Dynamic visualization of geospatial data on small screen mobile devices

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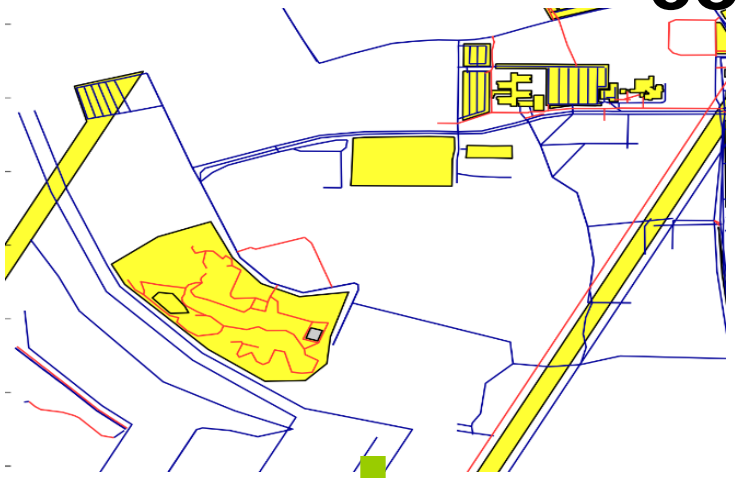
Transmission and delivery of rapidly-changing spatial data to mobile devices is a complex task



User select, transmit, view

VGI databases – changing very rapidly! Massive Spatial Data

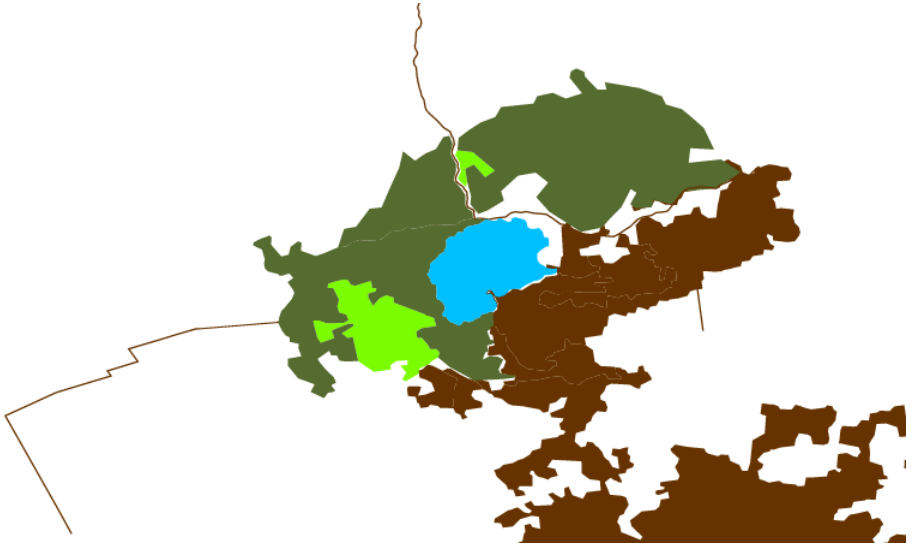
Constant re-generation of tiles not feasible

Different map rendering

Loading map ……	*Loading map ……*	*Loading map ……*
Loading map ……	*Loading map ……*	*Loading map ……*

Raster Map Rendering (Gird-based)

Vector Map Rendering (Object-based)



User Interaction with Web-based map

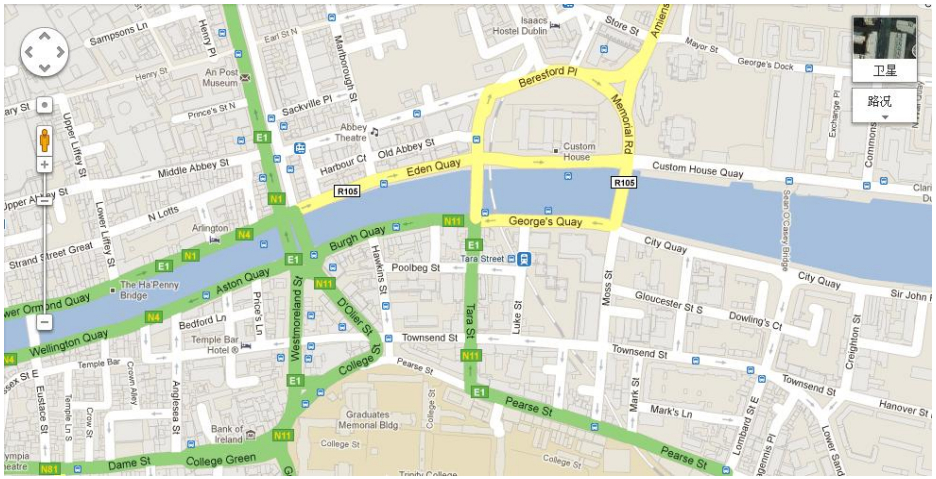
Panning

Zooming

Selecting

Dragging

……



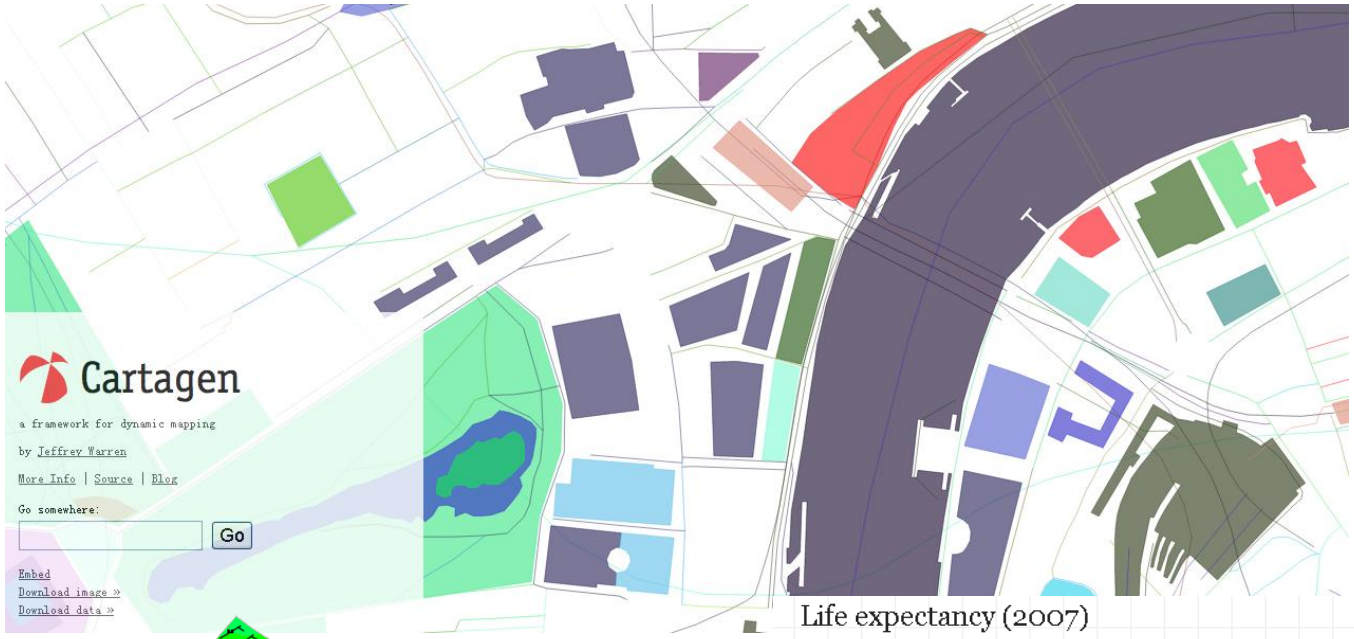
Rapid context switch –Users lose the global context

How can we make context transitions more smooth?

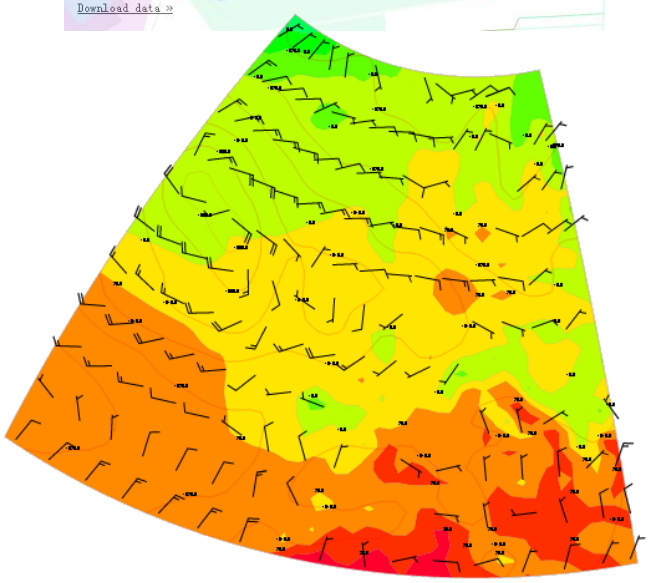
Interacting with vector data

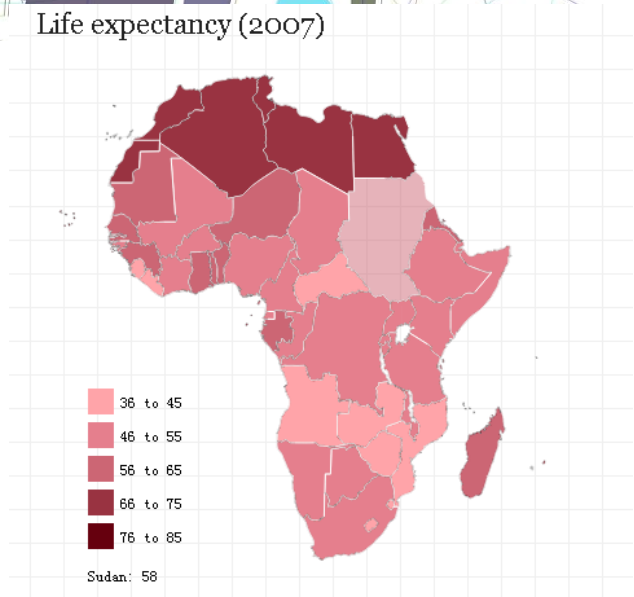
--- Using HTML5 Canvas and SVG

Cartagen project (HTML5 Canvas)



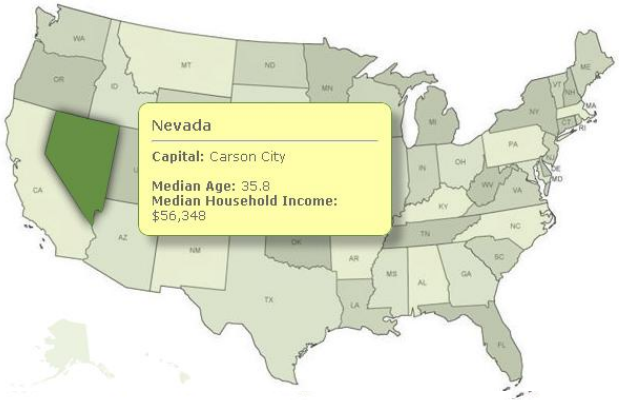
weather casting life expectancy (SVG)





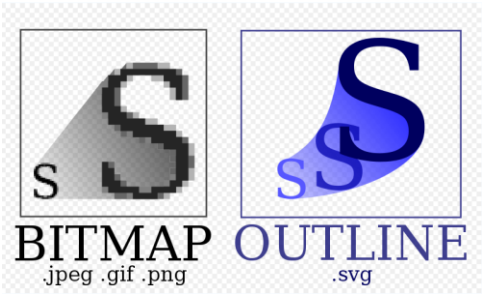
WHY VECTOR DATA?

Context-aware



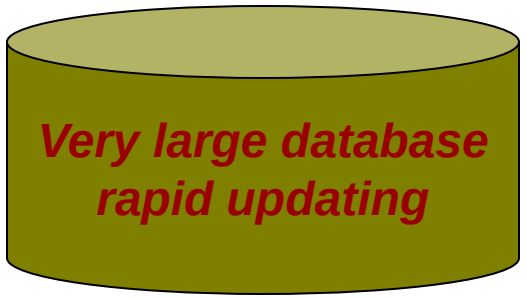
More interactivity

Customized rendering



Resolution dependent

Rapid update



...etc

Compression techniques for delivery of spatial data

Disadvantages:

NOT Context-aware

NOT Flexible update database

OR/LOSE some data

Advantages of Progressive transmission:

From low detail to high detail

Without loss context

Rapidly updates the data in background

Progressive map visualization

Level of detail

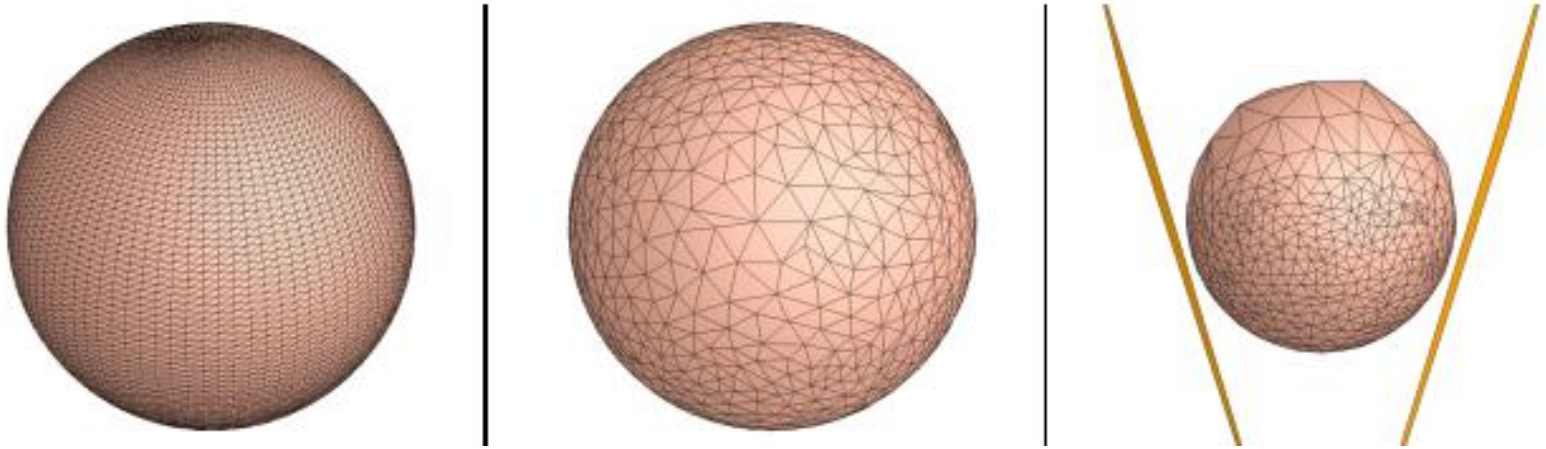
Low detail(20%)

Full detail

Selective progressive transmission only refine the significant part of the map regarding to human perception in specific zooming level

-Ying, F. al. Selective progressive transmission of vector data. Geocomputation, 2011.

View dependent Simplification of LoD in computer graphics



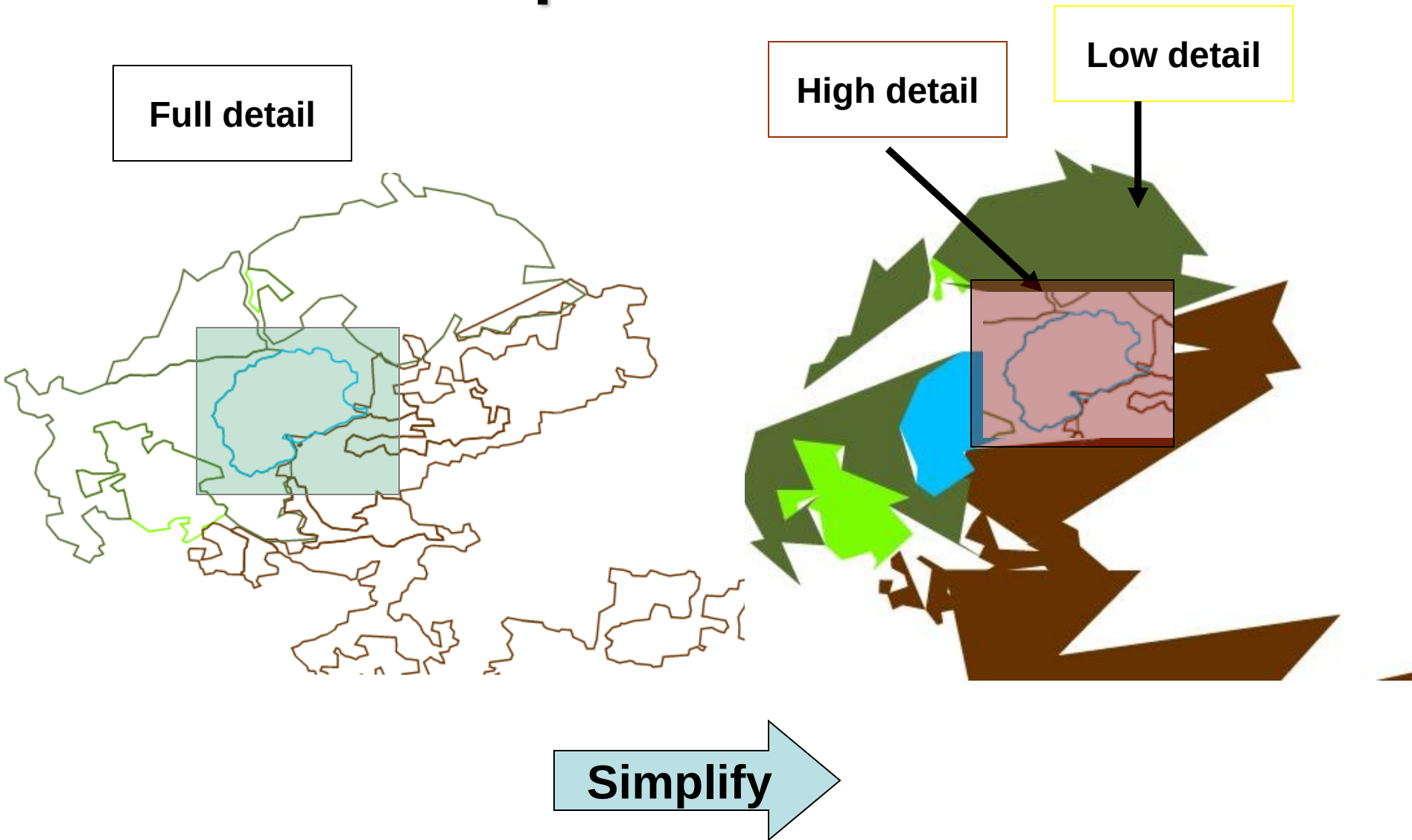
Full detail geometry

Regular view (Simplified)

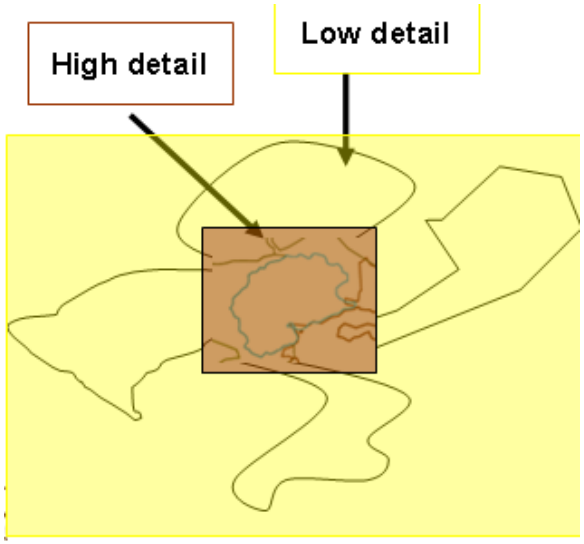
Top view (Simplified)

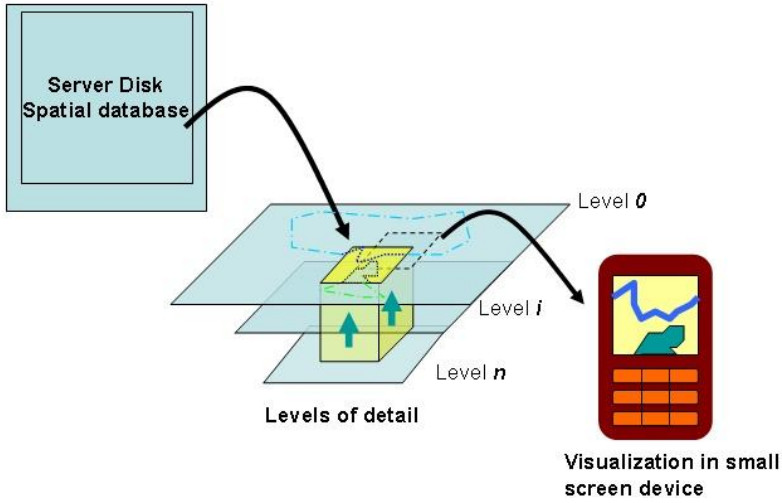
--Hoppe, H Visualization '98.

View-dependent Map Simplification



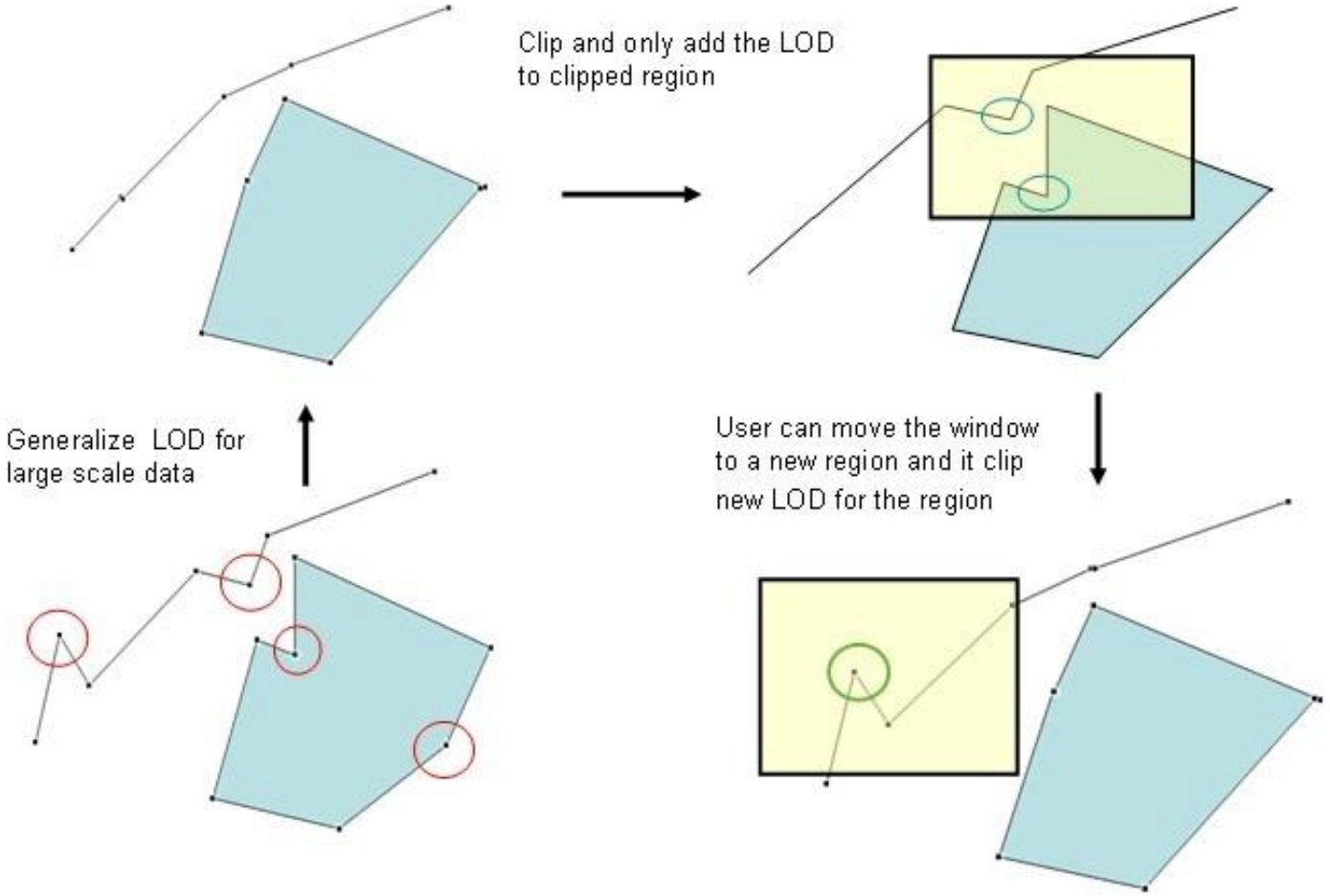
For mobile devices: View dependent + progressive transmission





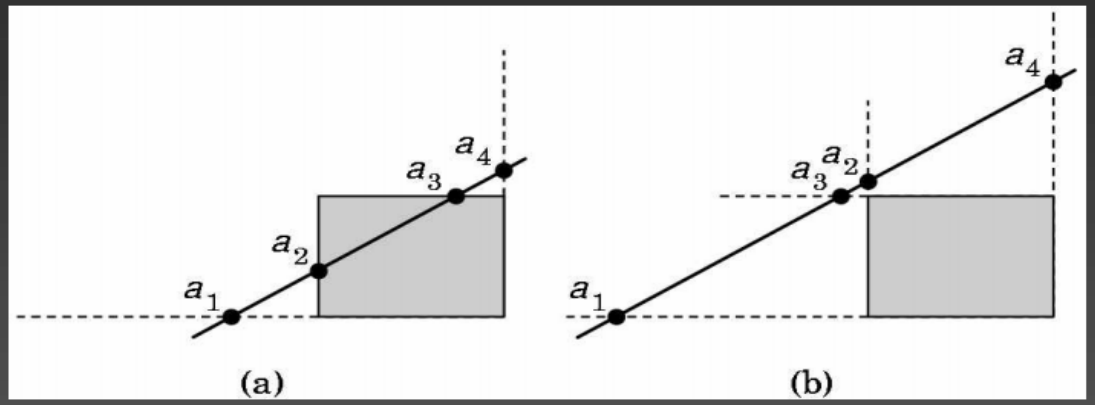
Send the data to the screen area first

Clipping methods for View dependent



Liang-Barsky Clipping

Ordering of intersection points



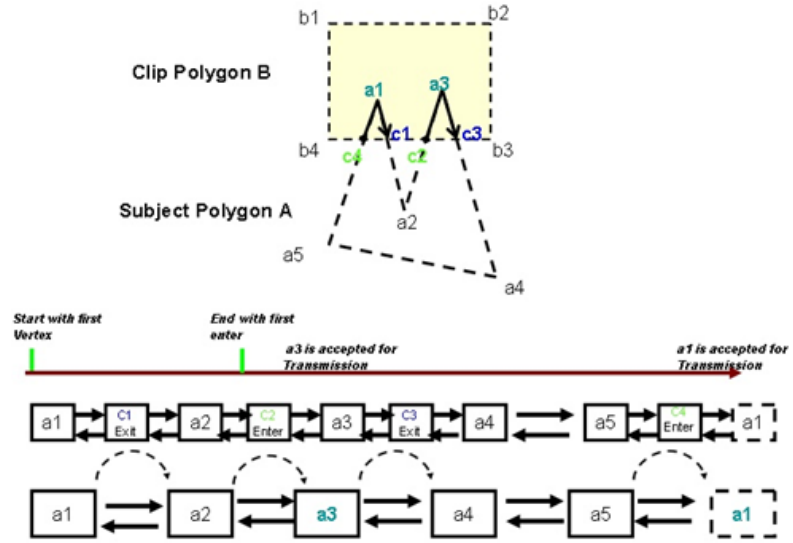
- Order the intersection points
- Figure (a): $1 > \alpha_4 > \alpha_3 > \alpha_2 > \alpha_1 > 0$
- Figure (b): $1 > \alpha_4 > \alpha_2 > \alpha_3 > \alpha_1 > 0$

Avoiding floating-point division. etc..

--- You-Dong Liang and B. A. Barsky.
A New Concept and Method for Line Clipping. ACM Trans. Graph.

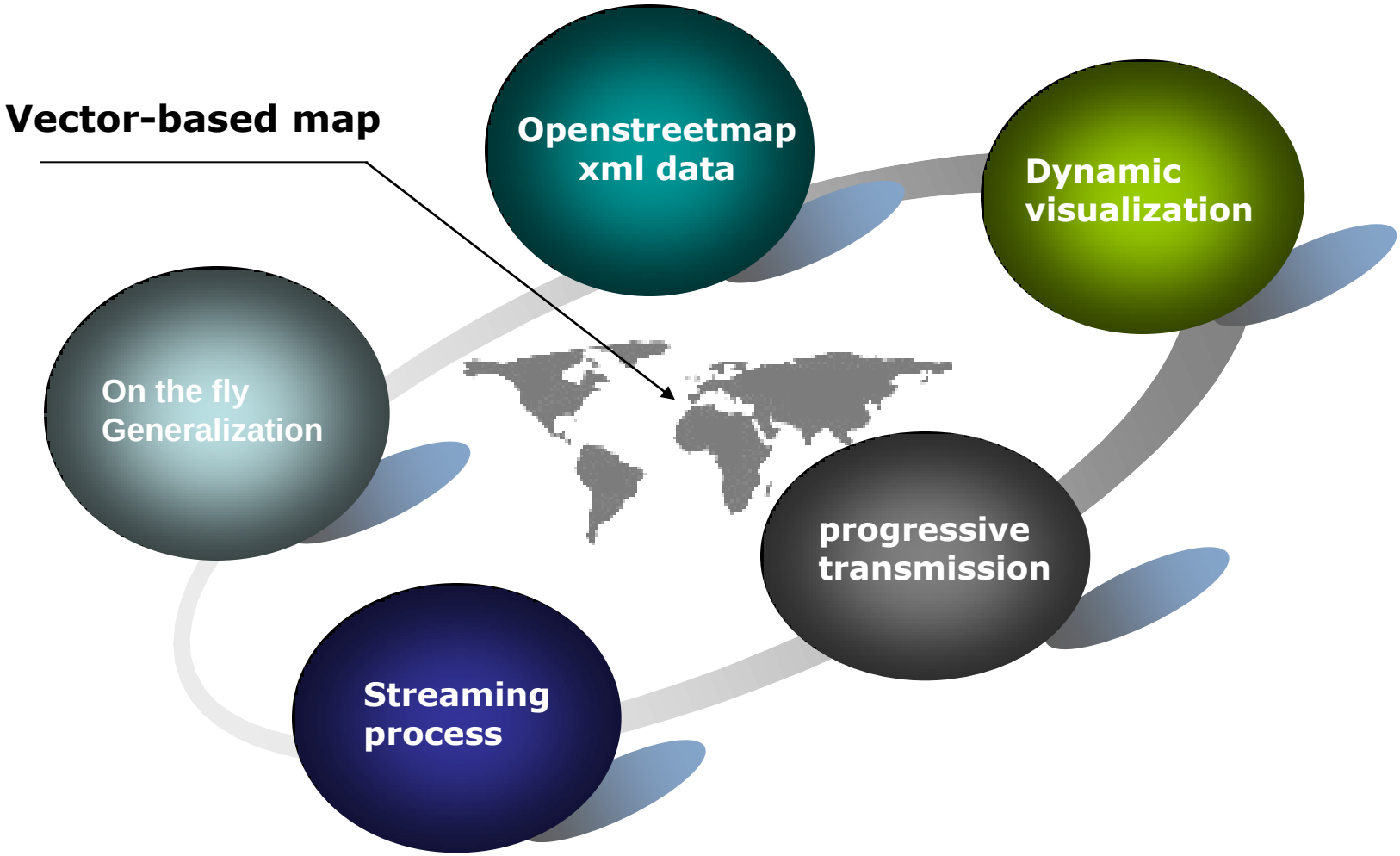
Data structure and algorithm

Data Name	Data Type	Description
lat,lon	geocoordinates	Location information
Next,prev	vID	Previous and next vertices
Entry_exit	boolean	Record the entry or exit
Interesect	boolean	If the vertex is on the intersection point
Clipped	boolean	Accepted as a candidate
K_level	int	Record the levels of detail
VetexOrder	vID	The vertex ID



Data Name	Data Type	Description
PolygonID	pID	Polygon ID
Vetice	VertexList	List of vertices
CompSim	double	Similarity score compare with original score
Inside	boolean	If the intersection existed in the polygon

A dynamic framework for real time processing of geospatial data



Our model + data structure for progressive transmission

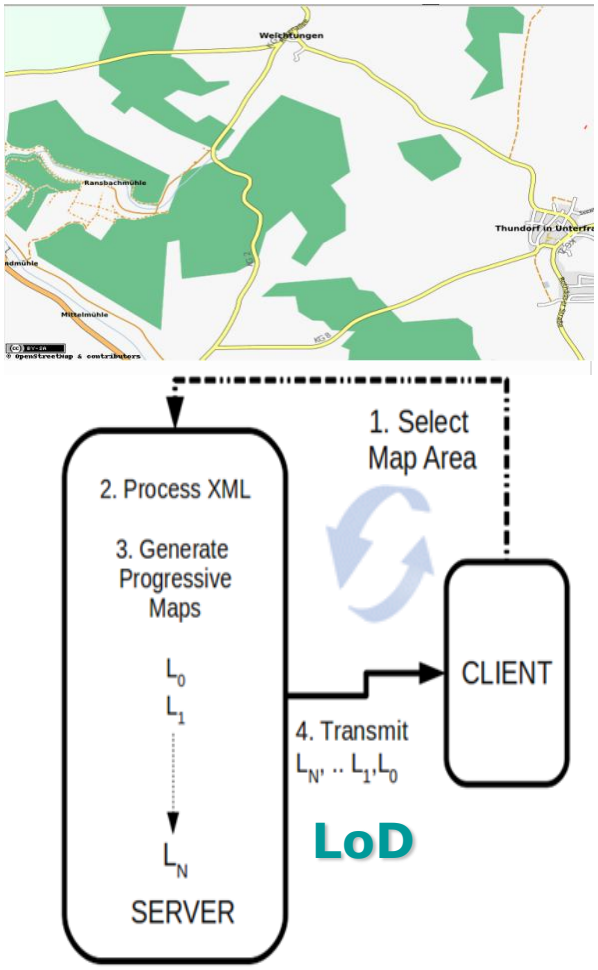
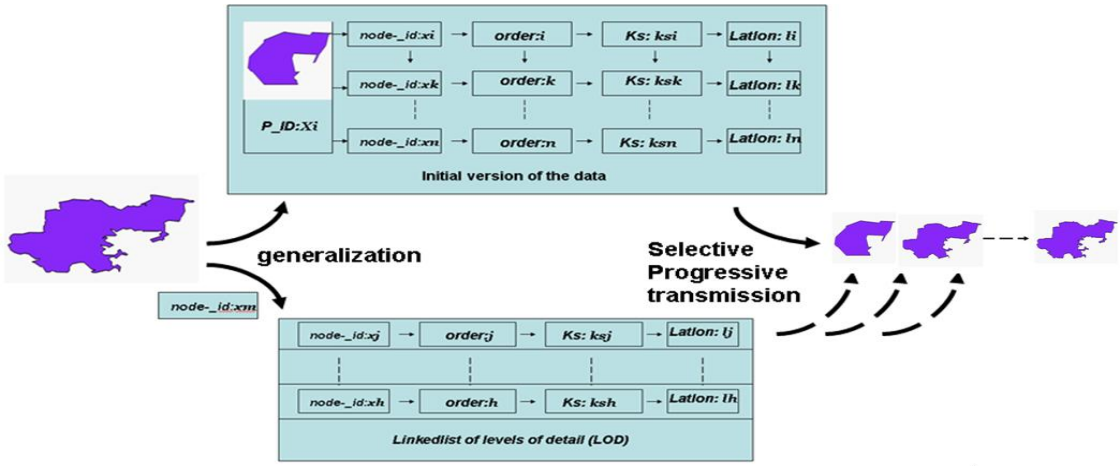


Figure 2: Schematic diagram of the implementation of our progressive transmission model

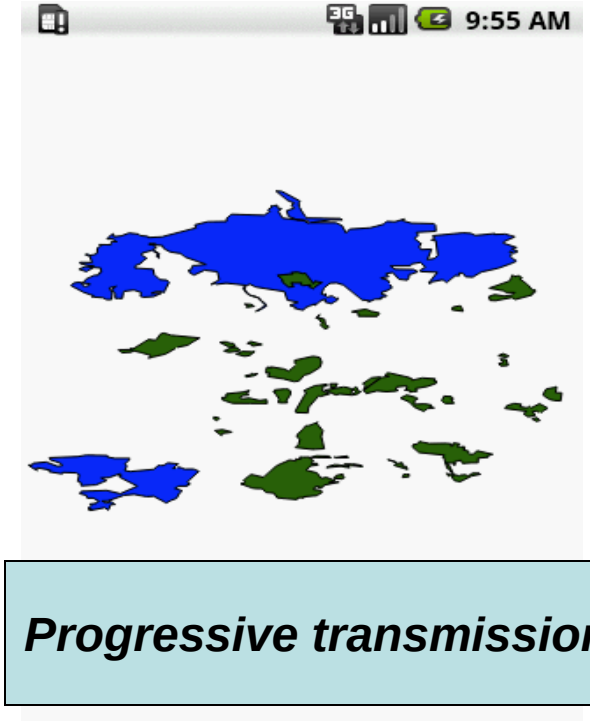


Application Process

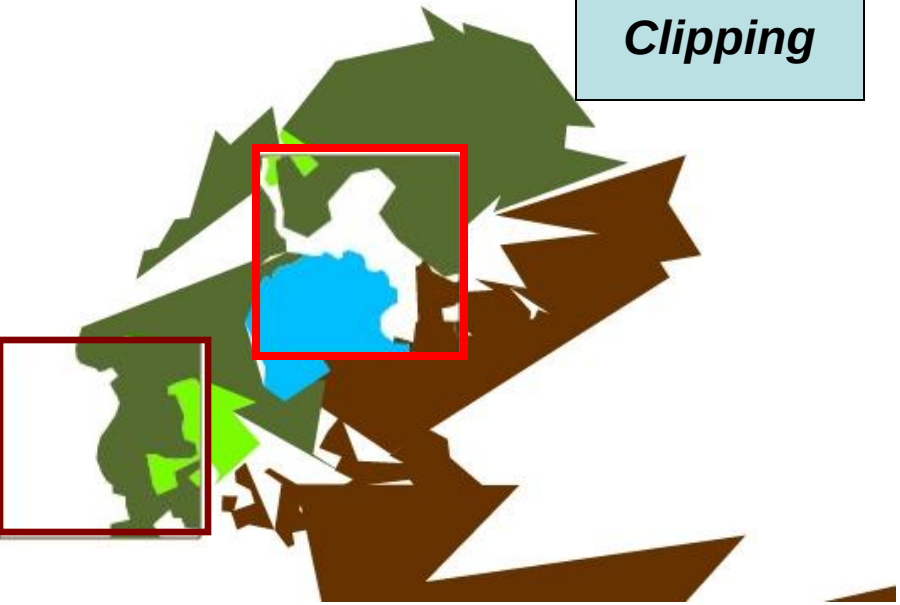
- **User Selects the OSM in a small area**
- **Streaming OSM XML data by OSM API**
- **Process Data based on Opensource XML Tool**
- **Deliver increasing Levels of details (LoD) to LBS**
- ***Reduced map visualization with progressive transmission***

Visual results

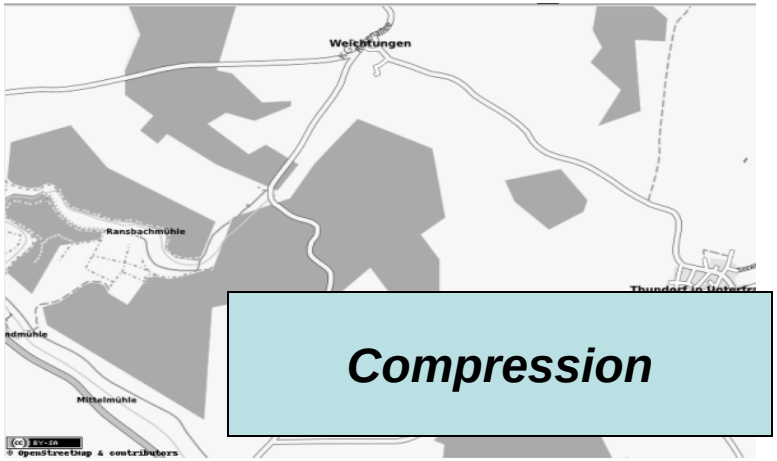
Raster



Progressive transmission

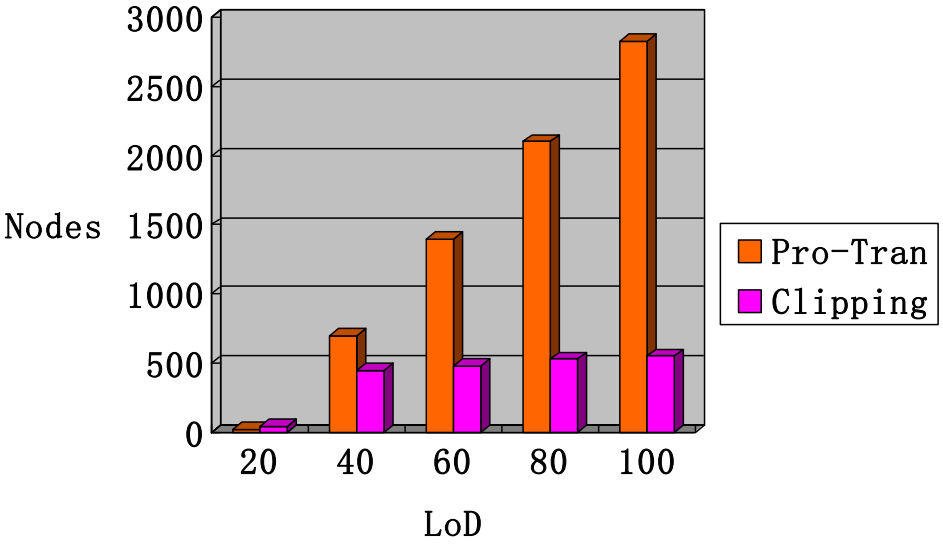


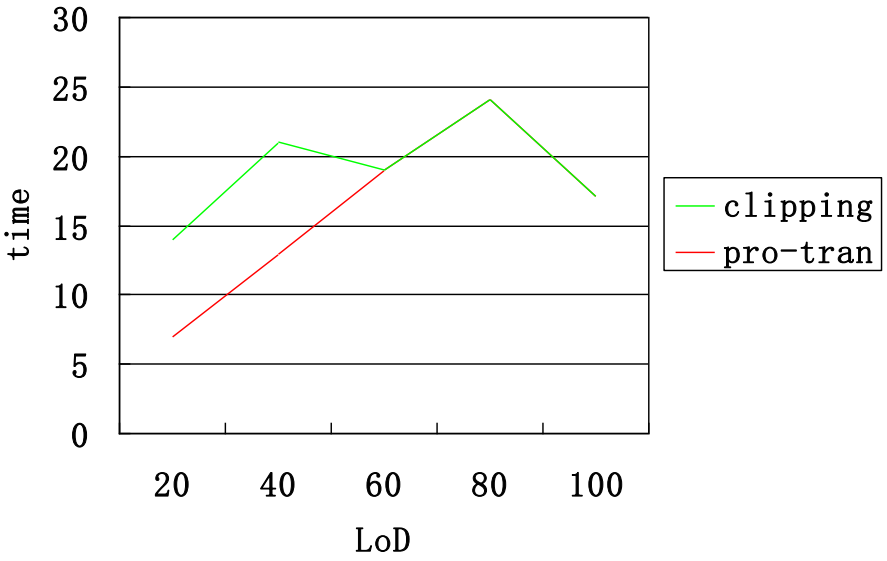
Clipping



Compression

Performance comparison



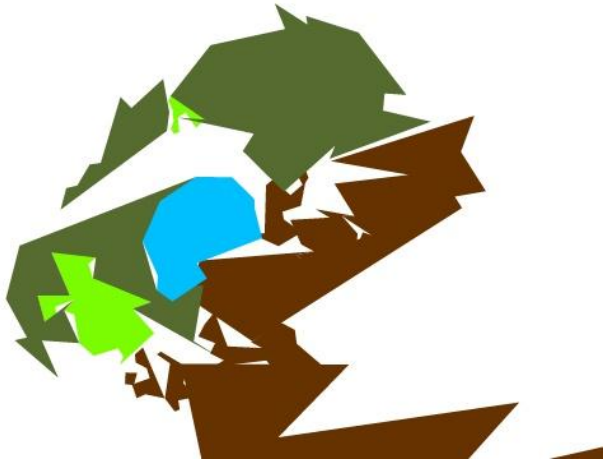


Node Increasing

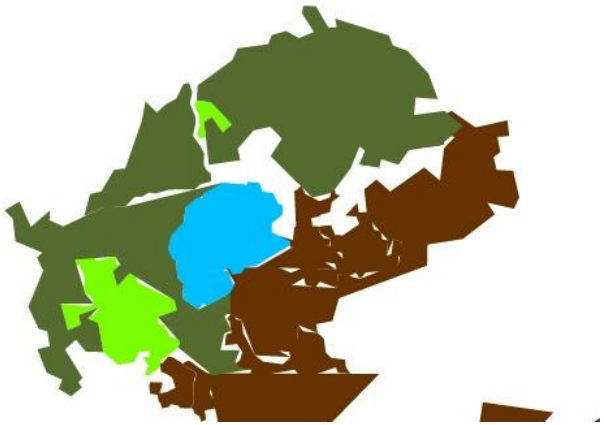
Time Increasing

Step by step demonstration

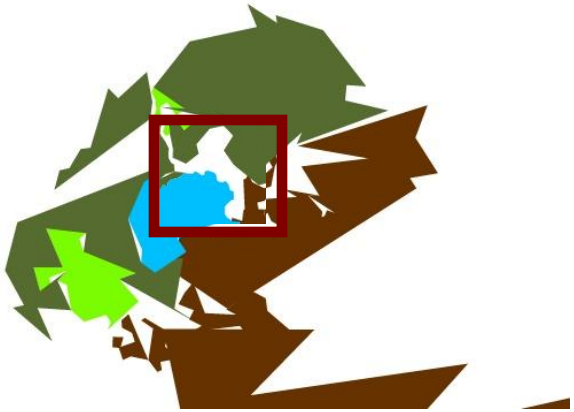
393nodes



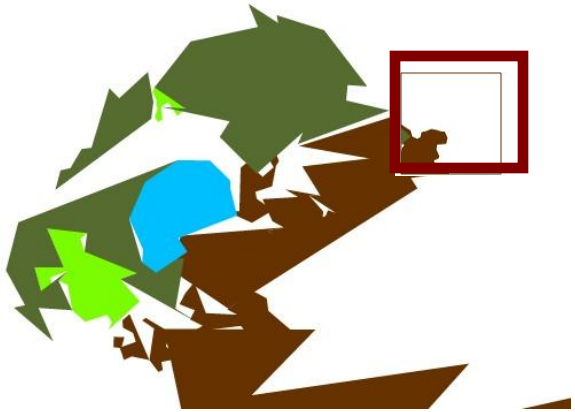
634nodes



1364nodes



489nodes



477nodes

Key Outcomes from Current Stage of this PhD Work

- **DATA:** – The approach outlined here can reduce/simplify data that is adapted to specific user requirements

- **VISUALISATION:** Using OSM/VGI as a specific data source – rapid changes in the spatial database are dealt with by our model

- **INTERACTIVITY:** The progressive transmission/clipping approach allow users to rapidly switch context on the map interface

Conclusions

we attempt to design a framework for efficient spatial query and adaptive transmission of spatial data and information to mobile devices

addressed some limitations of the delivery of spatial data and subsequent visualisation and query on small mobile devices

In the future, our work will do more user study and enhance the perception model for the progressive transmission