Routes: Segmentation, Reduction and Optimization

17.8.2009

MOPSI Project

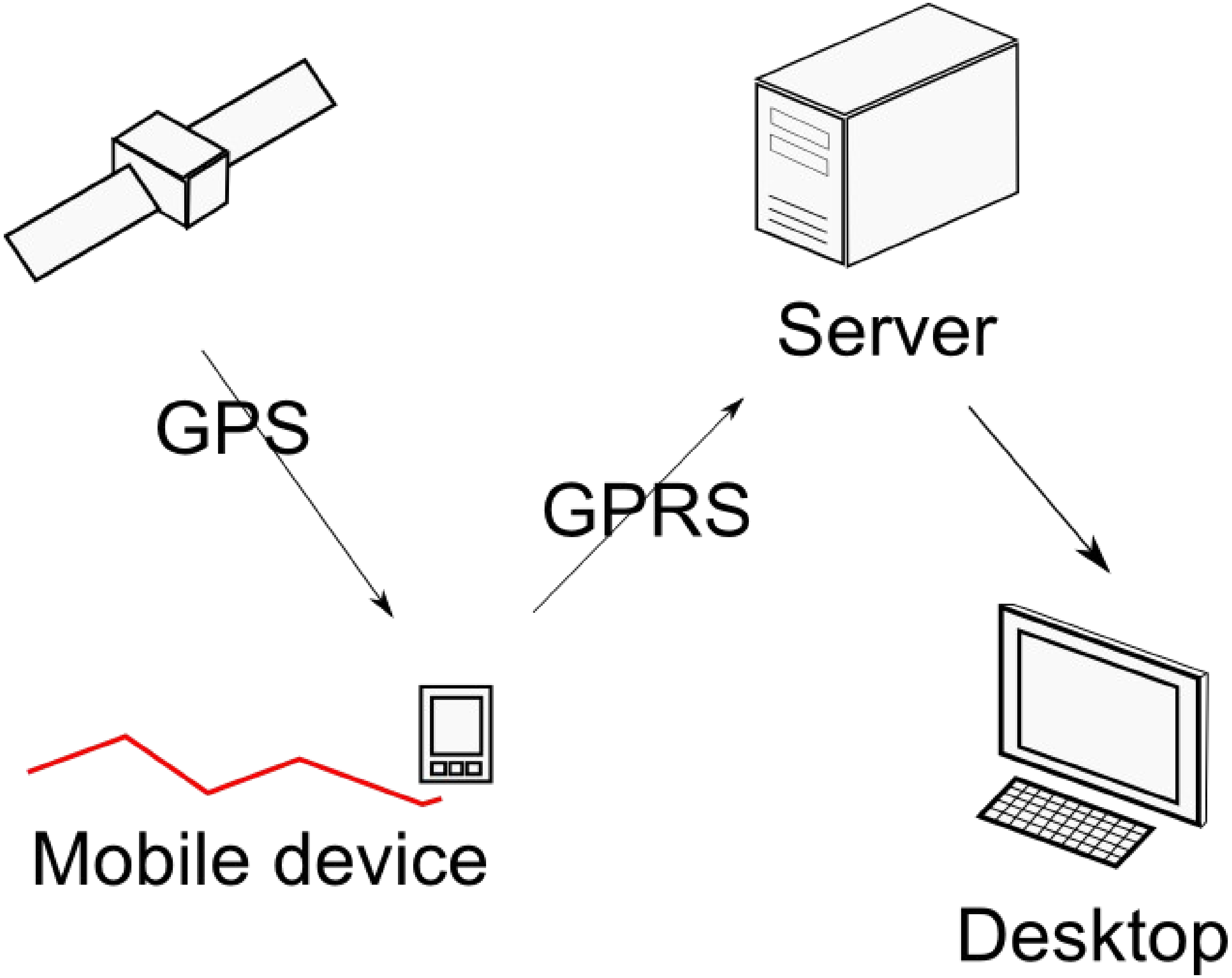
Speech and Image Processing Unit

University of Joensuu

Introduction

- We use mobile application to collect points
- Point data contains:
  - Username
  - Coordinates
  - Time
- Points are send to the server and stored to the database
- Points compose routes
- Routes are presented using Google Maps

Overall structure



Server

GPS

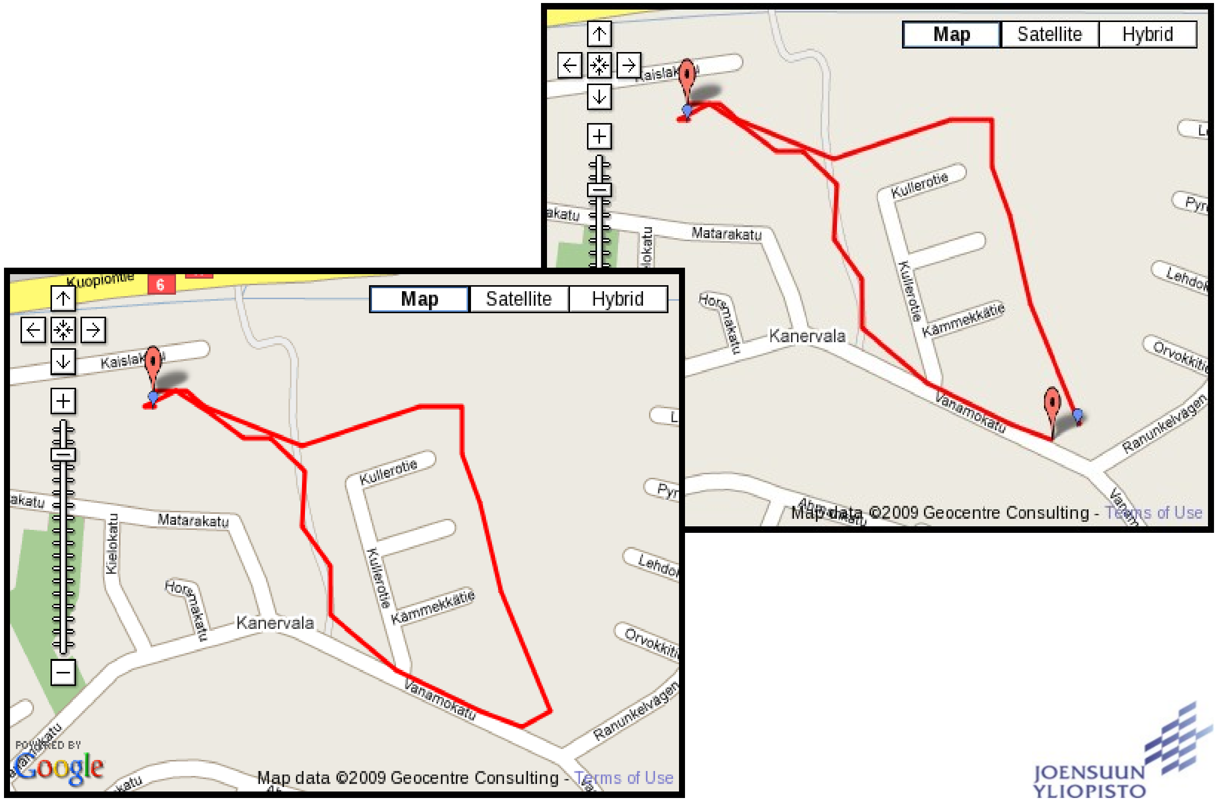
GPRS

Mobile device

Desktop

Segmentation

- The beginning and the end of the route are not defined or stored to the database
- We have to decide how to split points to separate routes
- Default settings:
  - 180 seconds
  - 400 meters



Limitations

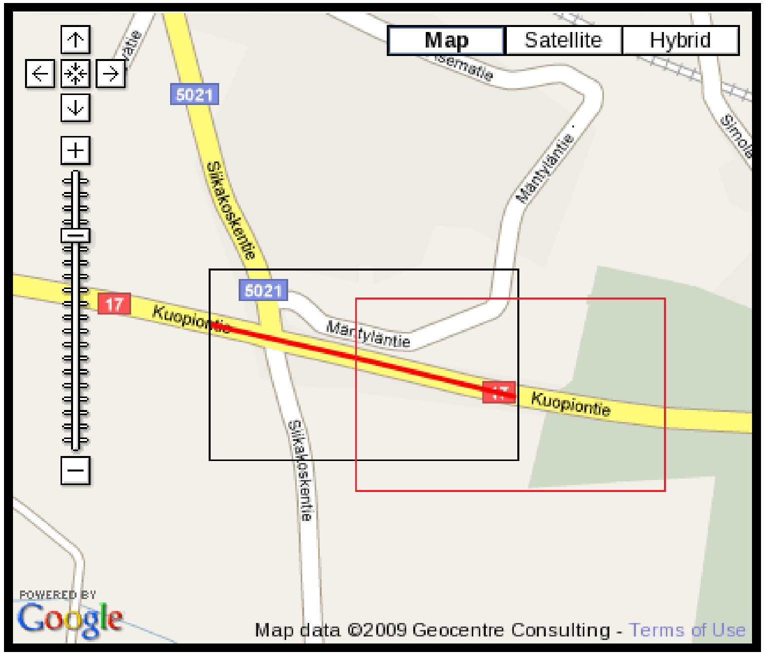
- Routes contain a huge amount of points
  - A point is collected every 8 seconds
  - Route lasting 1 hour contains about 400 points
- Routes are presented in Google Maps
  - JavaScript is not very effective

Kartta
Satelliitti
Hybridi
Lamminranta
Kuplunkylä
Törönpuro
Raatekangas
Raatekankaantie
Käpykangas
Rantakylä
Utrantie
Kanervala
Siihtala
Otsola
Joensuu
Pekkala
Sirkkala
Karsikko
Kissamäki
Multimäki
Liksenvaara
Repokallio
Penttilä
Linnunlahti
6
17
74
Google
Karttatiedot ©2009 Geocentre Consulting - Käyttöehdot

View

- Usually only a small part of the map is shown
  - There is no need to draw all the points
  - JavaScript application is not able to handle huge amounts of data, but server can
- Solution: client defines view of the map and requests points via HTTP from server
- Request is done every time when the view is changed

View


Map
Satellite
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Siikakoskentie
Kuopiontie
Mäntyläntie
POWERED BY Google
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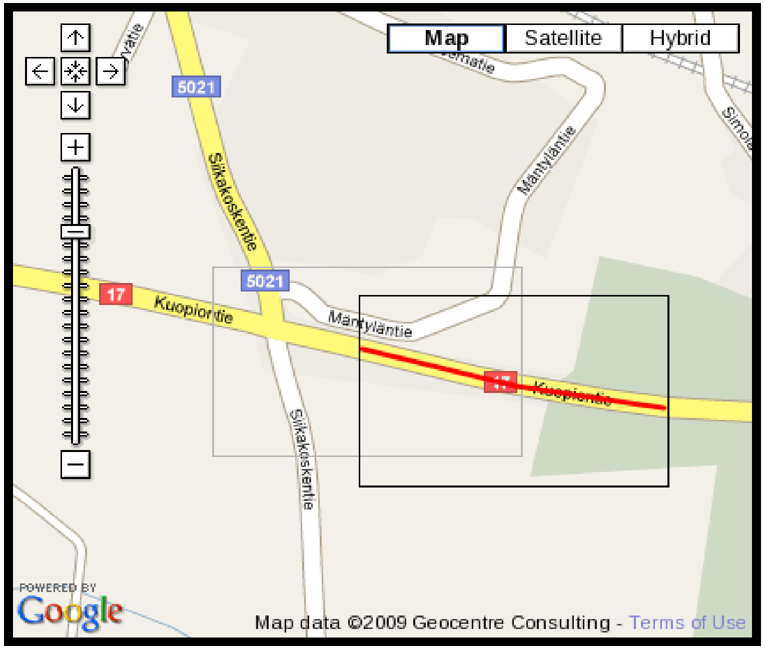
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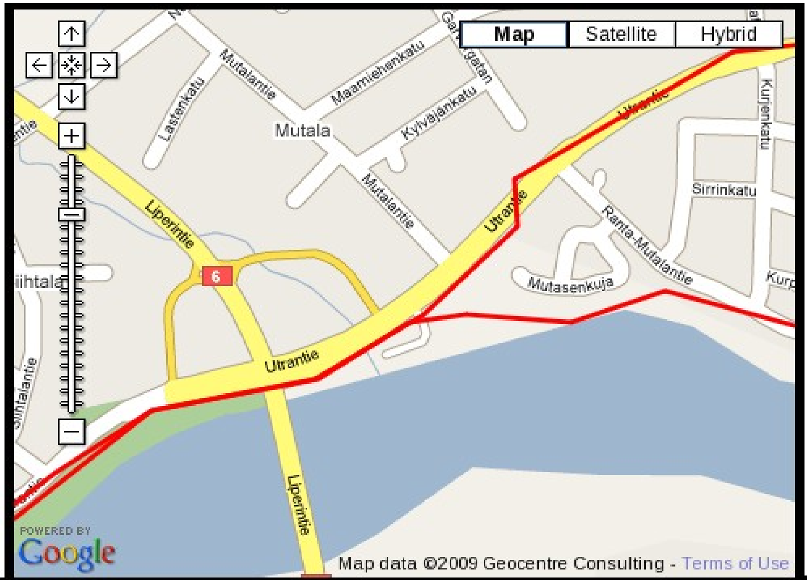
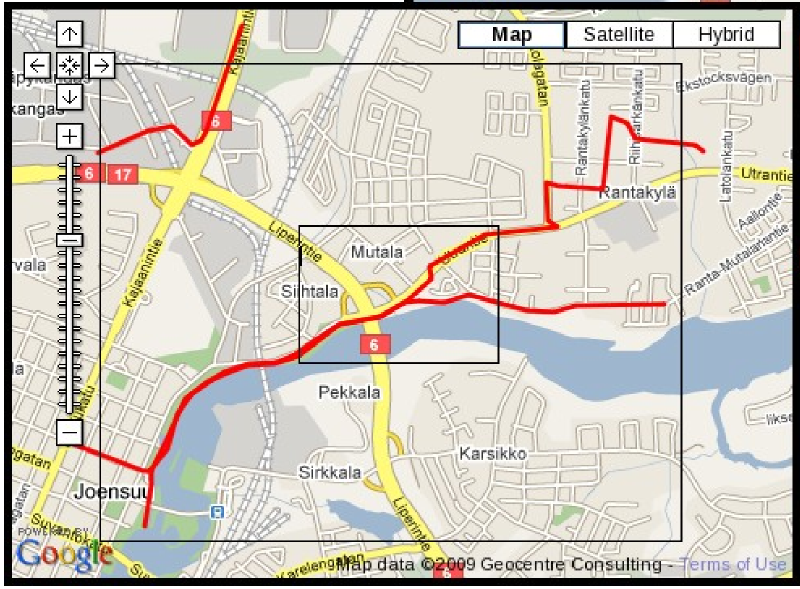
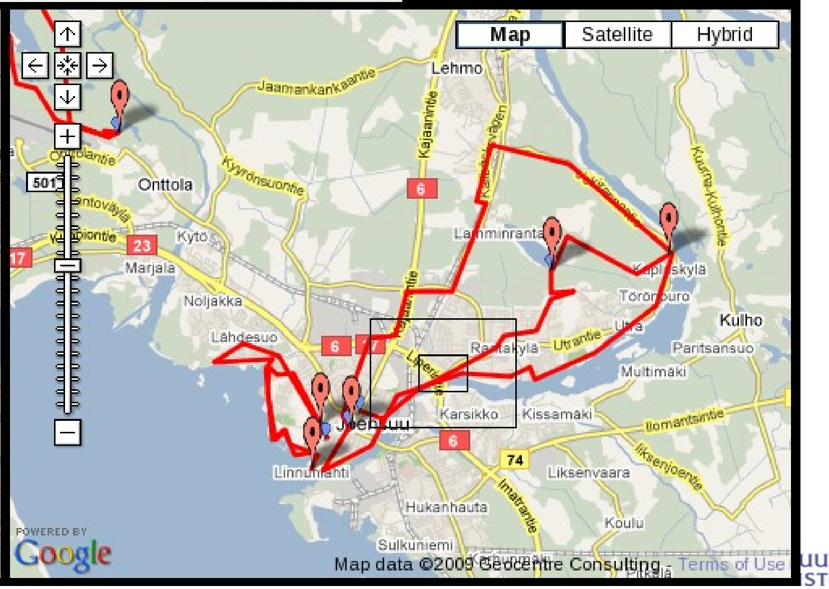
Bounding box

- When the view is changed, user sees routes ending before HTTP-request is completed
- We draw a bit larger area – a bounding box
- Now user won't see routes ending when the view is changed
- After the view is changed, the bounding box is updated and we get consistent view as a result

Bounding box



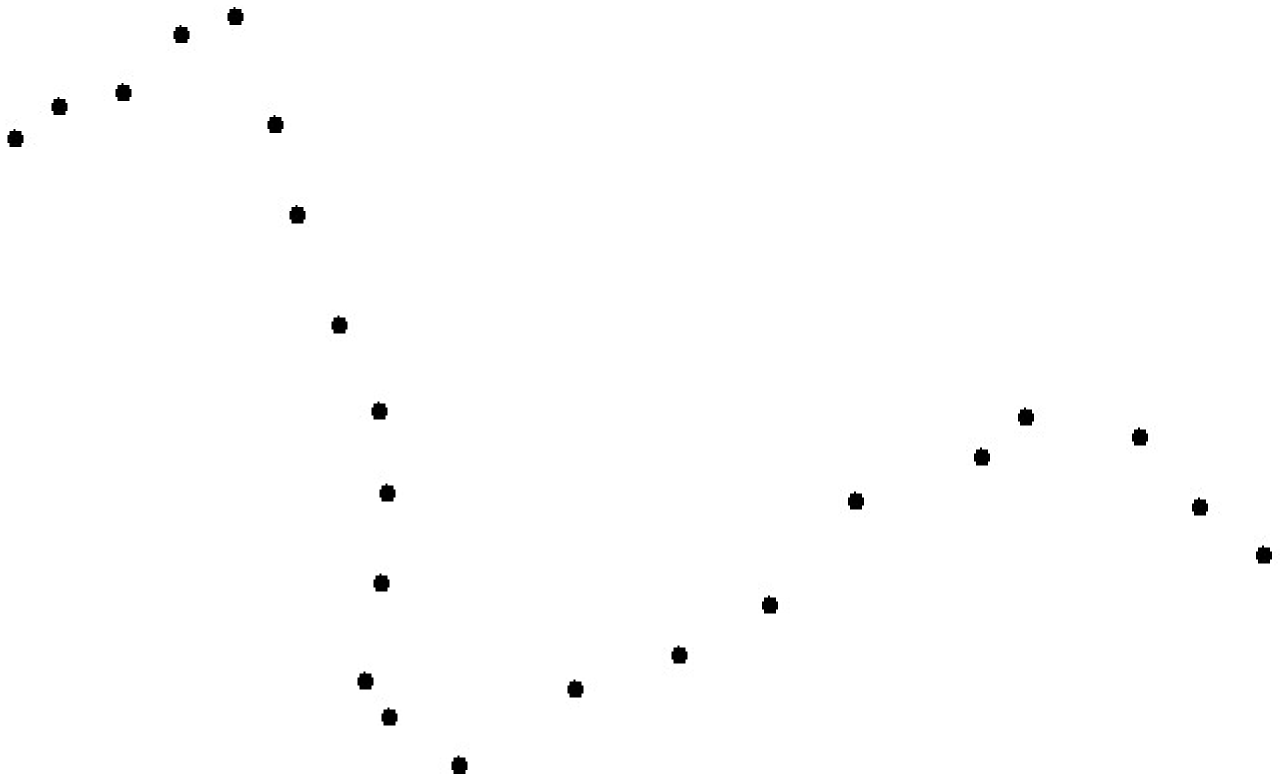




Route reduction

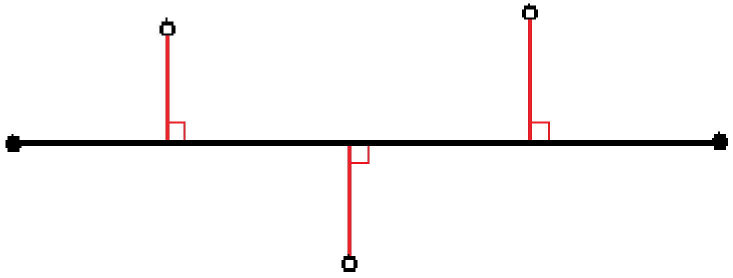
- How about if the whole map is in the view
  - All routes are shown
  - Fortunately we can reduce number of details
- We can approximate route with a small number of points and forget about the rest.

Reduction example



Reduction algorithm

- Idea
  - We define error limit
  - Number of points is minimized
  - Error limit must not be exceeded

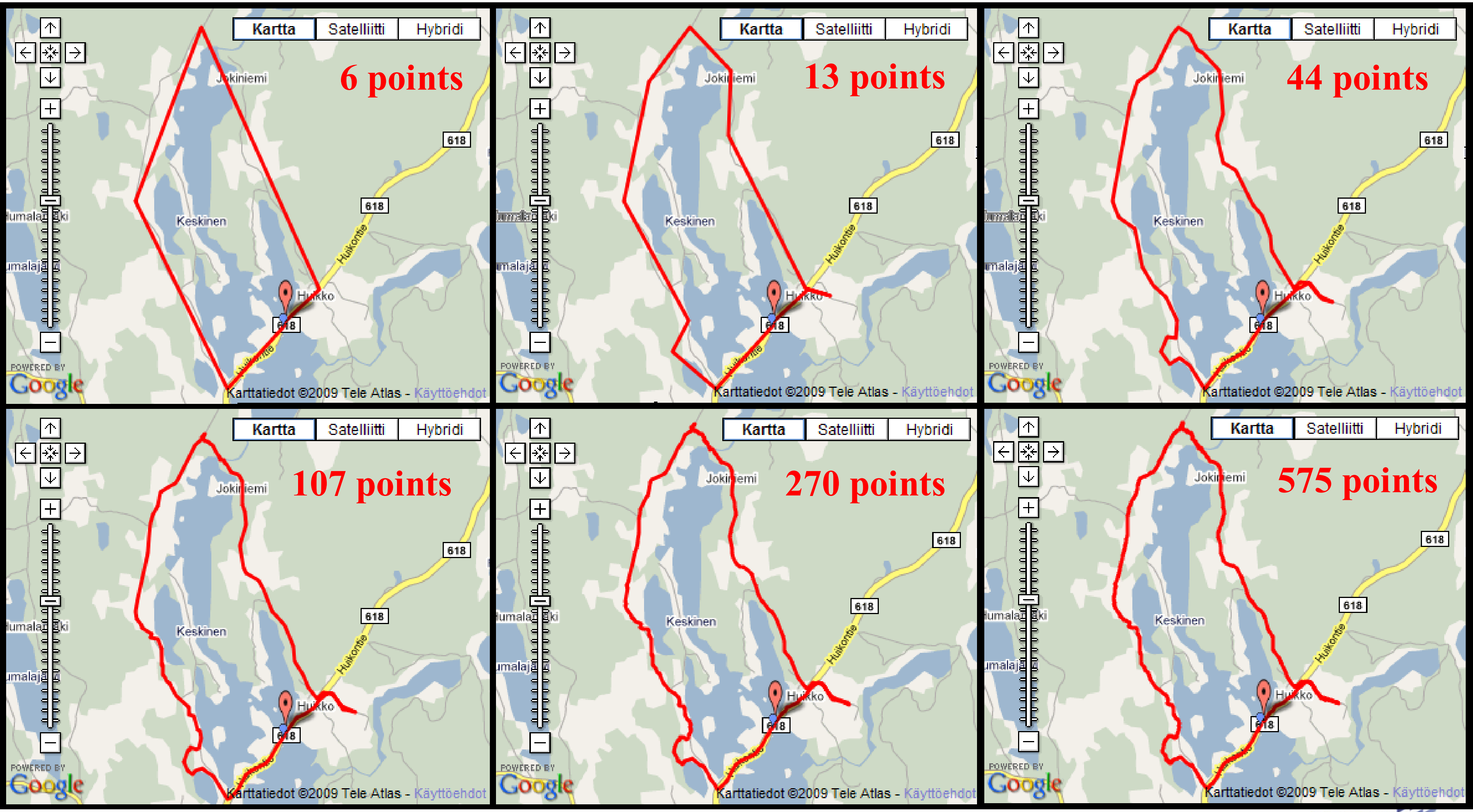


- Linear time complexity: 10 000 points in 0.3 seconds

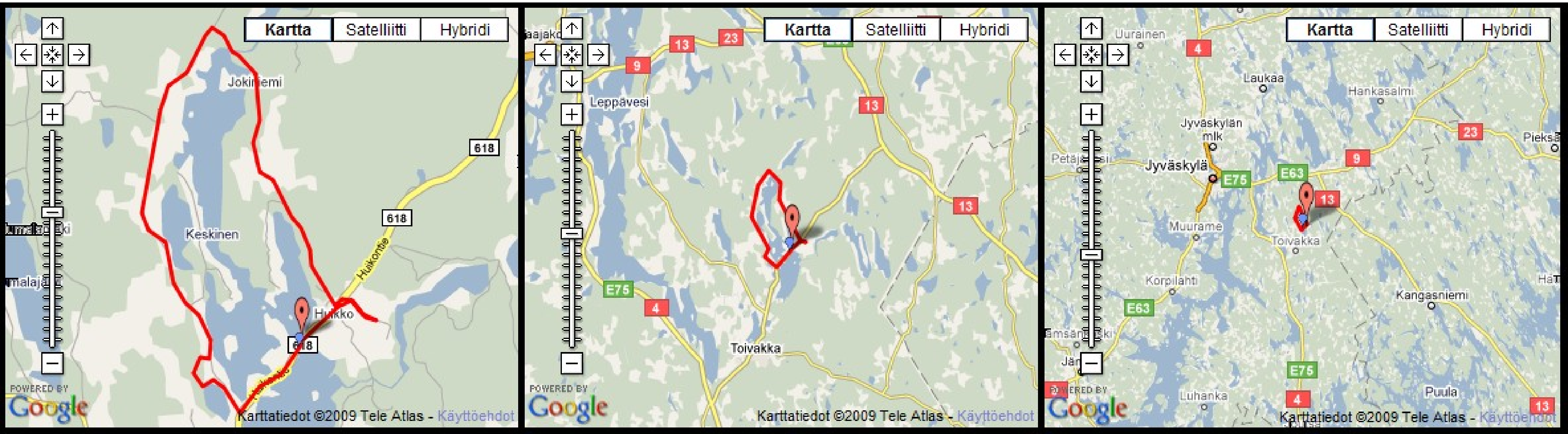
Scale levels

- Google maps has 18 zoom levels
- To get good balance between data amount and precision we need different scale levels
- We use 6 different scale levels

Real example

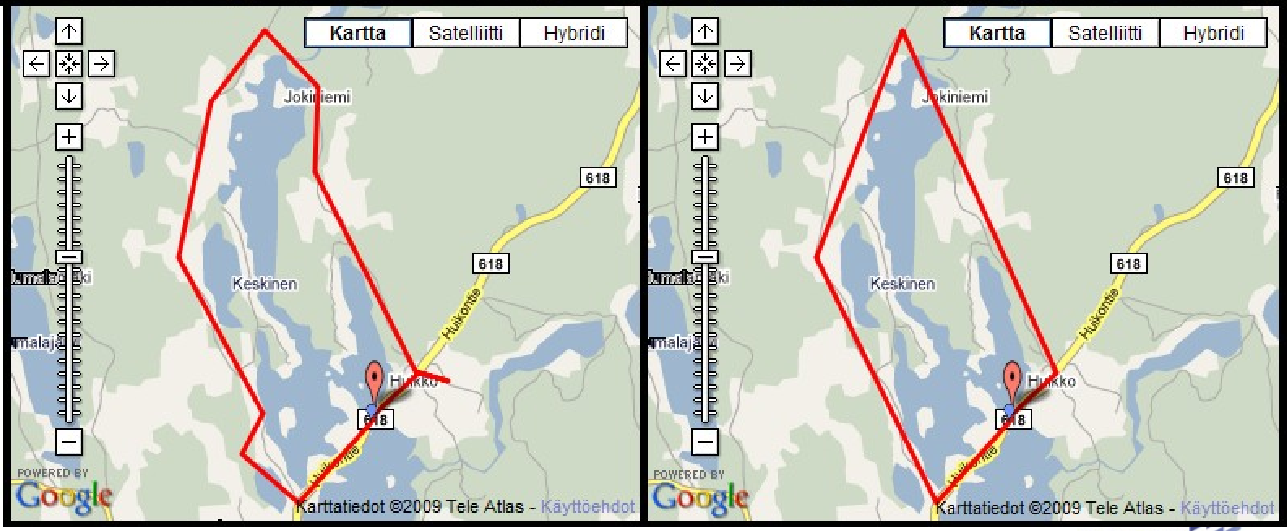


Real example



Shown in application

Closer look

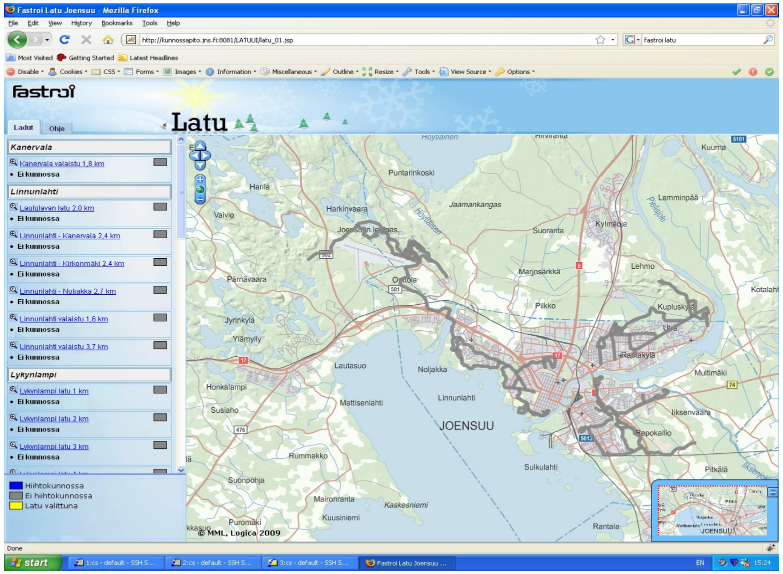


Optimization

- Address caching
    - We store address information to points, which are often the beginning or the end of the route
- Prevent bounding when not needed
    - When we zoom-in and scale level is the same
    - When the whole map is on the bounding box, we don't have to update bounding box

Applications

- Traffic: taxi and transportations
    - Organization and optimization
    - Tracking
- Sports
    - Events are easier to follow
    - Route service
- Simulations
    - Possibility to analyze and improve performance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Most Visited Getting Started Latest Headlines
fastroi
Latu
Ladut
Ohje
JOENSUU
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Done
start

Kanervala

Kanervala valaistu 1,8 km
- Ei kunnossa

Linnunlahti

Laululavan latu 2,0 km
- Ei kunnossa

Linnunlahti - Kanervala 2,4 km
- Ei kunnossa

Linnunlahti - Kirkonmäki 2,4 km
- Ei kunnossa

Linnunlahti - Noljakka 2,7 km
- Ei kunnossa

Linnunlahti valaistu 1,6 km
- Ei kunnossa

Linnunlahti valaistu 3,7 km
- Ei kunnossa

Lykynlampi

Lykynlampi latu 1 km
- Ei kunnossa

Lykynlampi latu 2 km
- Ei kunnossa

Lykynlampi latu 3 km
- Ei kunnossa

🟦 Hiihtokunnossa
⬜ Ei hiihtokunnossa
🟨 Latu valittuna

Demonstration

- http://cs.joensuu.fi/paikka/web/pure/route_test.php

Thank You !