Applying Mobile Data for Transport Planning

Japan Transport and Tourism Research Institute

Research Fellow

Toshiaki MUROI

ASEAN Transport Ministers Meeting

- The ASEAN Traffic Ministers Meeting was held 24 times so far.
- Japan also participated in this ASEAN Transport Ministers Meeting, proposed various action plans for improving traffic, and gained approval.

Past Achievements of ASEAN-Japan Transport Partnership

- Issued ASEAN-Japan Transport Statistics Book
- Objective: To establish and implement effective transport policies

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Information Platform for the Transport Statistics

- To establishing KPIs and are making efforts to build traffic statistics

- It is not easy to calculate the KPIs of these traffic volume.

- It is a situation that the value deviates greatly over time, or data can not be collected in the first place

- To explain the method in Japan, but it is a problem that it takes enormous cost and a long time.
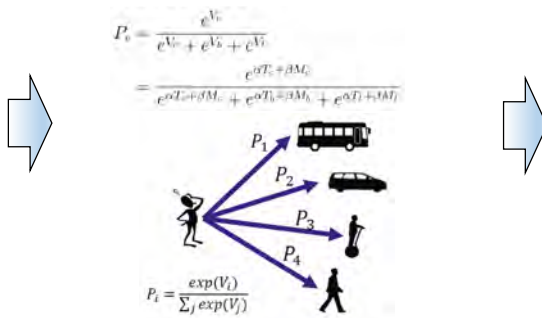
Present situation of traffic survey in Japan

① Questionnaire on the means of transportation Distributed **to 1.4 million**

Necessary expenses:
¥1,700 JPY/ person
⇒ some millions US$/ 1 survey

- Tremendous expenses, long period
- Reduction of collecting rate
- Risk of lowering accuracy

- **A new method to replace questionnaires is being discussed in Japan**

② Estimation of traffic behavior model

$$P_0 = \frac{e^{V_c}}{e^{V_c} + e^{V_b} + e^{V_t}}$$
$$= \frac{e^{\beta T_c + \beta M_c}}{e^{\alpha T_c + \beta M_c} + e^{\alpha T_b + \beta M_b} + e^{\alpha T_l + \beta M_l}}$$

P_1
P_2
P_3
P_4

$$P_i = \frac{exp(V_i)}{\sum_j exp(V_j)}$$

③ Identifying traffic congestion and checking statistics volume

Large   Small
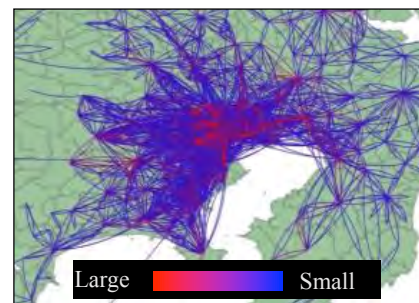
Hanoi Morning Traffic (October 10 2015)

※movie

Can you identify locations of traffic jam in your city?
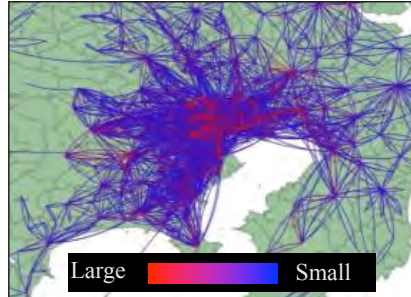**Do you know many people is exist these traffic jam area?**

How to estimate traffic volume from statistical data

Transport
Statistics

Identify the location of
traffic congestion
⇒Establish Transport
policy planning

Large   Small

- · Public transport planning（LRT, BRT..）
- · Highway construction planning
- · Urban development planning
- · Urban zoning planning

Present transport statistics
do not provide sufficient
information for planning

1
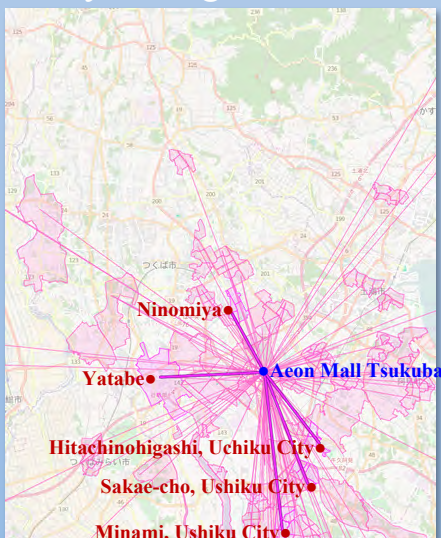# Traffic volume Survey Using Mobile Big Data

Mobile Big Data : "Mobile Spatial Statistics"

※movie
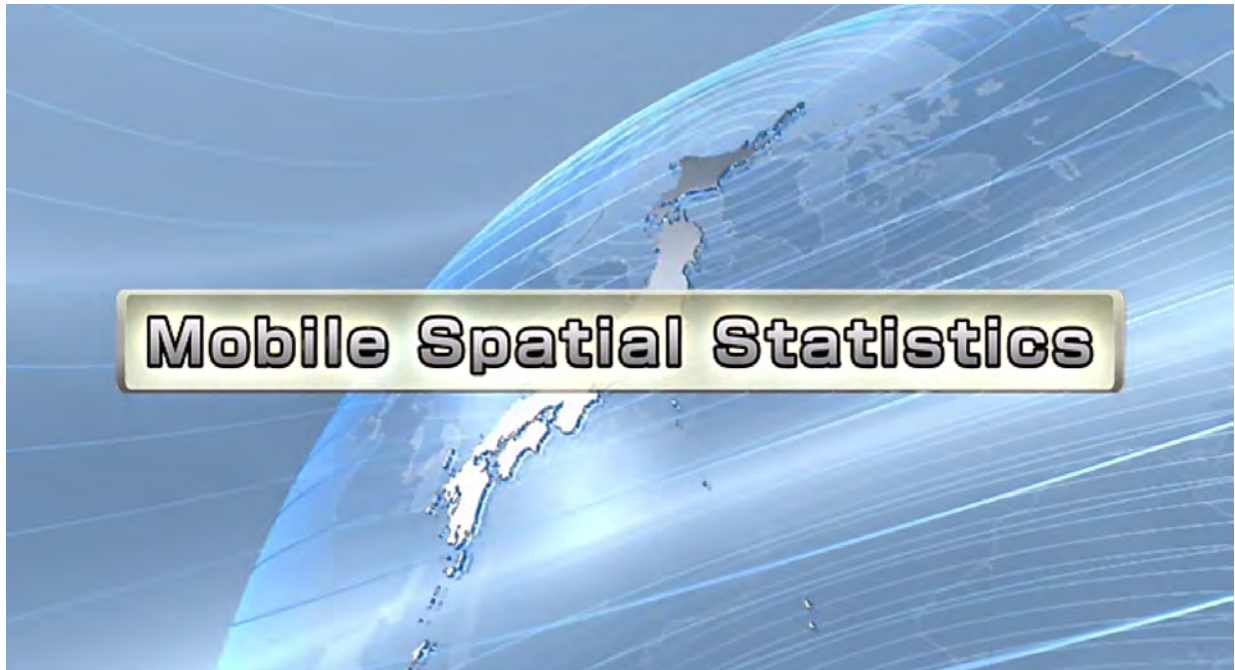
Estimation : Movement to Aeon Mall Tsukuba

Traveling to Aeon Mall Tsukuba

Note: Opened in 2013

Visited by **residents of a large area** outside the city as well as in the city during the afternoon

Ninomiya

Yatabe● ●Aeon Mall Tsukuba

Hitachinohigashi, Uchiku City●

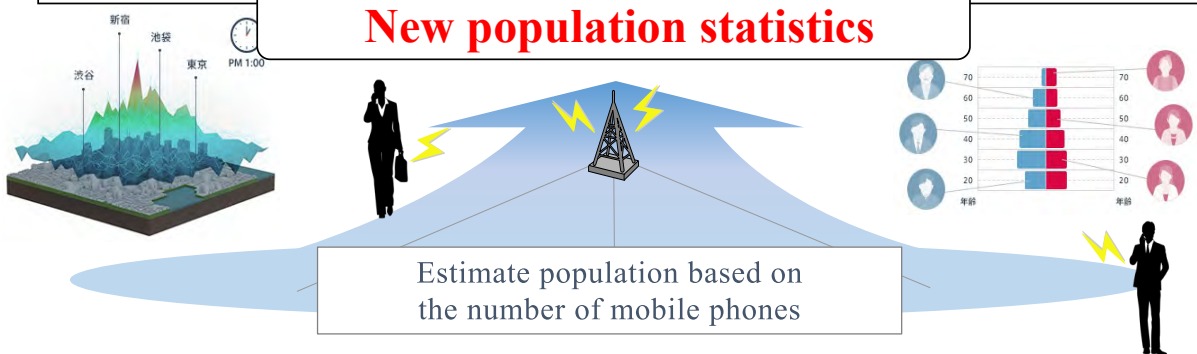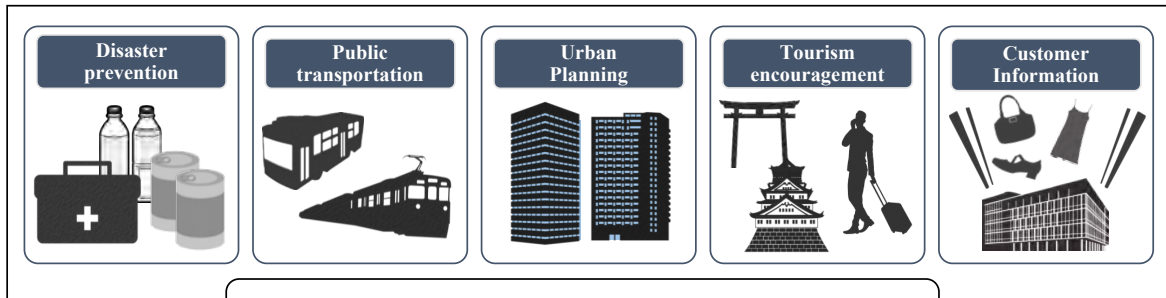Sakae-cho, Ushiku City●

Minami, Ushiku City●

1:00 p.m. – 2:00 p.m.
Friday, July 24, 2015

What is "Mobile Spatial Statistics"

- New population statistics that can find "what kind of person has moved when, from where, and to where"

Disaster prevention	Public transportation	Urban Planning	Tourism encouragement	Customer Information

New population statistics

Estimate population based on the number of mobile phones

OPTION : Mobile Big Data (1) CDR (Call Detail Record)

Mobile Spatial Statistics

CDR（Call Detail Record）

Data that indicate which BTS controls mobile phones for calling and communication

Mobile phones are just turned on. （Not in the communication mode）

Data of call time (communication volume) that telecommunication carriers need to charge fees for calls and communication to the users

Data is collected if mobile phones are in the communication mode.

Both are valid as mobile big data

OPTION : Mobile Big Data (2) Data collected from APPs

- Estimate the extent of road congestion from usage data of applications
  - A variety of apps are already in widespread use in many ASEAN countries.
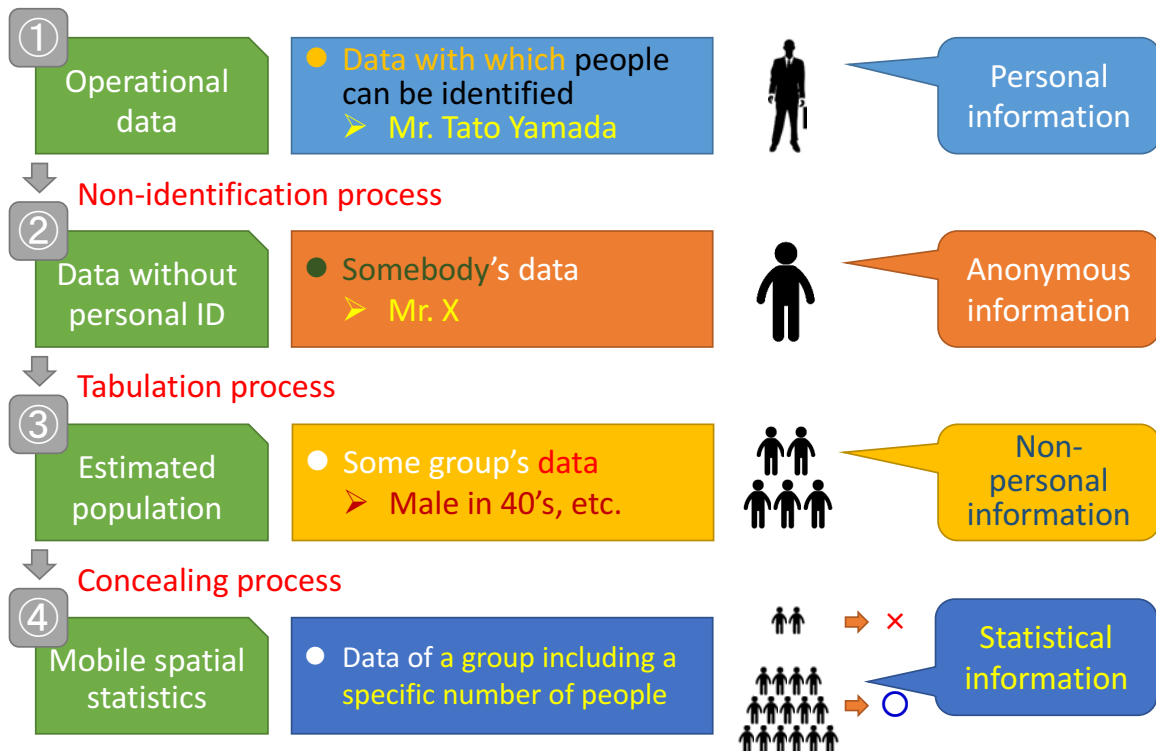 - The number of samples is small, but they make trend identification possible.

Data that can be obtained from apps

Data is collected when the apps are used.

Traffic Jam (8:00-10:00a.m.)

Road

Route16

Graph Legends
+50%~ ↑
+30%~+50% ↑
+15%~+30% ↑

Relationship between operation data and mobile spatial statistics

① **Operational data**
- Data with which people can be identified
  - Mr. Tato Yamada

Personal information

Non-identification process

② **Data without personal ID**
- Somebody's data
  - Mr. X

Anonymous information

Tabulation process

③ **Estimated population**
- Some group's data
  - Male in 40's, etc.

Non-personal information

Concealing process

④ **Mobile spatial statistics**
- Data of a group including a specific number of people
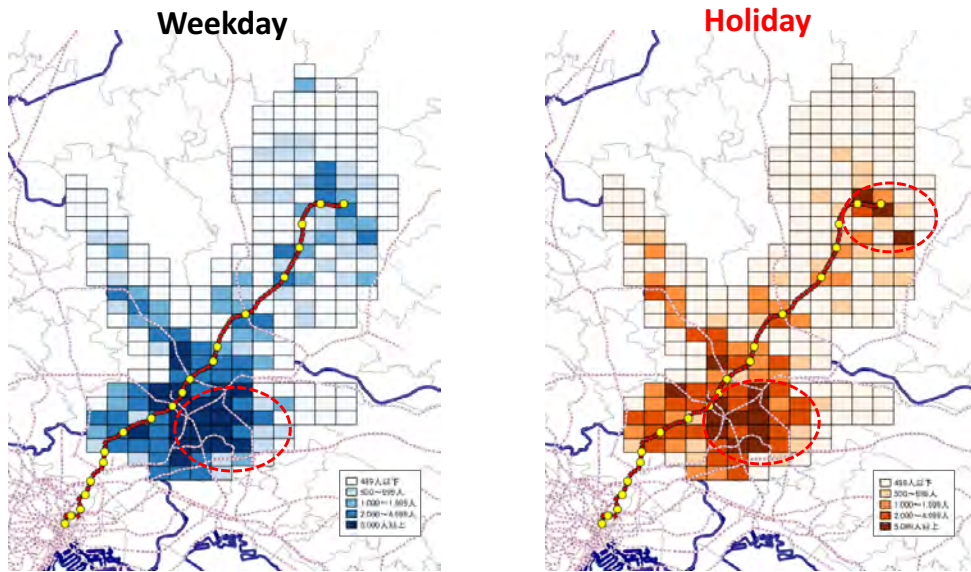
Statistical information

2
Case study of
Mobile Big Data in Japan

Case1. Train (Traffic demand forecasting of TX railway)

- Open: 2005
- 58km in length
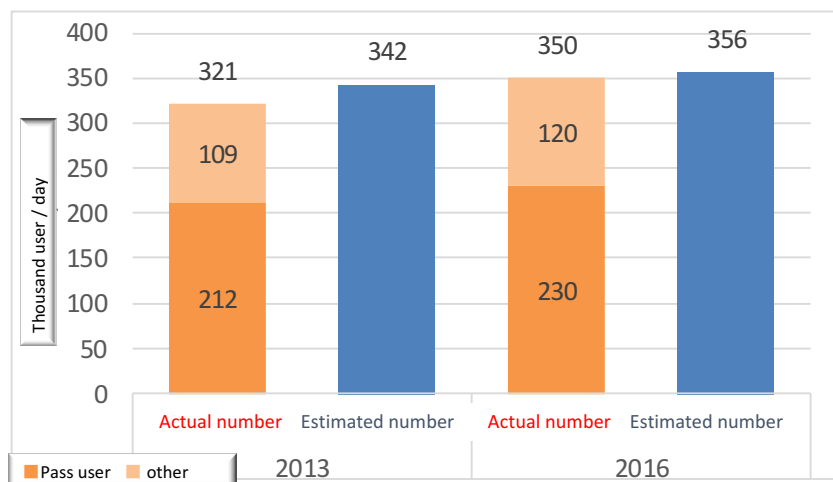- 45 minutes
- 354,000 riders use per day

Estimation for Transport Demand in TX line

Weekday

Holiday

Traffic volume by mesh（Oct. 2016）

Comparison between estimated user number of MBD and actual user number of TX

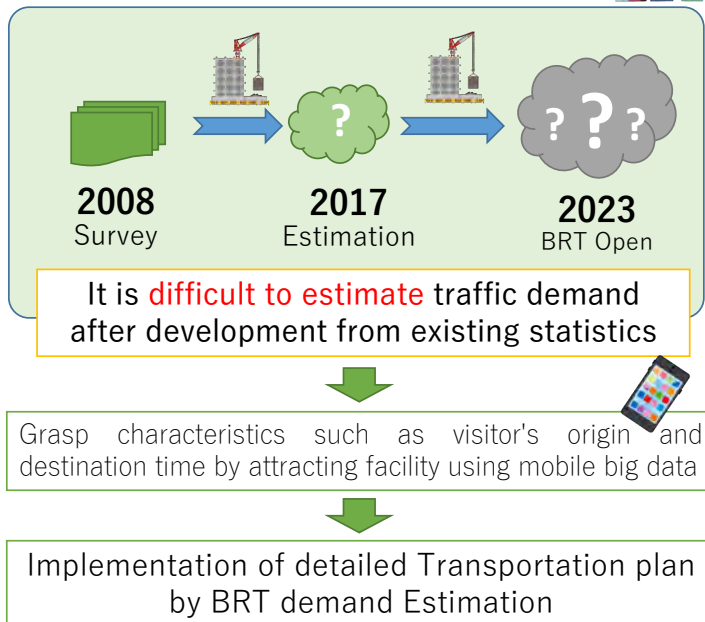- Good correlation between estimation and actual number is observed

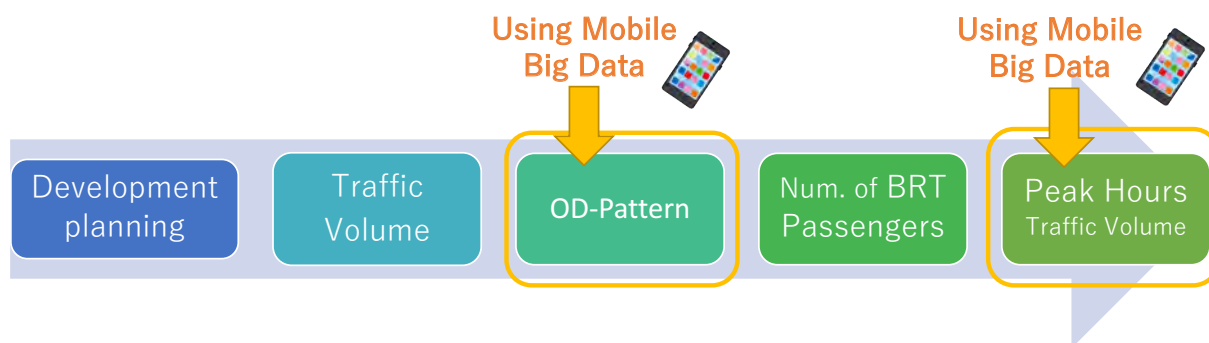**Comparison between estimation and actual number (TX user)**

Case2. BRT(Bus Rapid Transit) in Tokyo Metropolitan Area

- Large scale development of coastal area Olympic Games held
- Changes in migration of a large number of residents and tourism movements

2008 Survey → **2017** Estimation → **2023** BRT Open

It is difficult to estimate traffic demand after development from existing statistics

Grasp characteristics such as visitor's origin and destination time by attracting facility using mobile big data

Implementation of detailed Transportation plan by BRT demand Estimation

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What is possible using Mobile Big Data

Using Mobile Big Data

Using Mobile Big Data

| Development planning | Traffic Volume | OD-Pattern | Num. of BRT Passengers | Peak Hours Traffic Volume |

It became possible to predict time-dependent traffic demand by bus stop

- It became possible to estimate the number of traffic origin and destination for each attracting facility
- Demand forecast for short distance transportation like BRT which was difficult until now became possible
- High sample rate (about 40%) data can be used compared to survey of person trip (3% sample rate)

Case 3 : AI Taxi

An example of a taxi operator in Japan (Tokyo)

- Travel distance of vehicles for business use in December 2016

    Approx. 29,140,000 km

    727 trips around the equator

- Of the total, how long did the taxi cabs run with no passengers?
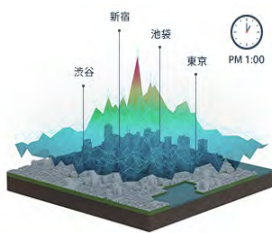
    Approx.15,540,000 km
    （53.3%）

    388 trips with no passengers
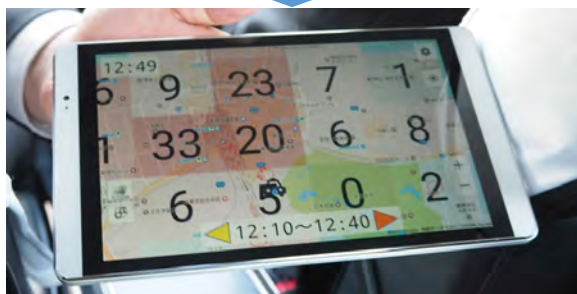

AI Taxi System and Achievements

MBD   Operation data of taxis

Autoregressive model / deep learning

↑6,723 yen/day

Average of those who introduced AI taxi

Overall average

Nov. 2016   Dec. 2016

Sales increased 49% after introducing AI taxi

3

Sample Analysis for Data of Transerco, Vietnam

Sample analysis for sample data of Transerco

We challenged an analysis for 3 types of data provided by Transerco.

1. Bus stops

| No.	Name of bus stops	Short Name	Longitude	Latitude
1	Đối diện KCN Quang Minh (Melinh Palaza) - Km 8+100 Cao tốc BTL-NB	Khu công nghiệp ng Minh	105.78053	21.185933
2	Nhà máy tấm lợp VitMetal- Km 8+850 Cao tốc BTL-NB	Tổ 7 Thị Trấn ng Minh	105.78073	21.192593
3	Soát vé cao tốc Bắc Thăng Long - Km 10+230 Cao tốc BTL-NB	Trạm soát vé Bắc Thăng Long	105.77978	21.205018

2. Route

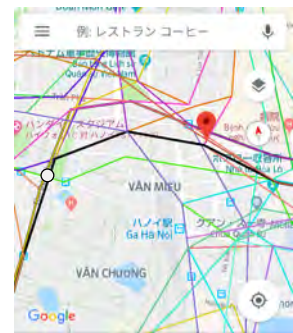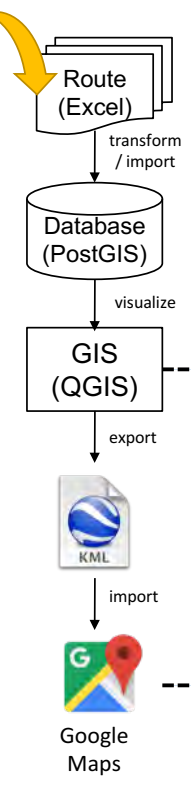| Line	Direction	Name of Bus Stops	No.	Longitude	Latitude
1	1	(A) BX Gia Lâm - Tuyến 01	1	105.8785	21.048159
1	1	549 Nguyễn Văn Cừ (cột trước)	2	105.88347	21.0497
1	1	Cty Cầu 5 Thăng Long - 307 Nguyễn Văn Cừ	3	105.87528	21.04555
1	1	135 Nguyễn Văn Cừ	4	105.87045	21.042352

3. Location

- All bus on Line-2 for 1 week

for monitoring
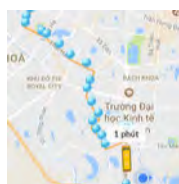
for Mobile Apps

```
00:00:30,105.74678,20.950567,0,0,1,0,1,0,km(0),vbgt(0)
00:01:07,105.746735,20.950569,0,0,0,1,0,0,km(0),vbgt(0)
00:01:37,105.746727,20.950565,0,0,0,1,0,0,km(0),vbgt(0)
00:02:07,105.746712,20.950563,0,0,0,1,0,0,km(0),vbgt(0)
00:02:37,105.746704,20.95056,0,0,0,1,0,0,km(0),vbgt(0)
00:03:07,105.746696,20.950558,0,0,0,1,0,0,km(0),vbgt(0)
00:03:37,105.746696,20.950556,0,0,0,1,0,0,km(0),vbgt(0)
00:04:07,105.746688,20.950556,0,0,0,1,0,0,km(0),vbgt(0)
```
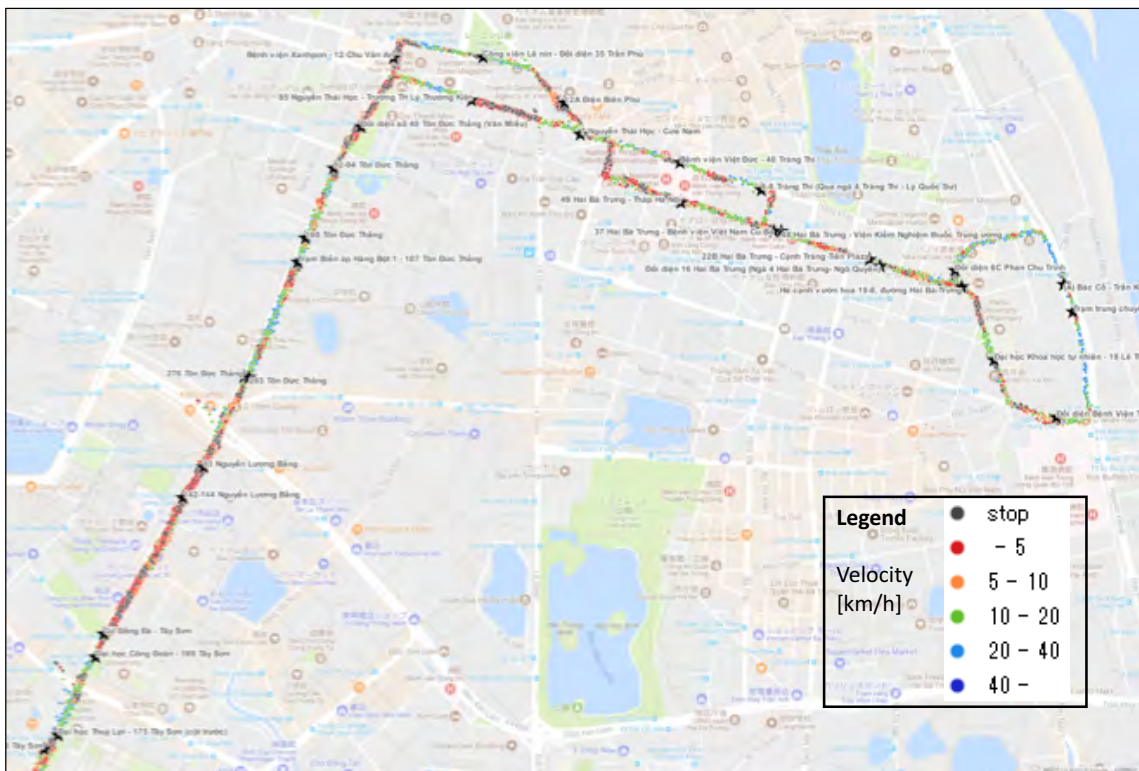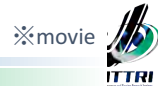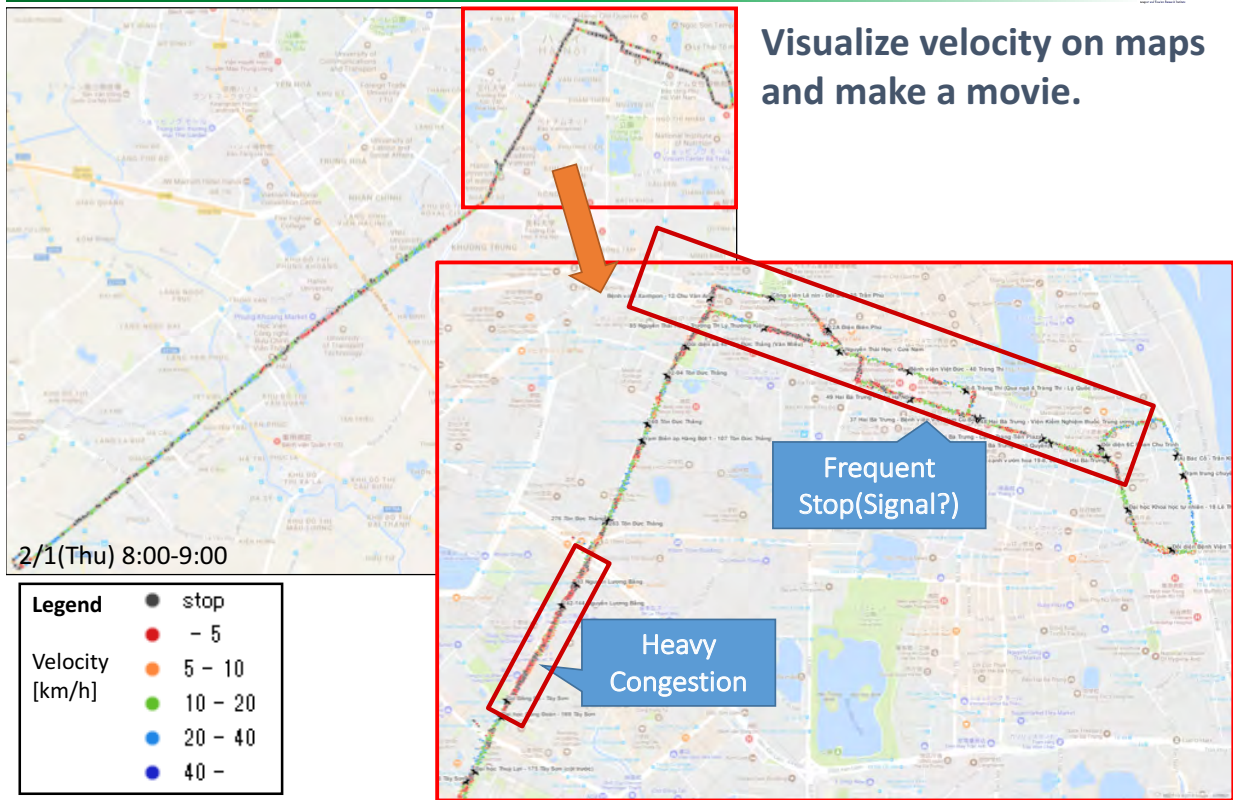
Time (hou

Longitude

Latitude

Route MAP

Existing

- Where is Line-2?
- Where am I now?
- Vietnamese only…
- Paper on a board…

Route (Excel)

transform / import

Database (PostGIS)

visualize

GIS (QGIS)

export

KML

import

Google Maps

We share the route map during visits!

Hanoi Bus Velocity (01st Feburary 2018)

※movie

Legend

Velocity [km/h]

stop	
– 5	
5 – 10	
10 – 20	
20 – 40	
40 –	

Delay analysis

Visualize velocity on maps and make a movie.

2/1(Thu) 8:00-9:00

Legend

Velocity [km/h]

stop	(black)
– 5	(red)
5 – 10	(orange)
10 – 20	(green)
20 – 40	(blue)
40 –	(dark blue)

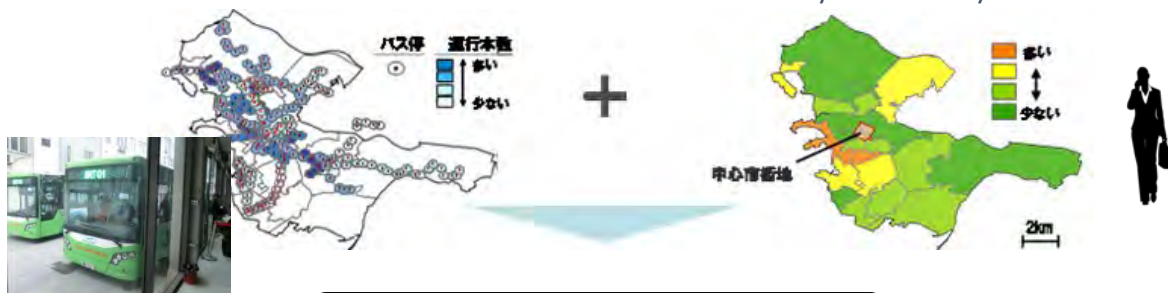Frequent Stop(Signal?)

Heavy Congestion

Proposed A New Solutions For Transportation Problem Using Mobile Phone's Big Data

At now, we can know number of bus user.

We can know number of person who do not use bus by future analysis.

+

We can identify the bus routes where traffic demand is laree

14:00   15:00   16:00

•••   •••

More effective and reasonable planning and design for bus operation than ever.

Thank you for your attention

This survey was conducted with support from the Nippon Foundation.

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About-us

Japan Transport and Tourism Research Institute is an independent, non-profit foundation established in 1968 under the auspices of Japan Ministry of Land, Infrastructure and Transport. The Institution conducts research to contribute to the formulation and proposal of new transport related policies for both domestic and international societies from the view point of answering the needs of the new socio-economic environment in and around Japan. The research is based on scientific knowledge and approach while the research projects undertaken concern policy issues relevant to actual social needs. The results of the studies are intended to be practical and easily understood by those parties and individuals at the front-line of transport administration and transport business.

The Research and Consulting Office conducts research that forms the basis of comprehensive policymaking aimed at tackling various transport problems. Its main activities revolve around research on topics entrusted to it by the central governments, local governments, and various organizations. The results of its research are applied as basic data by the transport sector, general industrial sectors, and public offices. The Office also cooperates with research undertakings in various fields by providing individualized information and resources.

Contact

The Japan Transport and Tourism Research Institute,
The Research and Consulting Office

Web   http://www.jterc.or.jp/eng/index.html
E-mail   muroi@jterc.or.jp

3-18-19 Toranomon,Minato-ku,Tokyo,105-0001,Japan
TEL +81-3-5470-8400
FAX +81-3-5470-8401

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