Exploiting mobility data from Nokia smartphones

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Nokia @ EPFL

- Nokia Research Centers research.nokia.com/locations
  - Bangalore, India
  - Beijing, China
  - Cambridge, UK
  - Cambridge, Ma
  - Helsinki, Finland
  - Hollywood, Ca
  - Lausanne, Switzerland (since June 2008)
  - Nairobi, Kenya
  - Palo Alto, Ca
  - Tampere, Finland

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Research project

- Objective:
  - Investigate the potential of Nokia smartphones for mobility data collection
- Project Manager: Jeffrey Newman
- Research assistant: Jingmin Chen
- Steps:
  - Design and prepare the data collection campaign
  - Organize the data collection
  - Estimate behavioral models

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Proposed data collection campaign

- Approximately 100 participants
- They receive a Nokia N95 phone, with data collection software preloaded
- They fill travel & activity surveys

Proposed data collection campaign

- They utilize their own personal SIM card, and are reimbursed for data-transmission charges incurred
- Data collected, and survey contents, will be coordinated between TRANSP-OR and other EPFL labs, to suit a range of current and future research needs

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Nokia N95 Phone Features

- GSM (regular wireless phone network) info
- GPS tracking, network-based Assisted GPS available
- Accelerometer
- 802.11b/g WiFi
- Bluetooth
- Camera
- Calendar
- Phone / Instant Message logs

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Ethical issue

- The project is currently submitted to an ethic committee
- Highly personal information is being collected
- Participants must be aware of:
  - What data is actually collected
  - What we are doing with the data
- They have the right to
  - Access the data about them
  - Drop from the survey and have the data erased

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Potential data uses

- GPS and accelerometer: current position, speed and acceleration → mode and route
- When GPS signal is unavailable, position can be guessed with GSM, WiFi, historical data
- Phone book, phone log: social network
- Calendar: activities
- Audio and video samples: contextual measurements

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Potential data uses

- Phone interface design and usage
- Signal processing
- Indoor positioning
- Etc.

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Progress to date

- A small number (6) of phones have been received by the TRANSP-OR lab for evaluation
- An online travel review and survey tool is in development
  - Designed to be (hopefully) intuitive, simple, and fast for participants
- Custom phone software for data collection is in development

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Online Personal Travel Survey

Online Personal Travel Survey

Battery Problems

- Standard Nokia phone batteries:
  - BL-5F (N95) provides 950 mAh
  - BL-6F (N95 8GB) provides 1200 mAh
- Autonomy: 6 hours
  - with GPS tracking enabled continuously
  - Obviously unacceptably short
- But:
  - the phone has other position-identifying tools (GSM, Wifi, etc.)
  - Not necessary to collect GPS info continuously

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GPS Switching

- Software development:
  - algorithm for switching the GPS receiver on and off at appropriate times
- Objectives:
  - minimize the loss of relevant positional data (when the subject is moving)
  - only drop unnecessary data (when the subject is stationary)

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GPS Switching

- Issue:
  - The GPS unit when switched on will take some time to acquire a fix (a few seconds to a few minutes).
- Possible solution:
  - The use of the Nokia Assisted-GPS feature reduces this time
  - but it requires an active internet connection (GPRS or 3G), with concomitant battery usage

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GPS Switching

- Experiment:
  - We are collecting GPS data simultaneously from the Nokia phone and a second, dedicated GPS receiver
- This will allow comparison of switched and continuous tracks, to evaluate different switching algorithms
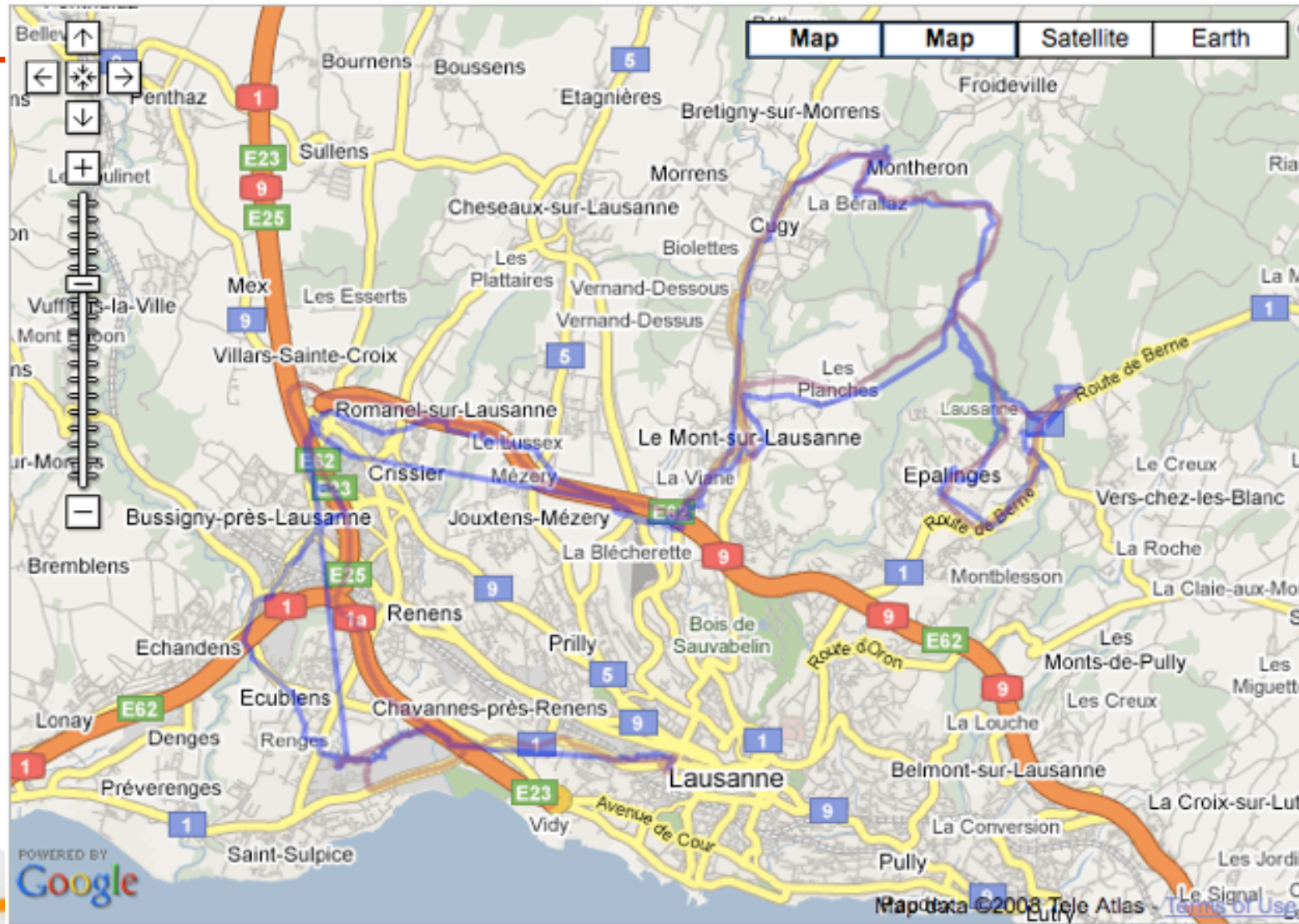
GPS Switching

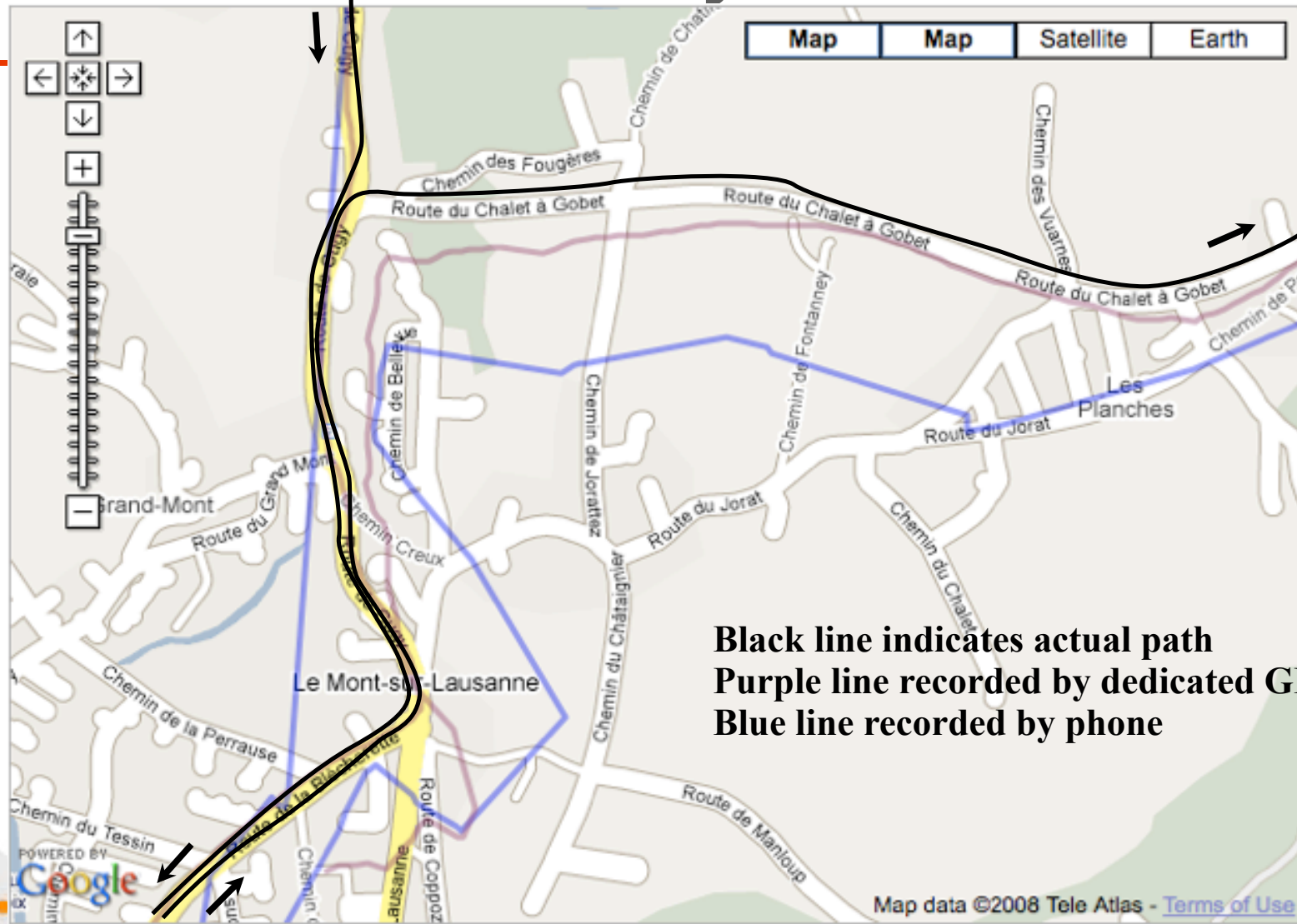- As a side effect, we discovered that the GPS accuracy for Nokia phones is pretty low…

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Phone GPS Accuracy is Low

Purple line recorded by dedicated GPS
Blue line recorded by phone

Phone GPS Accuracy is Low

Black line indicates actual path
Purple line recorded by dedicated GPS
Blue line recorded by phone

GPS Accuracy

- Low accuracy
  - not great for users
  - but provides opportunity for mathematical research: how can we account for the poor quality of GPS service?
- Traditional map matching of low quality GPS tracks could introduce large biases, creating inaccurate routes for trips
- Proposed solution: use of measurement equations

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Future Plans

- Integration of phone software and web survey system
  - the phone automatically uploads each day's data over wireless connection
- Spring 2009: pilot data collection campaign
  - about30 participants
  - test the system for functionality and bugs
- Summer 2009 (?):
  - Rolling out to 100 (or more) participants for a full scale data collection effort

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