CDR Data Analysis for Epidemic Control

ITU Technical Team for CDAEC

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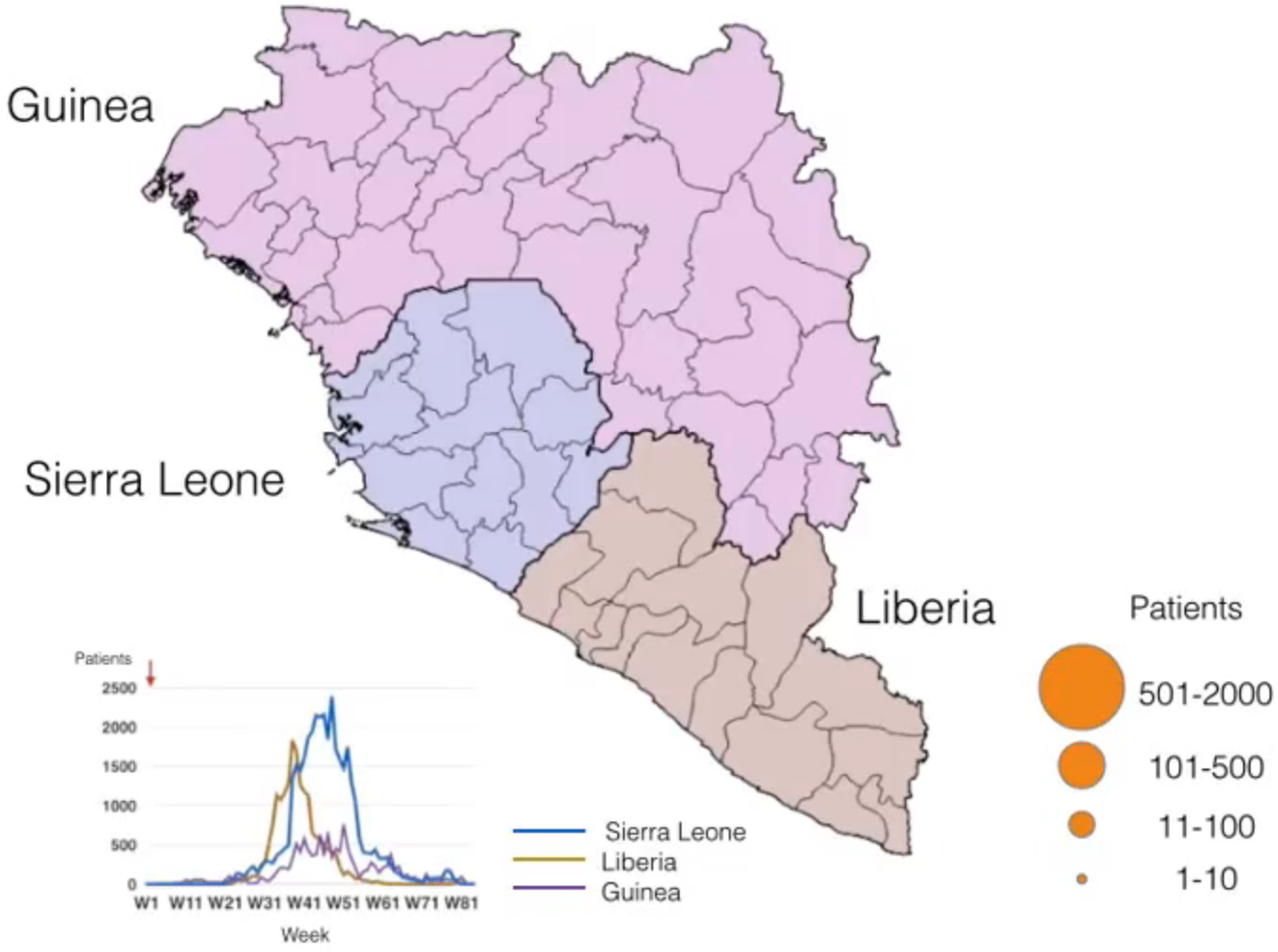
Ebola patient weekly spreads

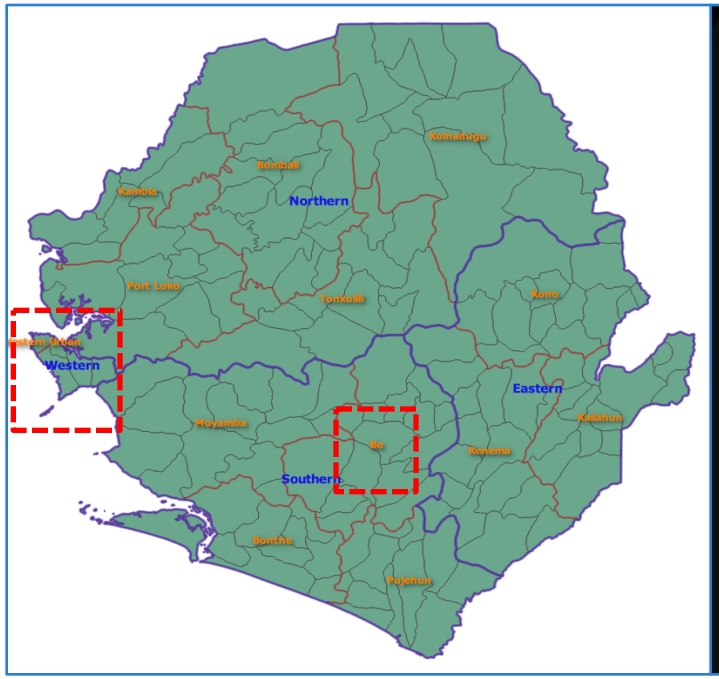
(Dec.30, 2013 - Jul. 22, 2015)

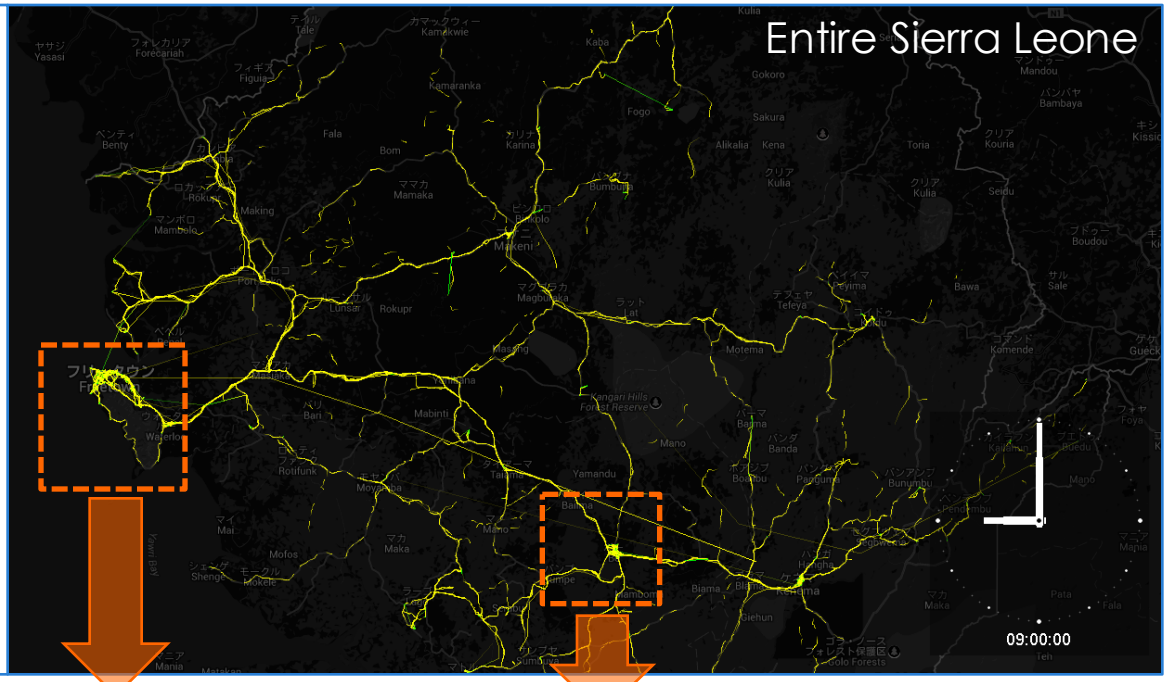


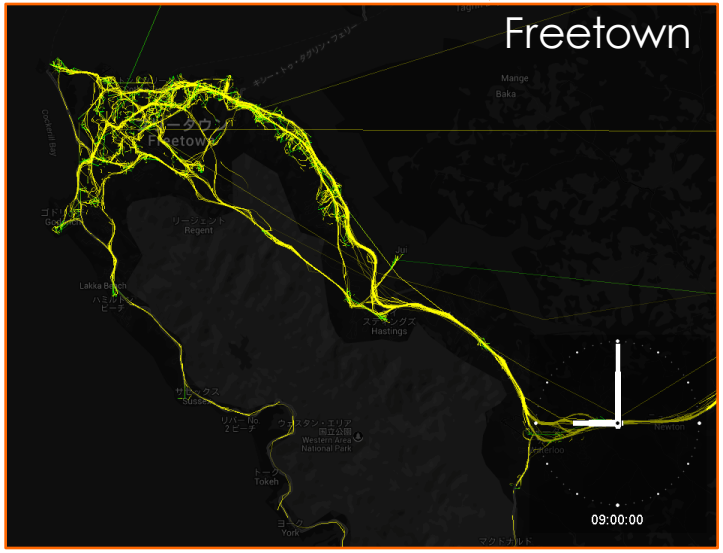
http://apps.who.int/gho/data/node.ebola-sitrep

Estimated People Movements (2015.06.07)

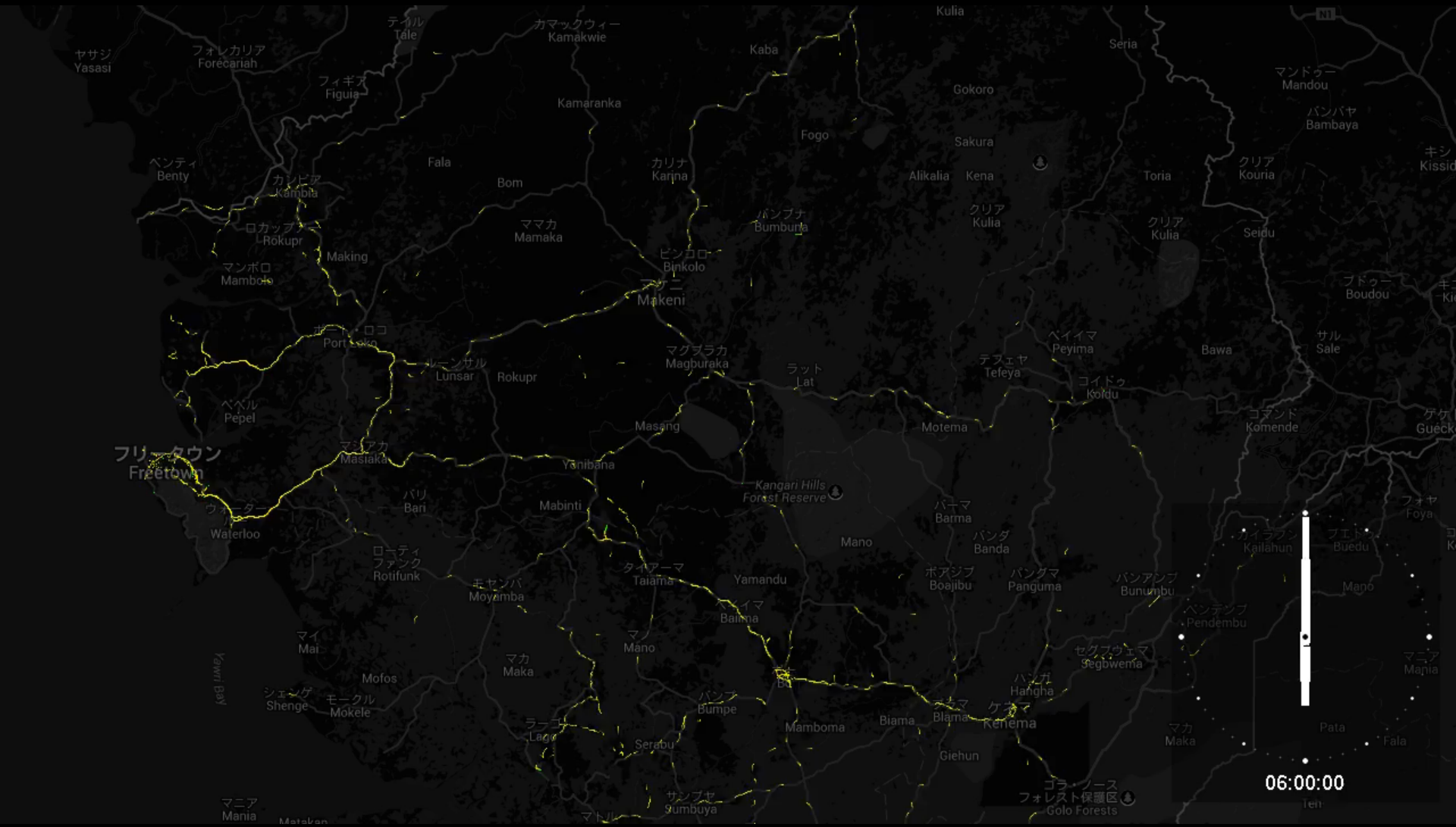
N=640,504







People Flow (7, June 2015)　Sierra Leone

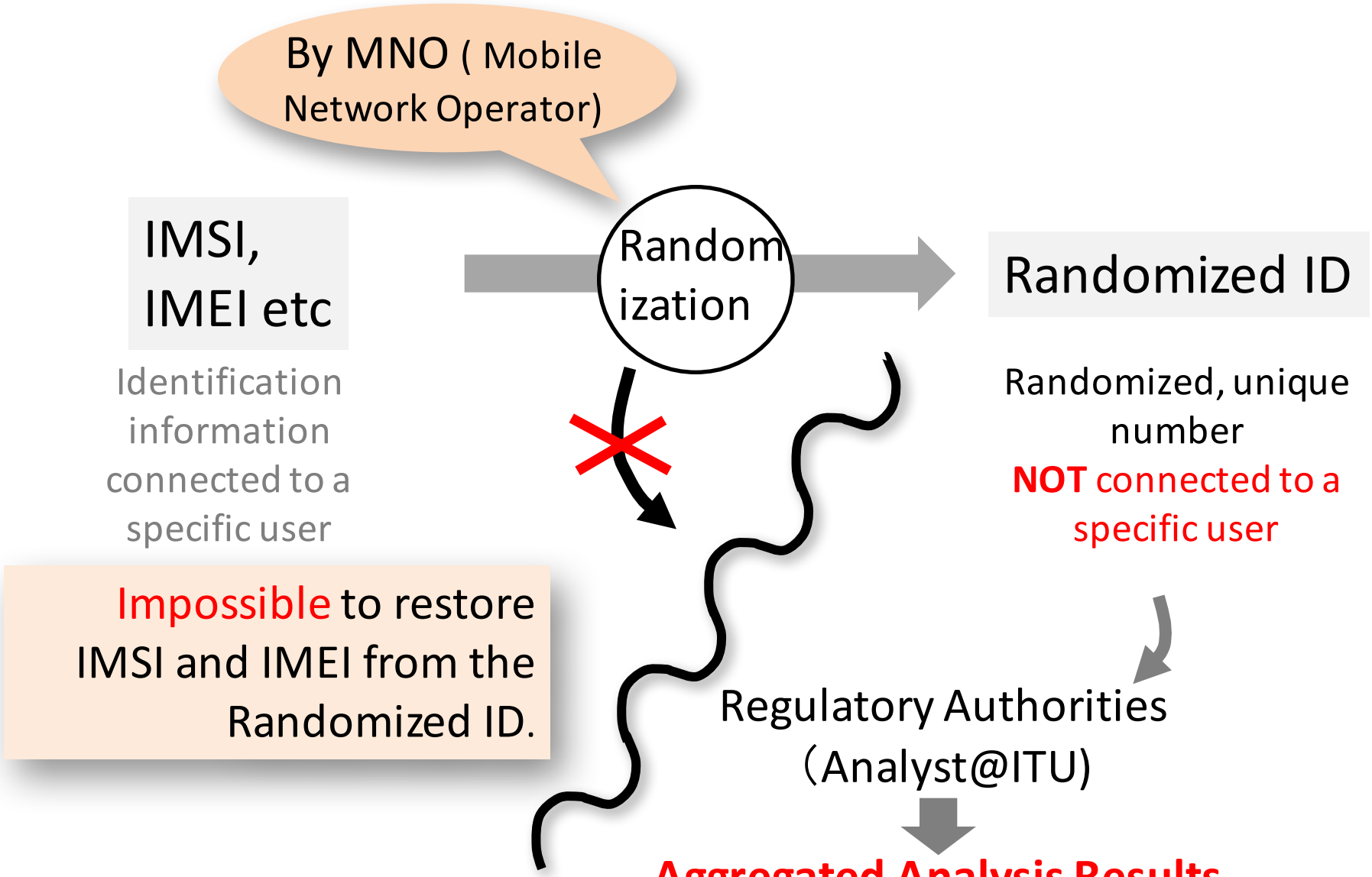



Map of Sierra Leone
Possible epicenter
Freetown
(Capital City)
Kenema
(Hospital)
Freetown
Kenema
Google

Contribution of CDR Analysis

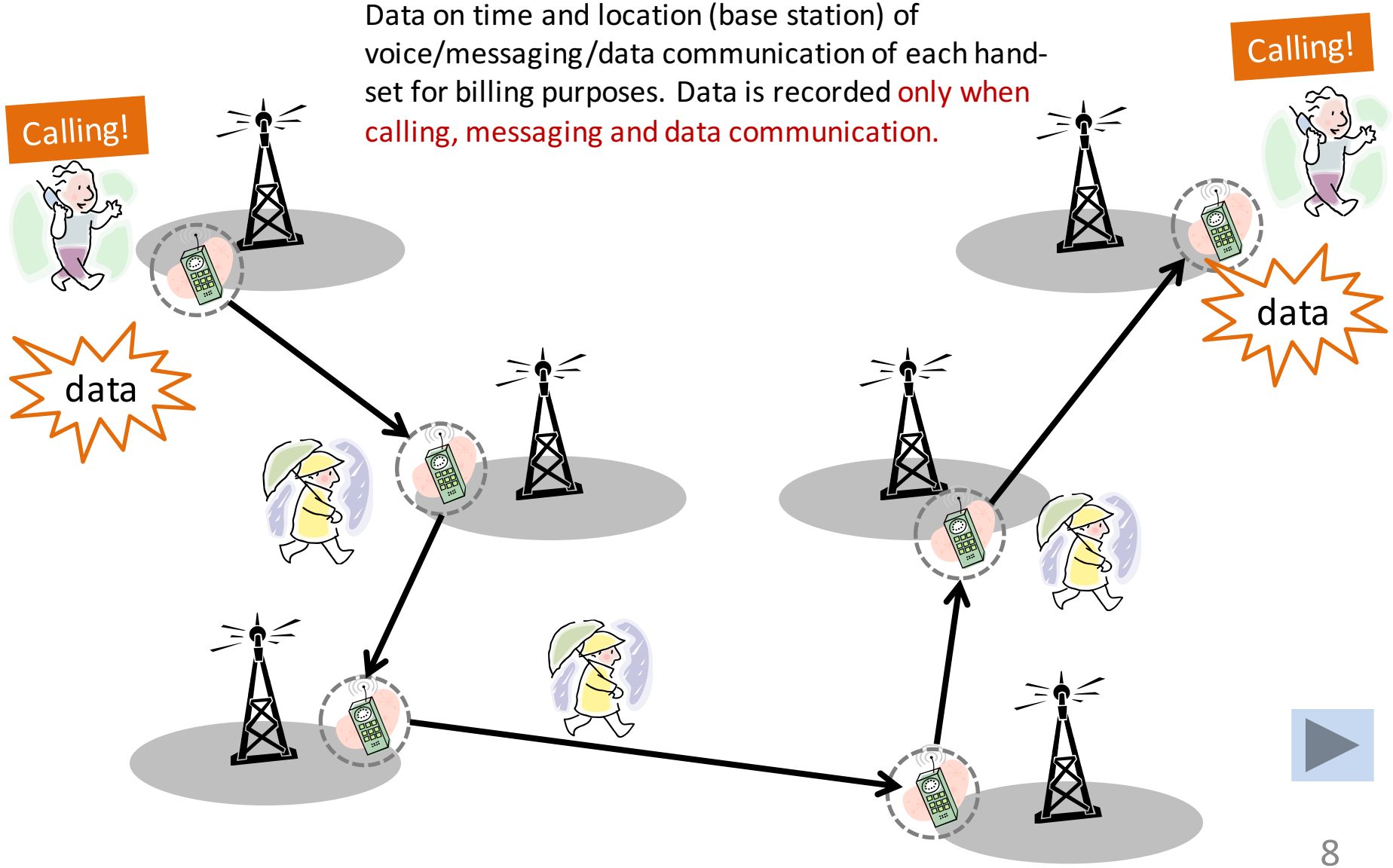
- Real-time Information on **People** Flow will help
  - Ebola outbreak analysis and control
  - Evacuation Guidance from Floods
  - Road Planning and Management etc.
  - Transboundary movement could be estimated by using IMSI, if randomized with the same seed number.
- For MNO's
  - Base station optimization etc.

Privacy is Protected with Randomization



CDR(Call Detail Record) data

Data on time and location (base station) of voice/messaging/data communication of each hand-set for billing purposes. Data is recorded only when calling, messaging and data communication.



An Important Finding

- Shifting from rural areas to cities and towns for the outbreak.
  - Together with People Flow.

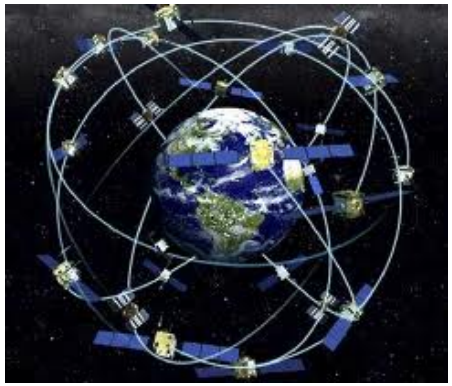
How to Track People Flow?

- Questionnaire or Interview?

- Counting vehicles at gates or surveillance points?

- Cellular phone data (CDR analysis)!

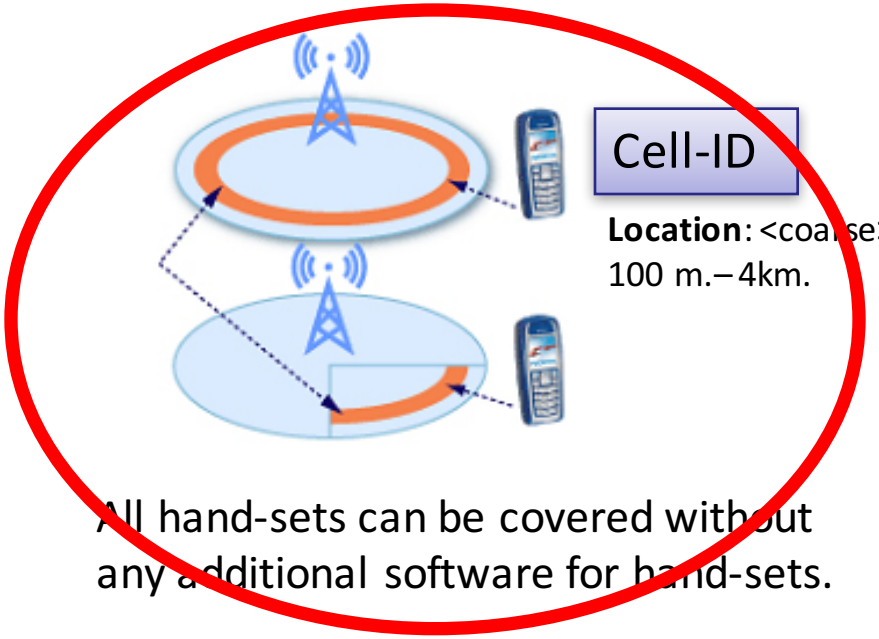
How to Identify the Location of Subscribers?



GPS

Location: <good>
10 m.– 200m.

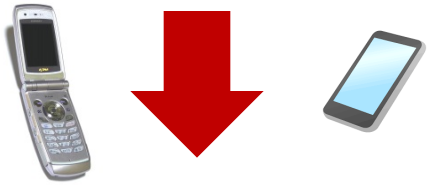
Need to embed location data transmission software



Cell-ID

Location: <coarse>
100 m.– 4km.

All hand-sets can be covered without any additional software for hand-sets.

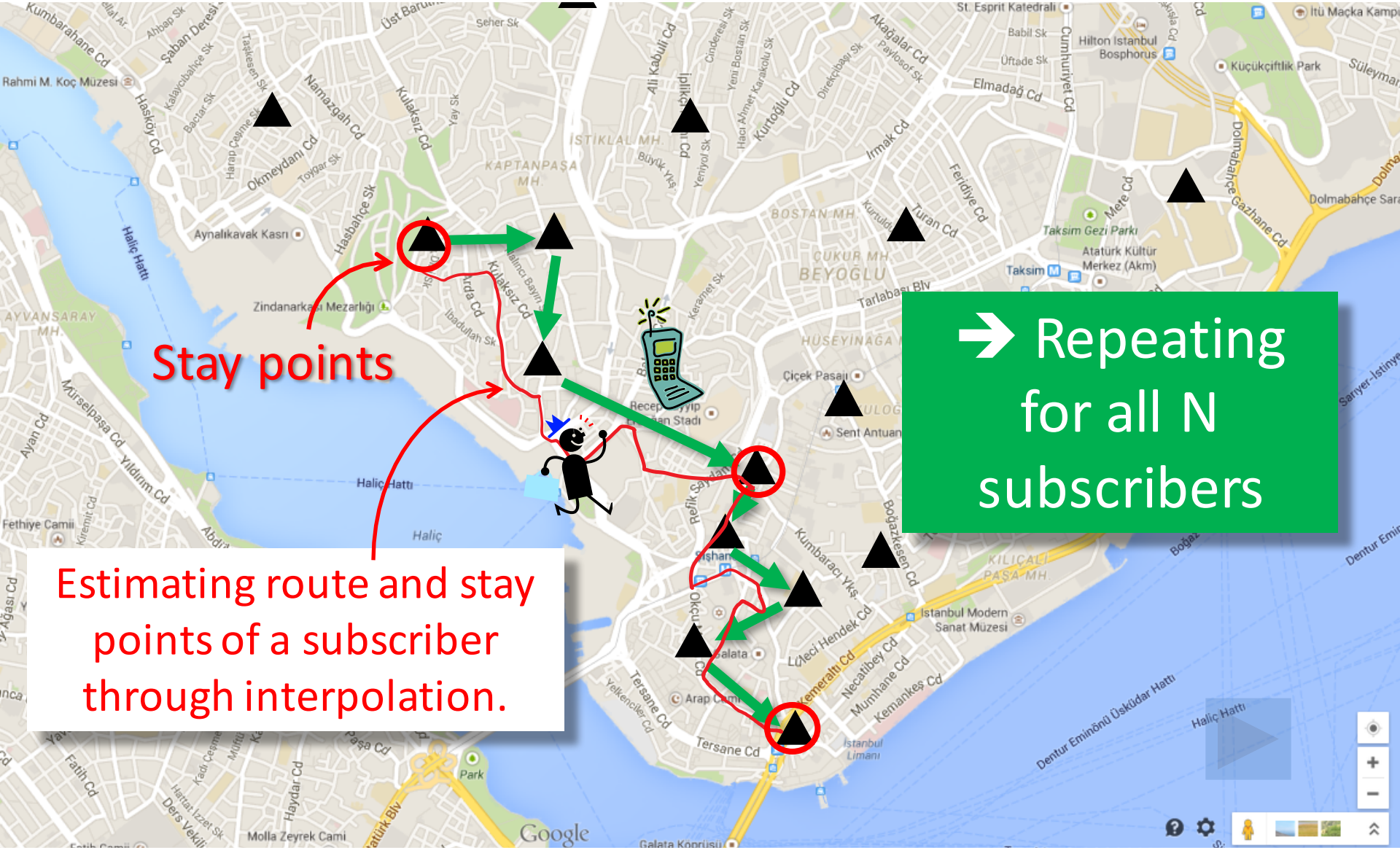


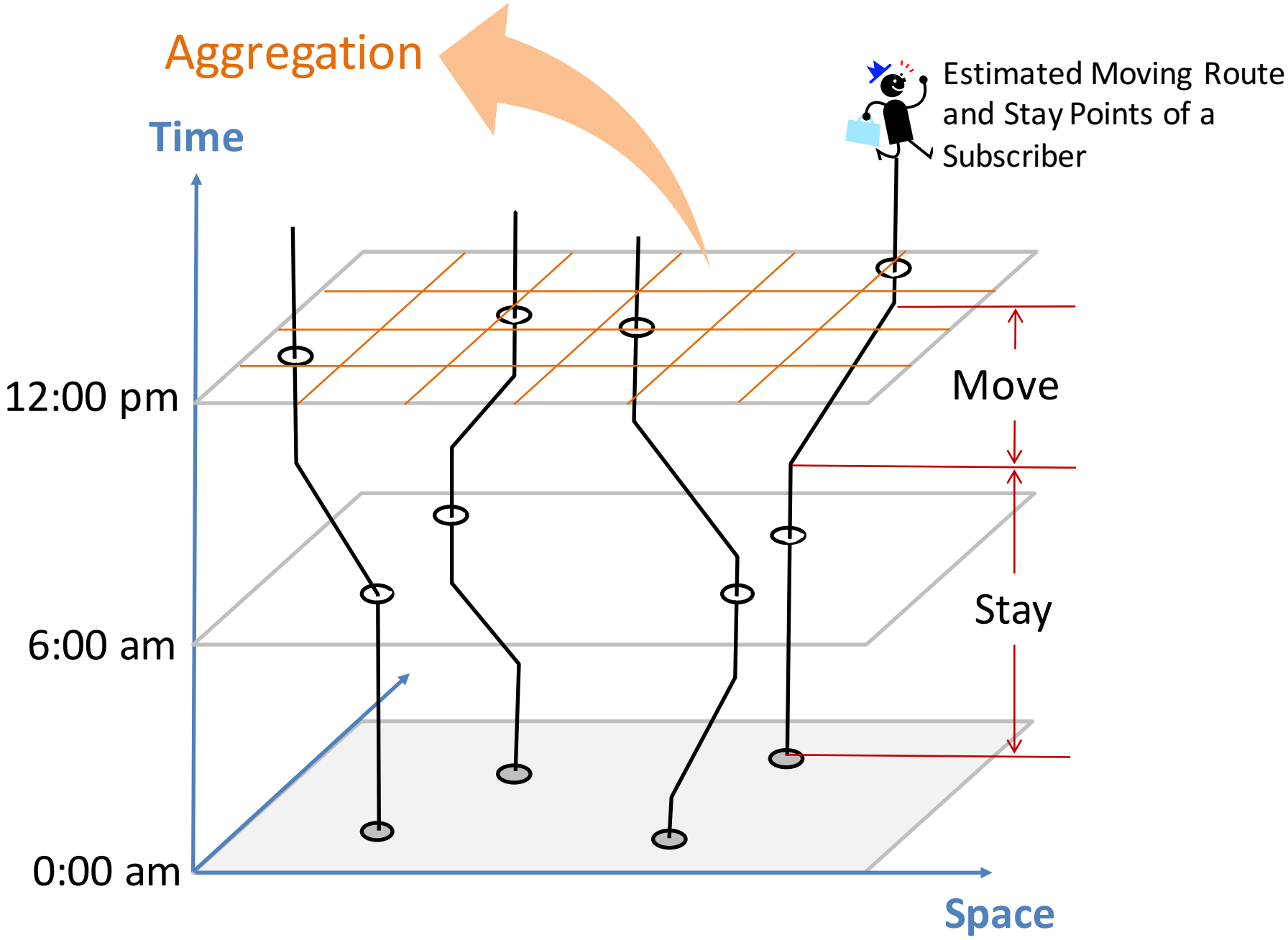
All hand-sets

Source: http://www.itisholdings.com/article.asp?id=296
http://5.freshminutes.it/2008/05/20/geolocalisation-mobile-computing/

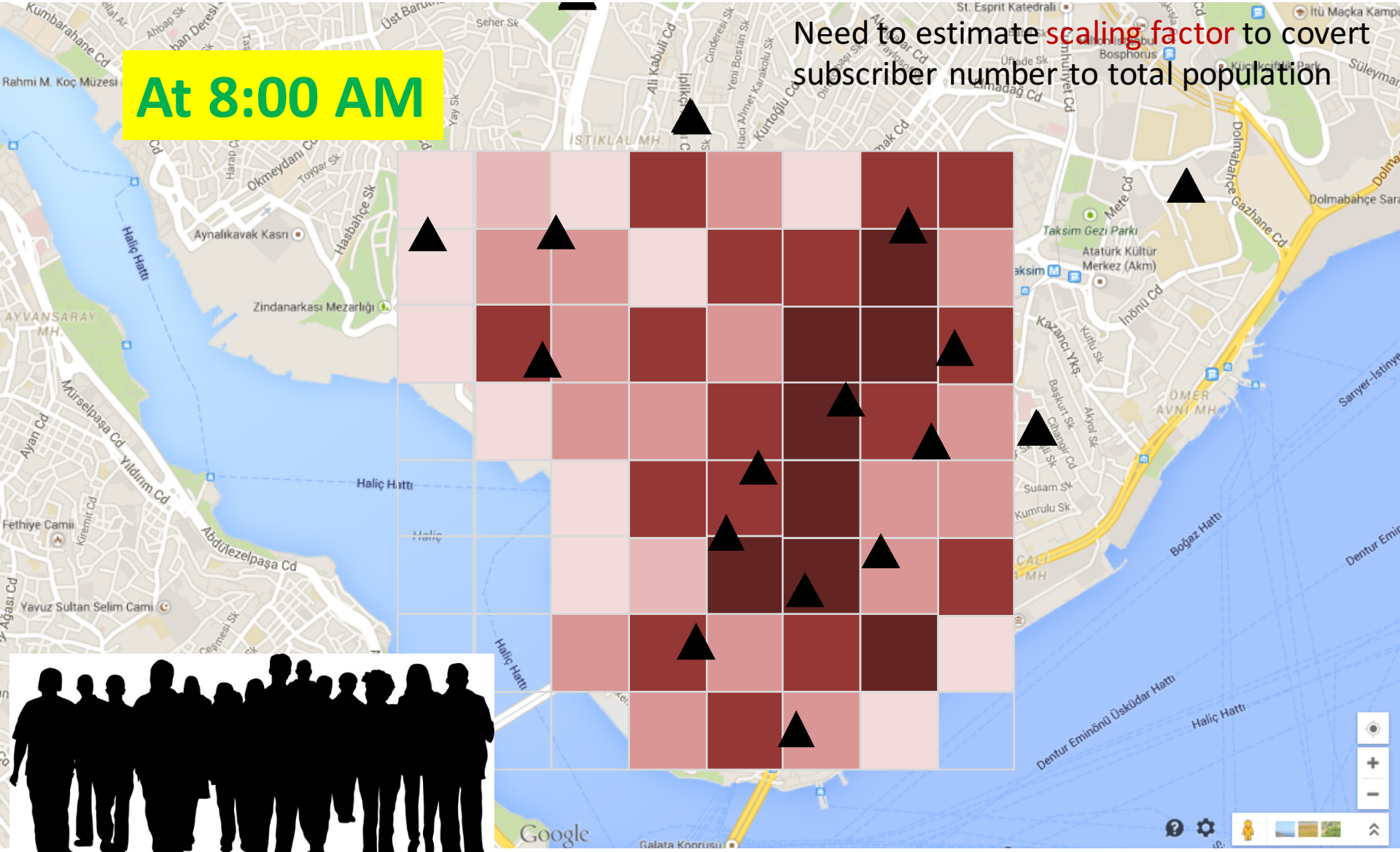
Mapping Movement of a Handset from CDR data

Estimating Moving Route and Stay Points of a Subscriber from the Movement of the Handset

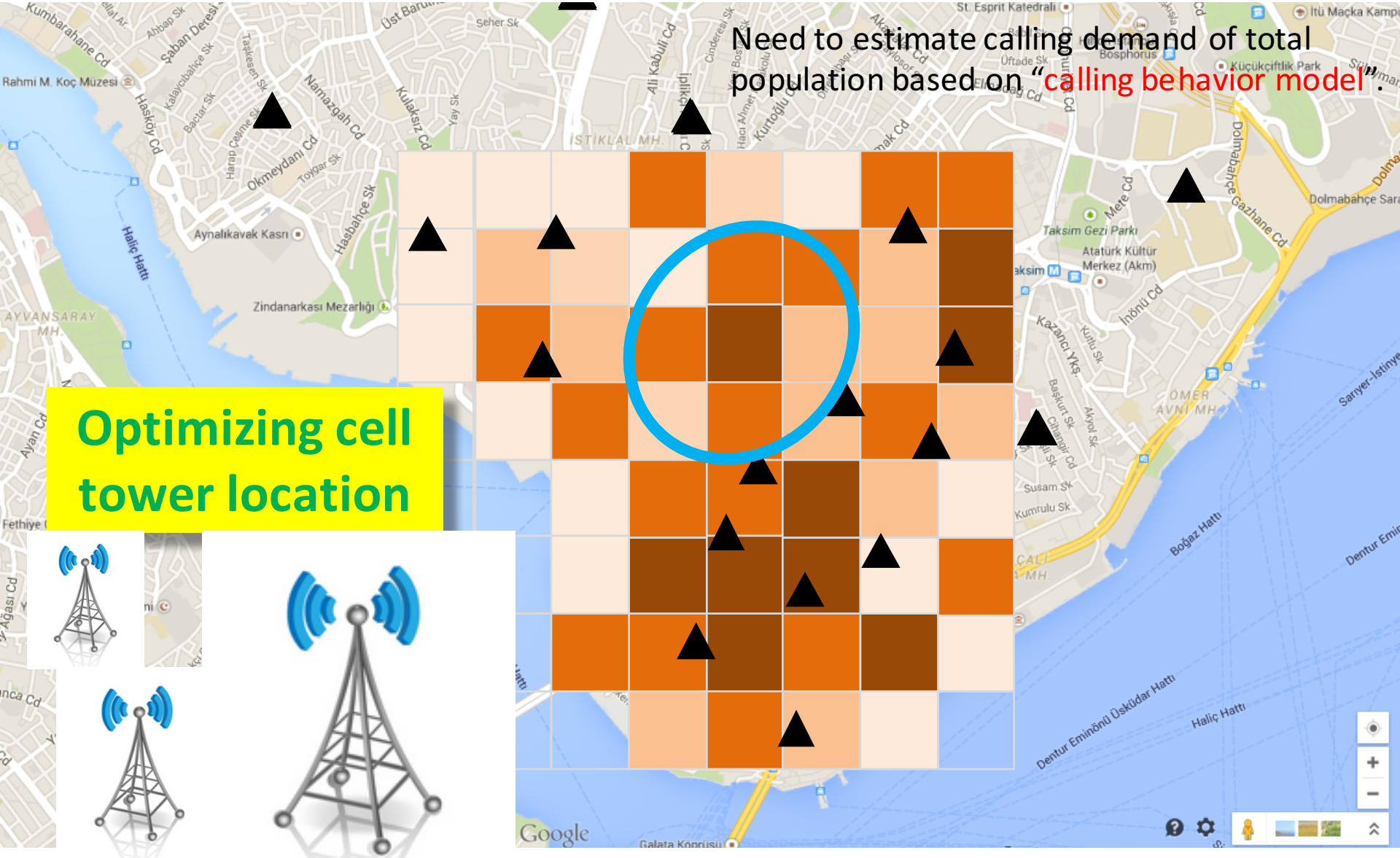



Aggregation
Time
Estimated Moving Route and Stay Points of a Subscriber
12:00 pm
6:00 am
0:00 am
Move
Stay
Space

Estimating Hourly Population Density by Aggregating Number of People in a Grid-Cell.

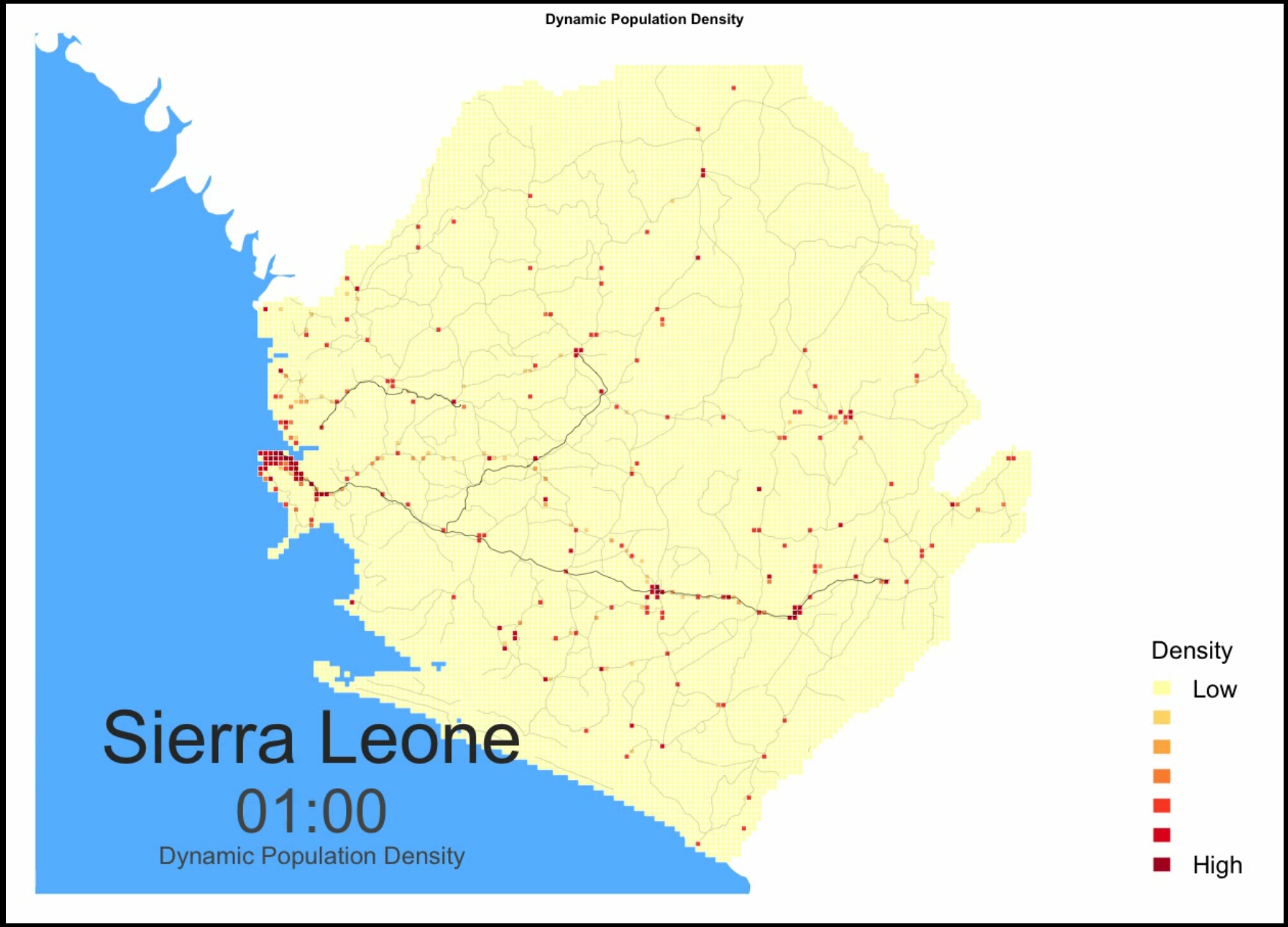


Calling Demand Density at a specific time slot by using population density and calling behavior model

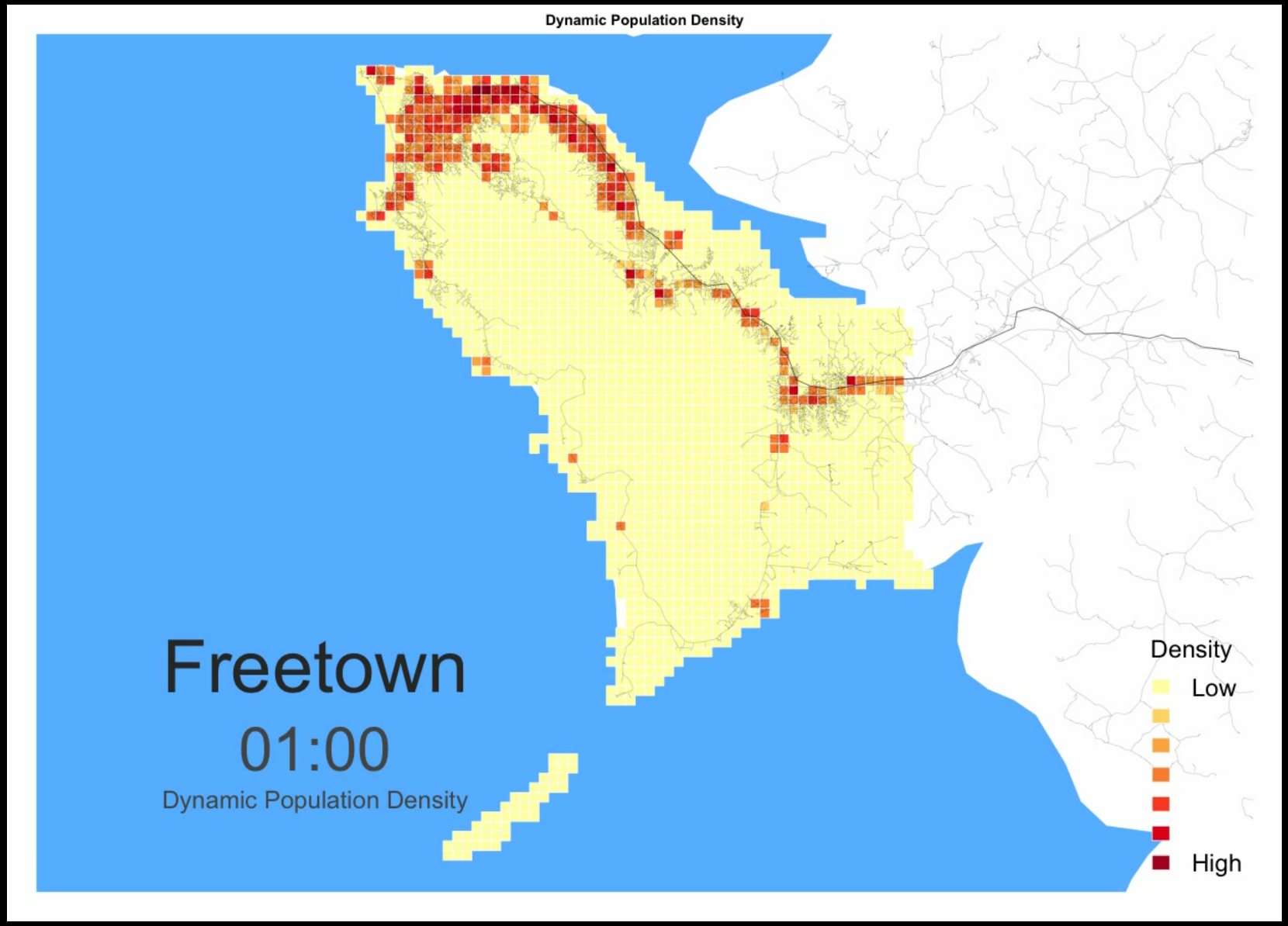


People Flow (7, June 2015)　Freetown

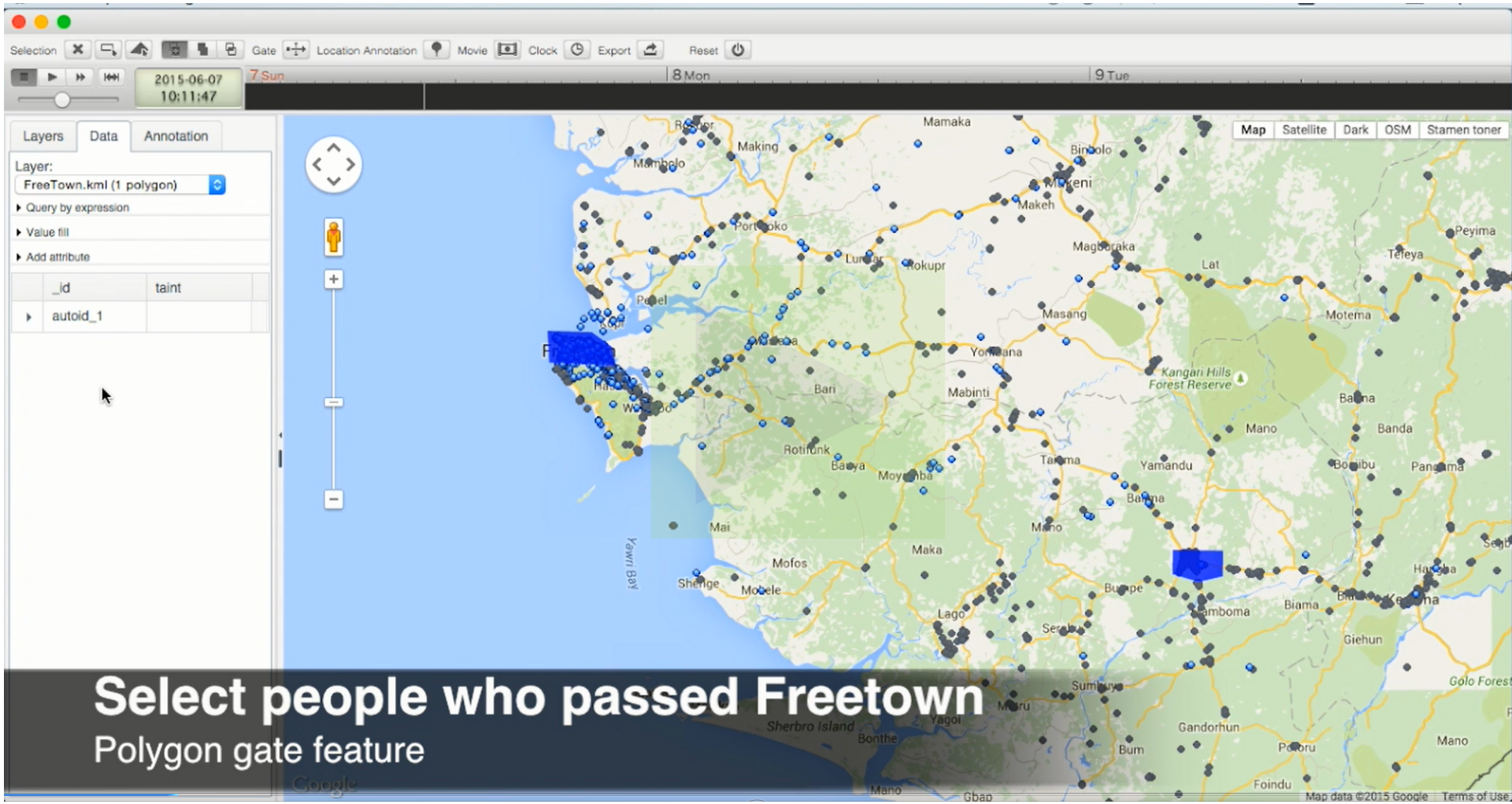
Hourly Population Density (7, June 2015) Sierra Leone



Hourly Population Density (7, June 2015) Freetown



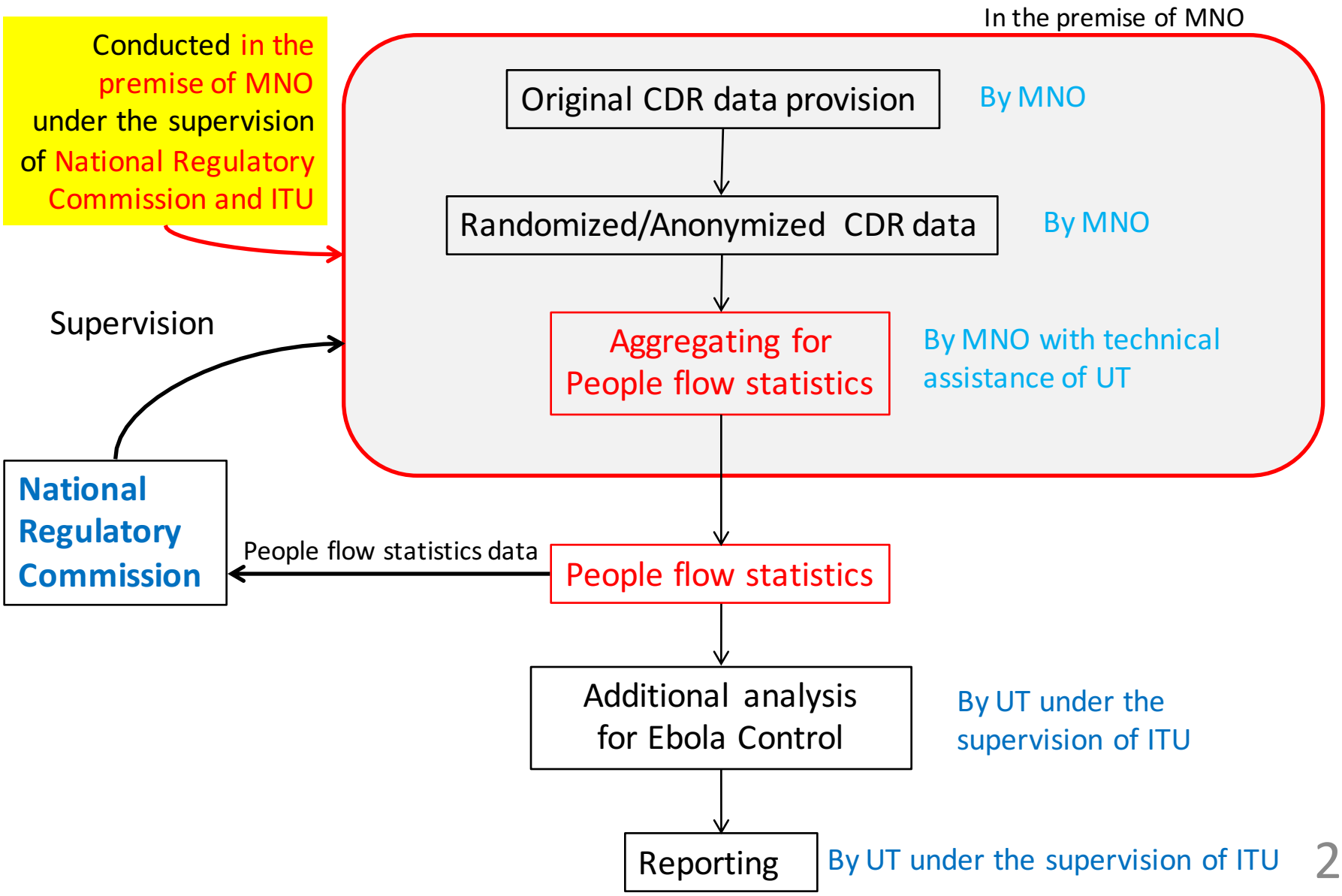
Further Analysis of People Flow; Freetown ⟷ Bo



Suggestions for future works

- 2nd Pilot project
  - Tracking transboundary (international) movement of people among Sierra Leone, Guinea and Liberia.
  - Connecting data with Randomized IMEI.
- Development of Real-time Monitoring and Analysis System for Sierra Leone, Guinea and Liberia
  - MNO's: Randomizing CDR
  - RA's: Integrating Randomized CDR and Conducting Analysis to Map Real-Time People Flow
  - ITU: Technical Support and Capacity Building

Appendix; Data Management Scheme



全体の流れ

- 課題
  - エボラは人の移動にともなって動く
  - 人の移動に関するデータが無い。
- ソリューション
  - CDR分析を行う。
- 効果、リスク（対応方法）
  - 日常的に得られるデータで、安価にリアルタイムに人の移動データが得られる。
  - 携帯電話事業者内でRandomizeし、統合解析はRAが行うことで、プライバシーリスクは避けられる。