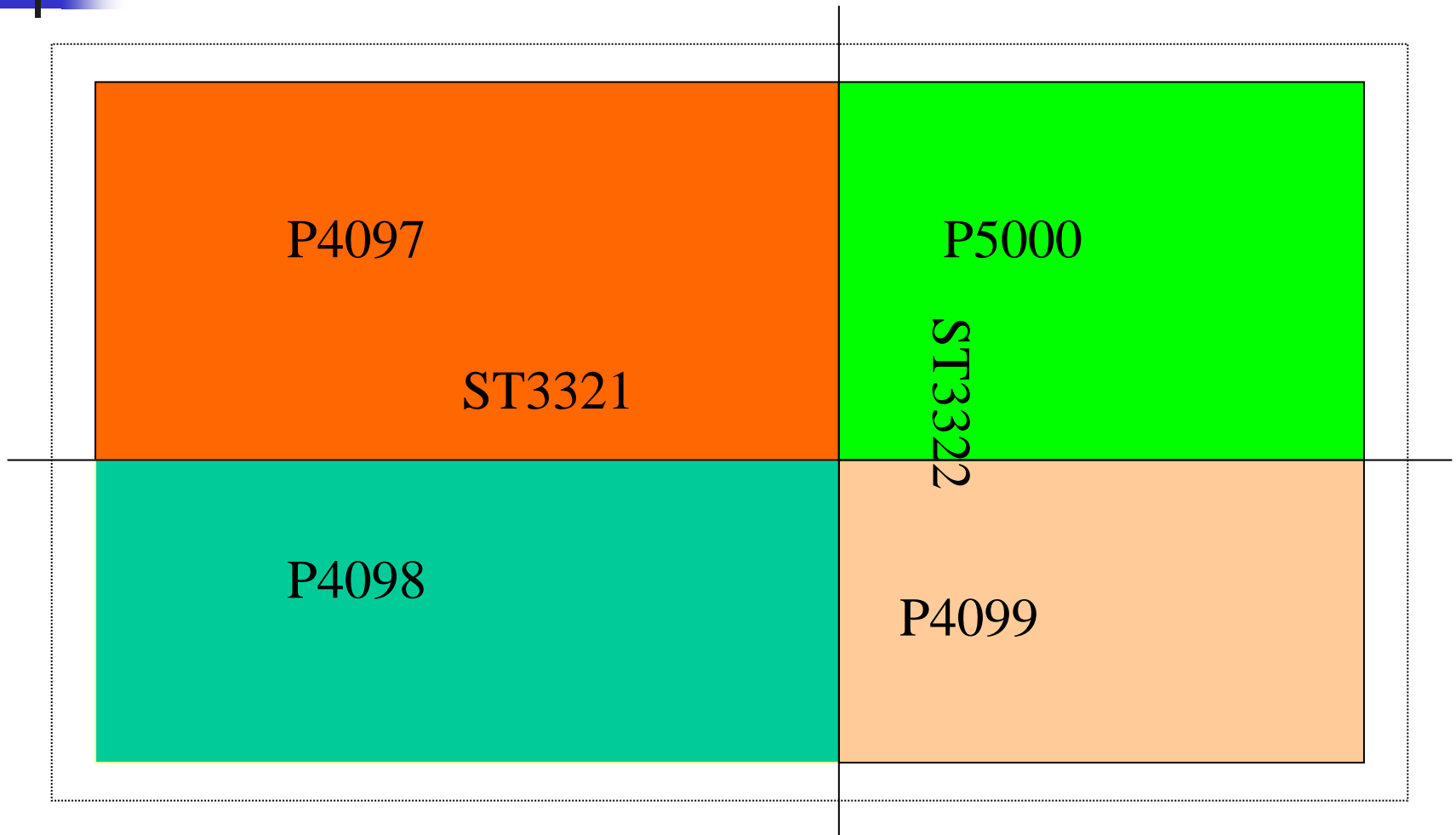
- `<BusRoute fid="route_15">`
- `<dateCreated>July 2002</dateCreated>`
- `<gml:featureMember xlink:type="simple"`
- `xlink:href="http://www.highway.gov/street.xml#TranSeg103.1"/>`
- `<gml:featureMember xlink:type="simple"`
- `xlink:href="http://www.highway.gov/street.xml#TranSeg101.4"/>`
- `<gml:featureMember xlink:type="simple"`
- `xlink:href="http://www.highway.gov/street.xml#TranSeg104.3"/>`
- `<gml:featureMember xlink:type="simple"`
- `xlink:href="http://www.stopfacility.gov/busstop.xml#stop3812"/>`
- `</BusRoute>`

# Using XLink to Model Feature Temporal Changes




```
<street xlink:type="extended" xlink:label="current"
  xmlns:xlink="http://www.w3.org/1999/xlink">
  <streetName>Broadway</streetName>
  <TransegID>102.10</TransegID>
  <history year="1990" xlink:type="locator"
    xlink:href="http://www.highway.gov/archive/1990/street.xml#
    TranSeg102.10"/>
    xlink:label="archive90_TranSeg102.10"
    xlink:role="http://www.dgis.org/"
    xlink:title="street archive data 1990 for TransegID 102.10"/>
</street>
```

# Using XLink to Encode Feature Associations



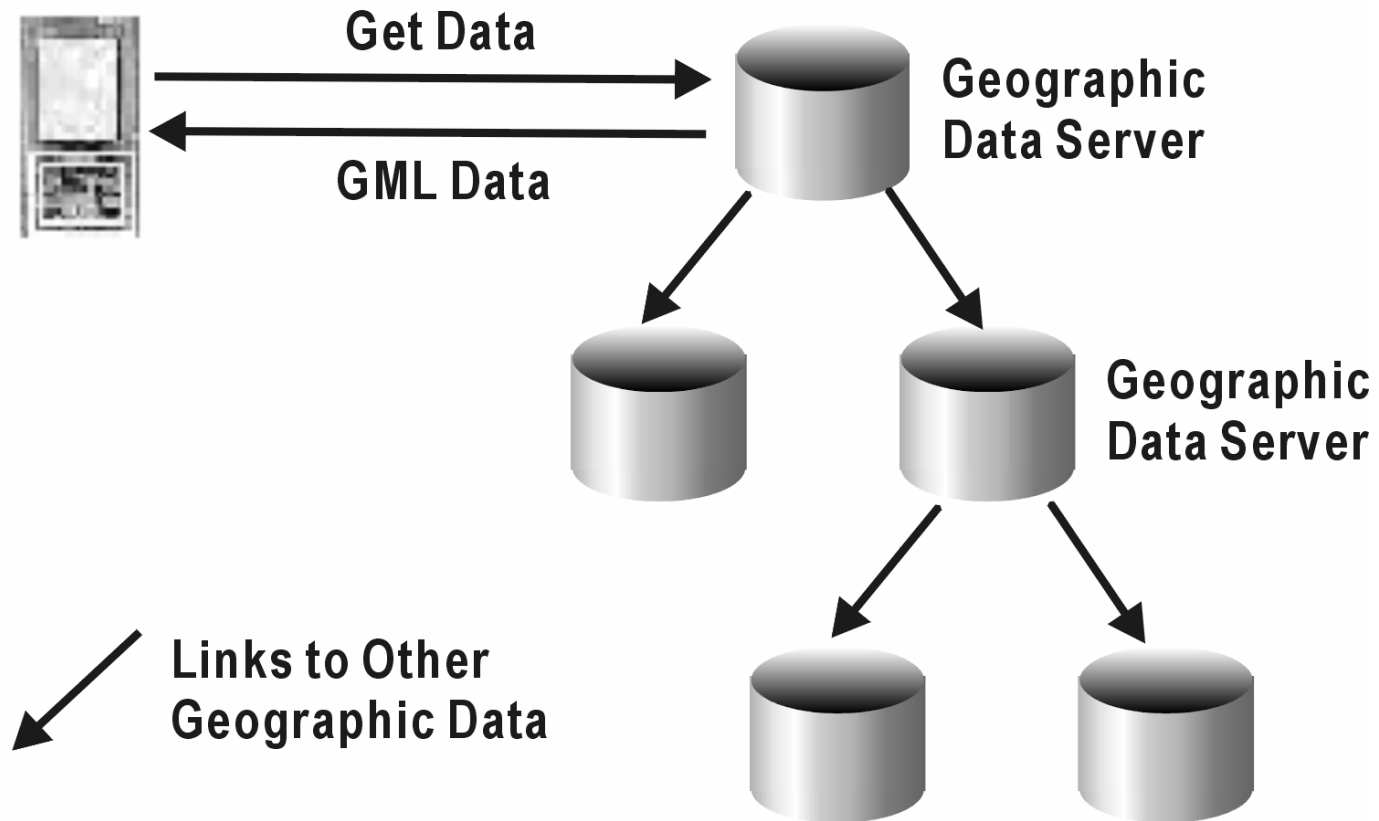


# Using XLink to Encode Feature Associations

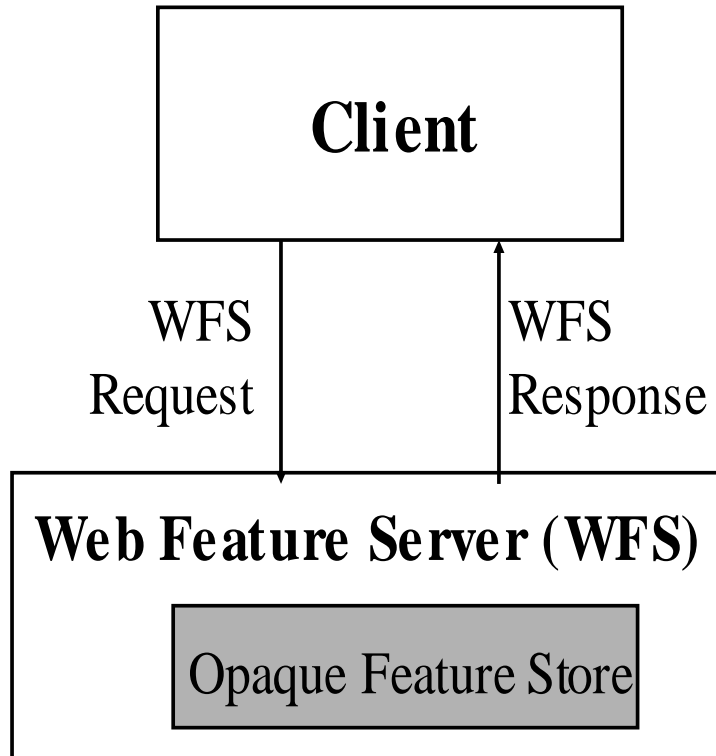


- `<Block fid="block_1005">`
- `<dateCreated>November 10, 2002</dateCreated>`
  
- `<blockMember>`
- `<street fid="st3321" xlink:type="simple"`
- `xlink:href="http://www.highway.gov/street.xml#TranSeg123.1"/>`
  
- `<blockMember>`
- `<Parcel fid="P4097">`
- `<Owner>Dave Smith</owner>`
- `<gml:extentOf>...</extentOf>`
- `<adjacentTo xlink:type="simple" xlink:href="#P4098"/>`
- `<adjacentTo xlink:type="simple" xlink:href="#P5000"/>`
- `</Parcel>`
  
- `</blockMember>`

# XLink and XPointer to Form A Geospatial Web

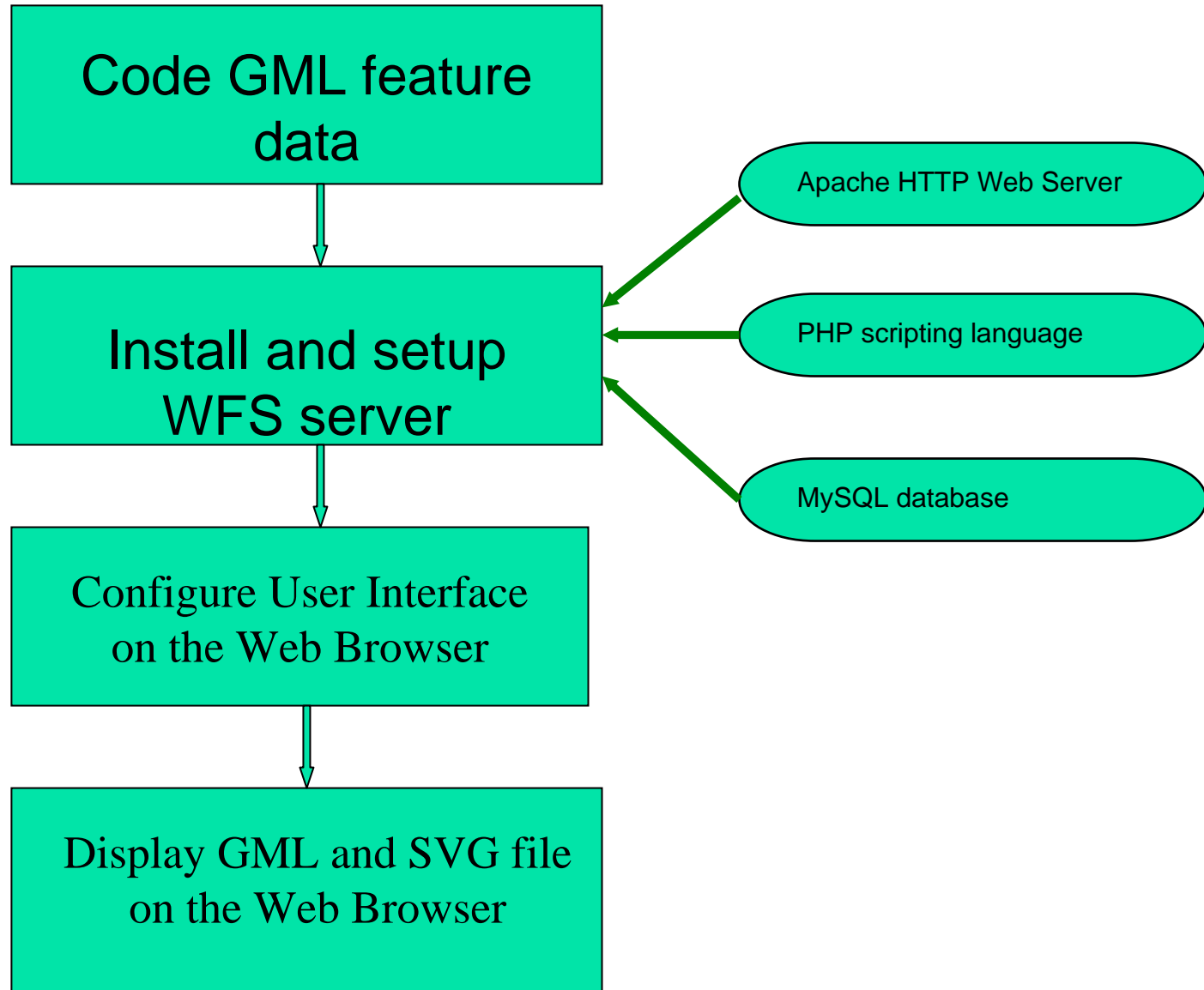


# Data Retrieval in WFS

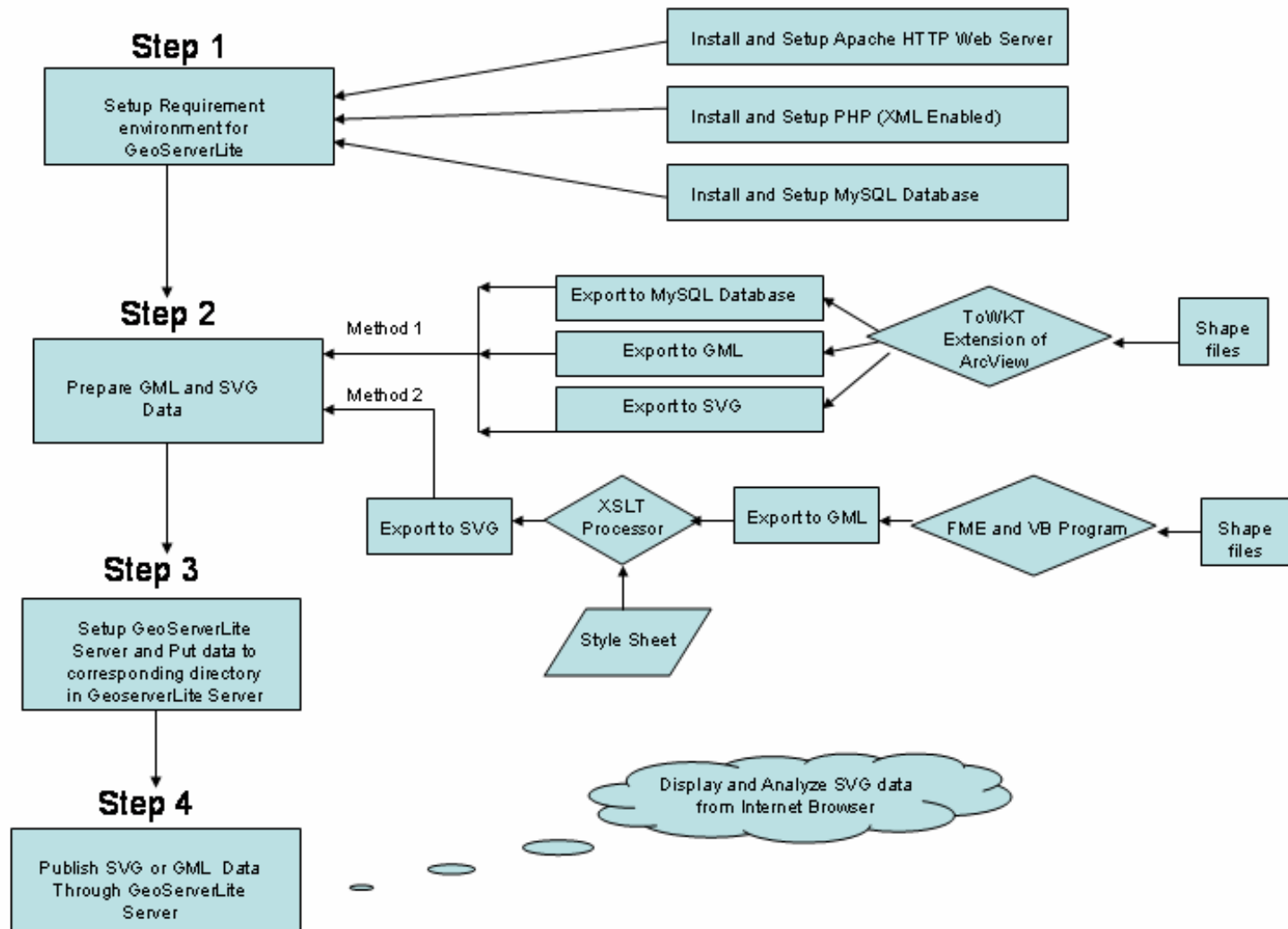


```
<GetFeature>
  <Query typeName="RoadType">
    <Filter>
      <FeatureId fid="P4097"/>
      <FeatureId fid="P4098"/>
      <FeatureId fid="P4099"/>
    </Filter>
  </Query>
</GetFeature>
```

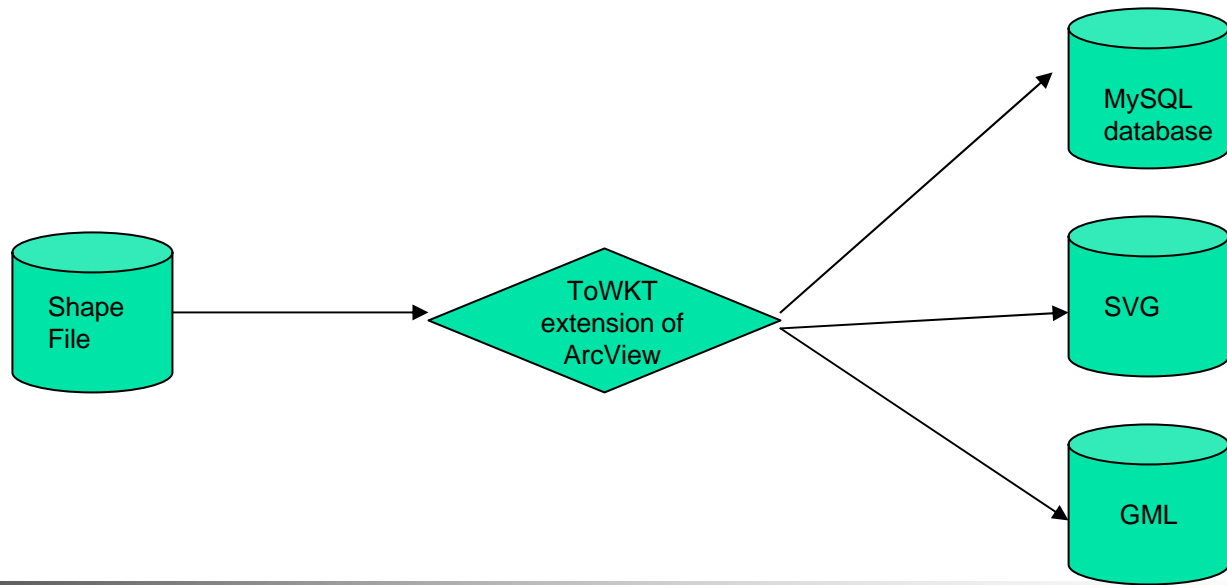
# The process of building the system



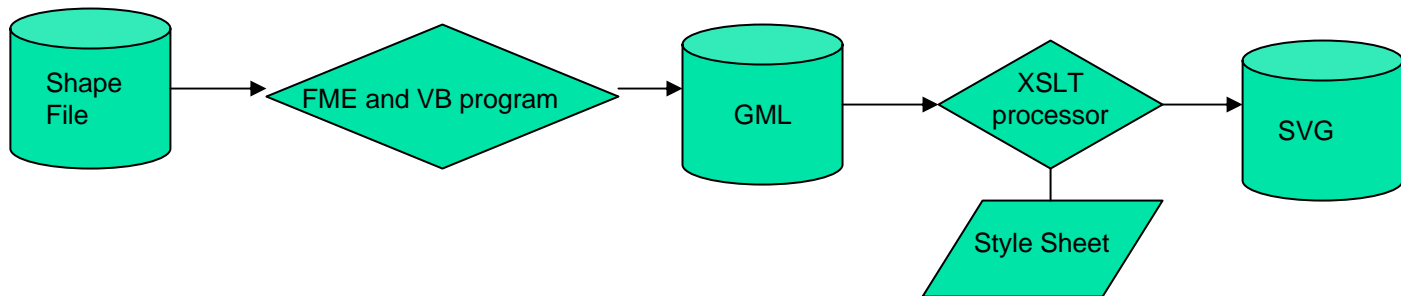
# Process of Developing the system



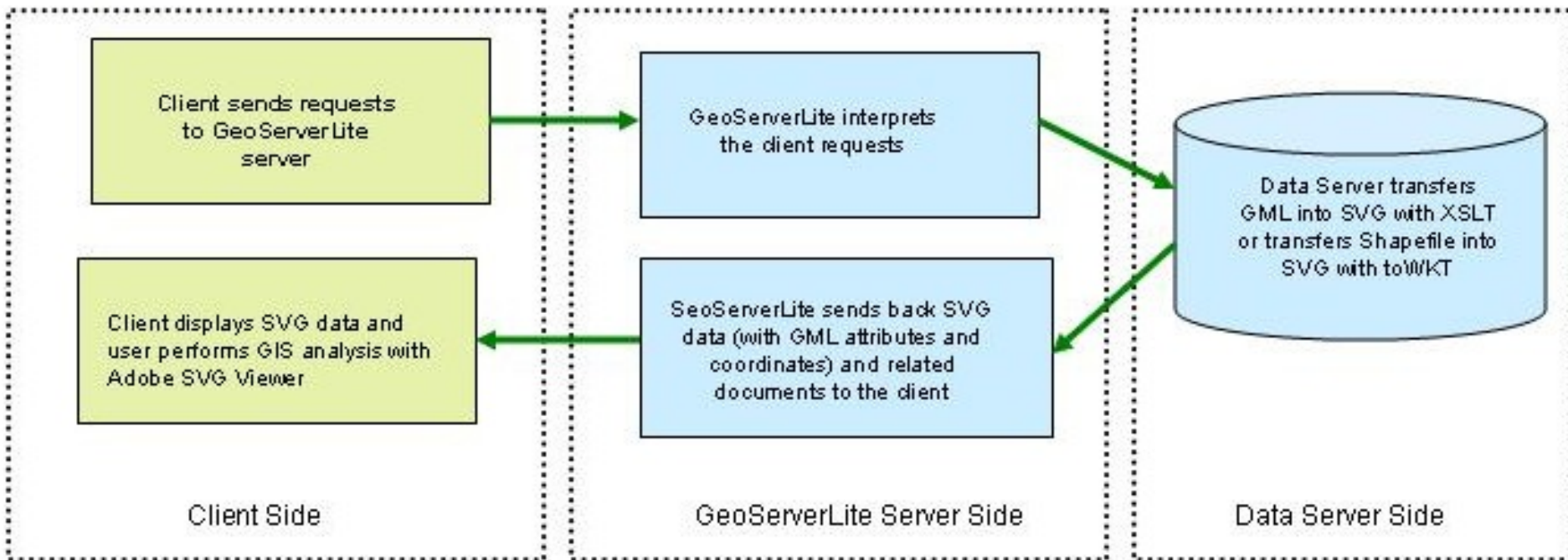
**Methode 1**



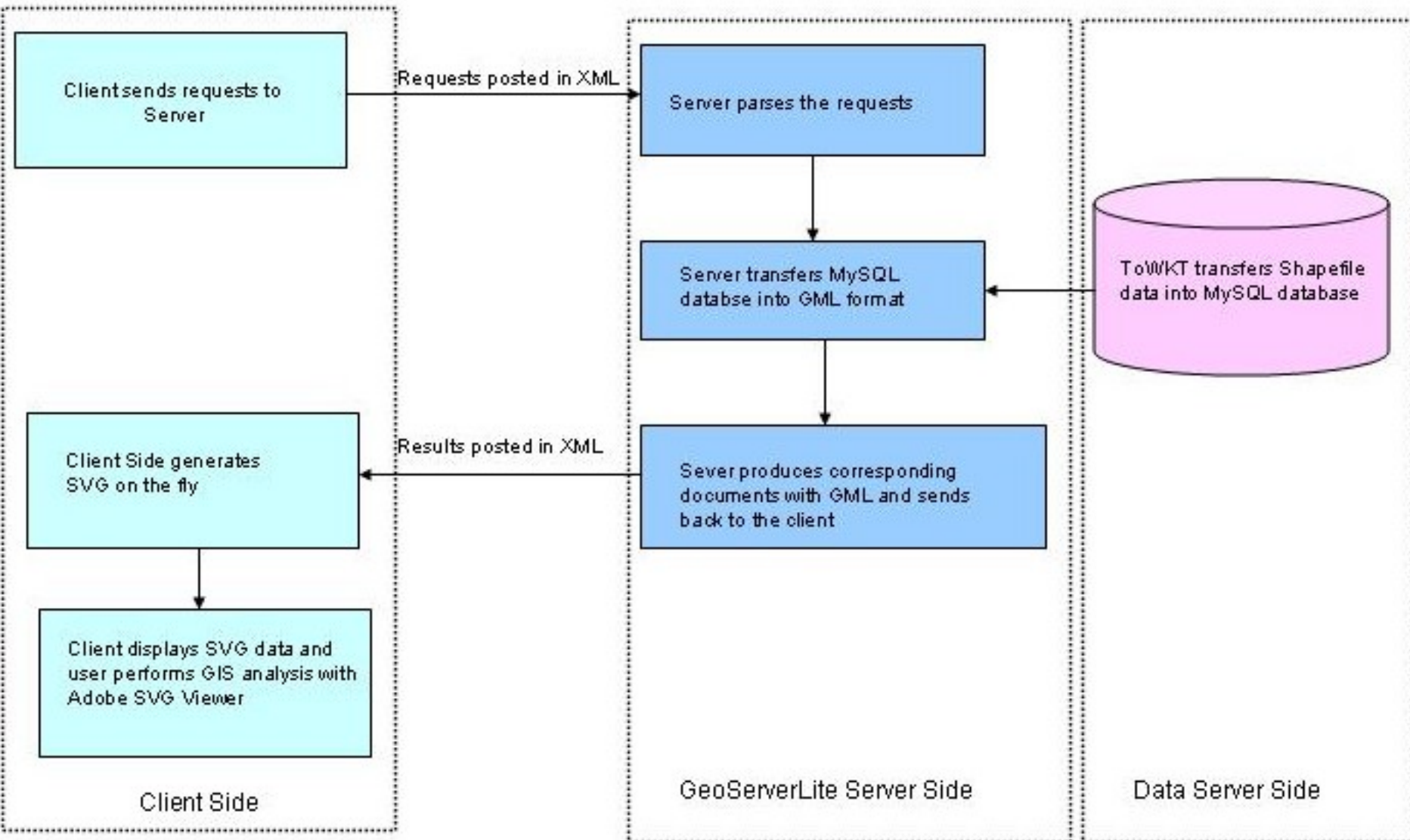
**Methode 2**



# Static GML Data Retrieval Process between Client and Server

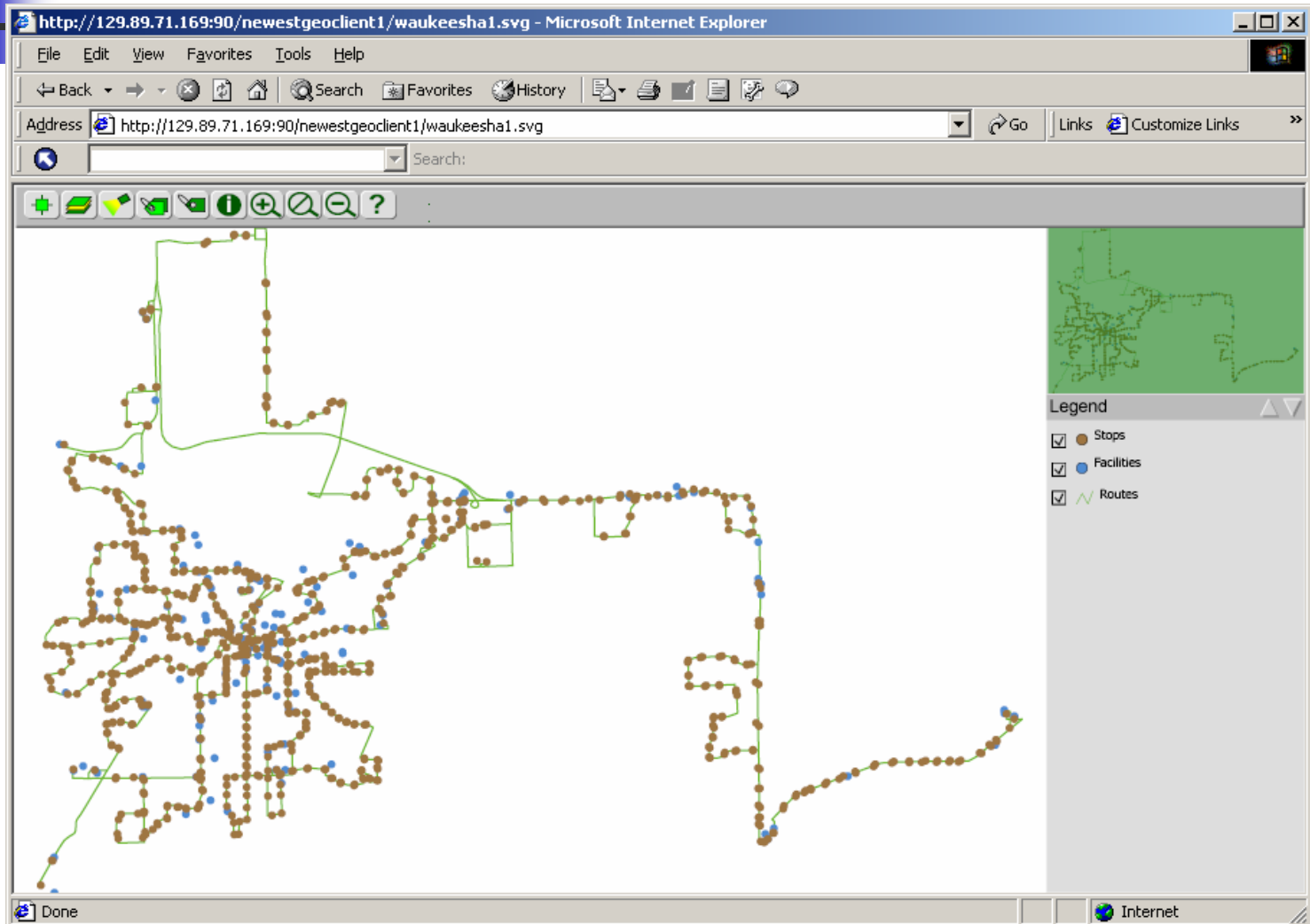


# Dynamic GML Data Transfer Process between the Client and the Server





# User Interface



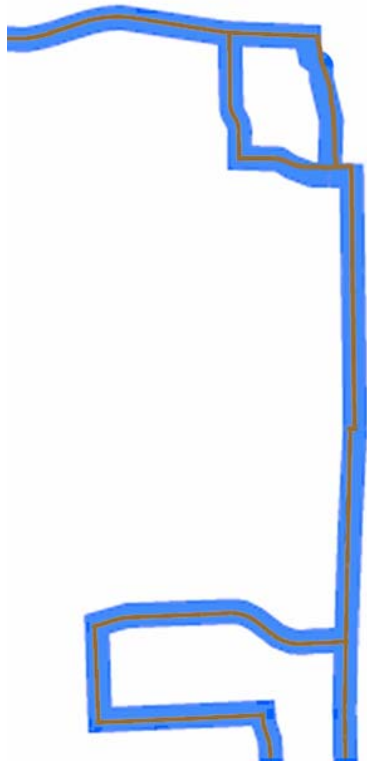


# Original data

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# Feature level search result





# Functions of Feature Level Data Access and Exchange

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- Users and client applications can
  - query,
  - create,
  - update and
  - delete data elements from the GML database server.
- Users and Client applications can access feature level data stored in one or more distributed data sources.
- The results are returned in the form of GML and displayed in SVG.



# Advantages of Feature Level Data sharing and Exchange Systems

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- Standard-based, Non-proprietary
- Interoperable GIS components and data,
- Text-based, easy to understand
- High quality maps on the Internet,
- Fast response on the client-side.
- Data can be in their original formats but could be retrieved using WFS and transformed into GML on the fly.



# Further research

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- Expand to more feature type (including polygons, curves, etc).
- Test Feature data access from different data sources with diverse data models.
- Proper compressing mechanism for GML and SVG files.
- Incorporate temporal data search at the feature level.



# Questions and Comments

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- <http://www.uwm.edu/~zpeng>