

# **Big Data for Remote Areas: The Use of Mobile Positioning Data for Measuring Tourism on the Indonesian Border**



By

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# Introduction

## 📌 Data Sources for Tourism Statistics

Main data source: Immigration Records

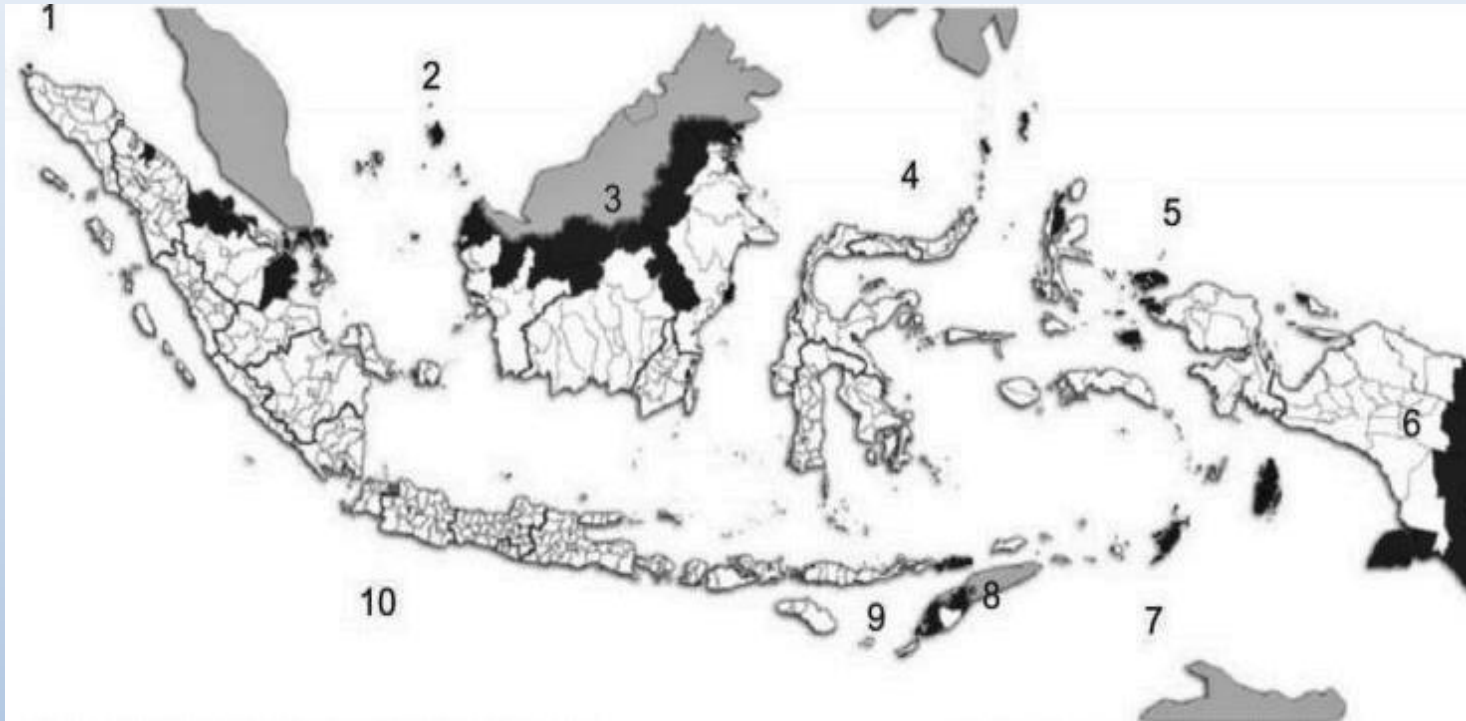
Other data source: Border (Shuttle) Survey

## 📌 Coverage (Under Coverage)

- Not all border have border gate
- Not All Border Gates have 24/7 Immigration service
- Border Survey is too expensive



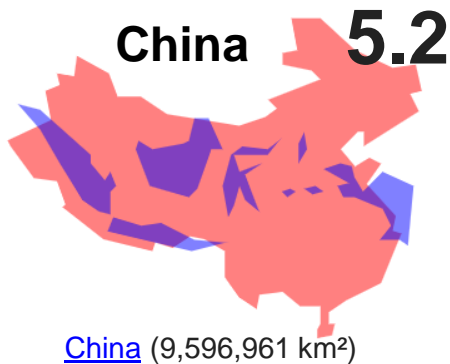
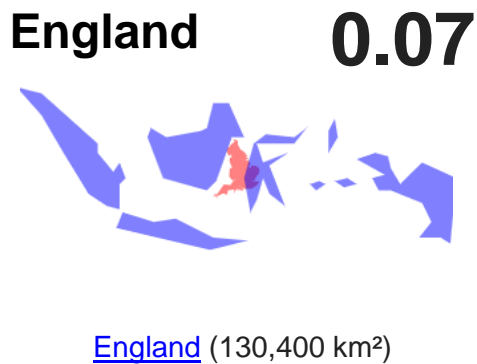
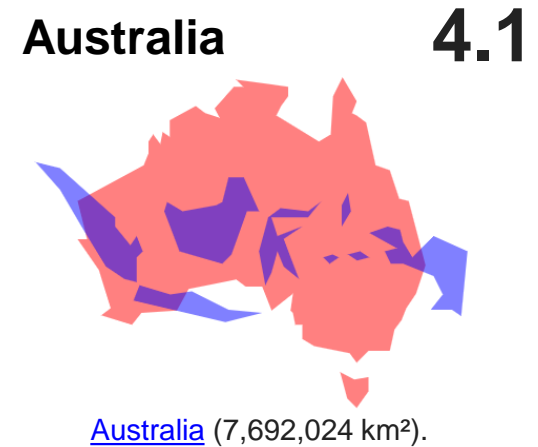
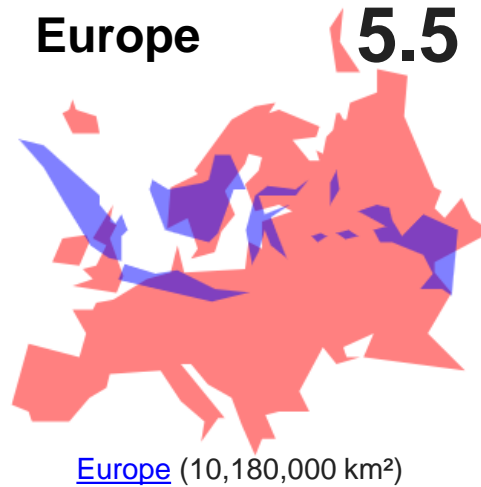
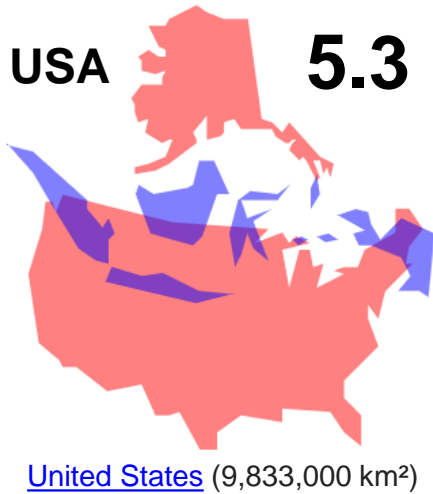
# Indonesia's Sea and Land Borders



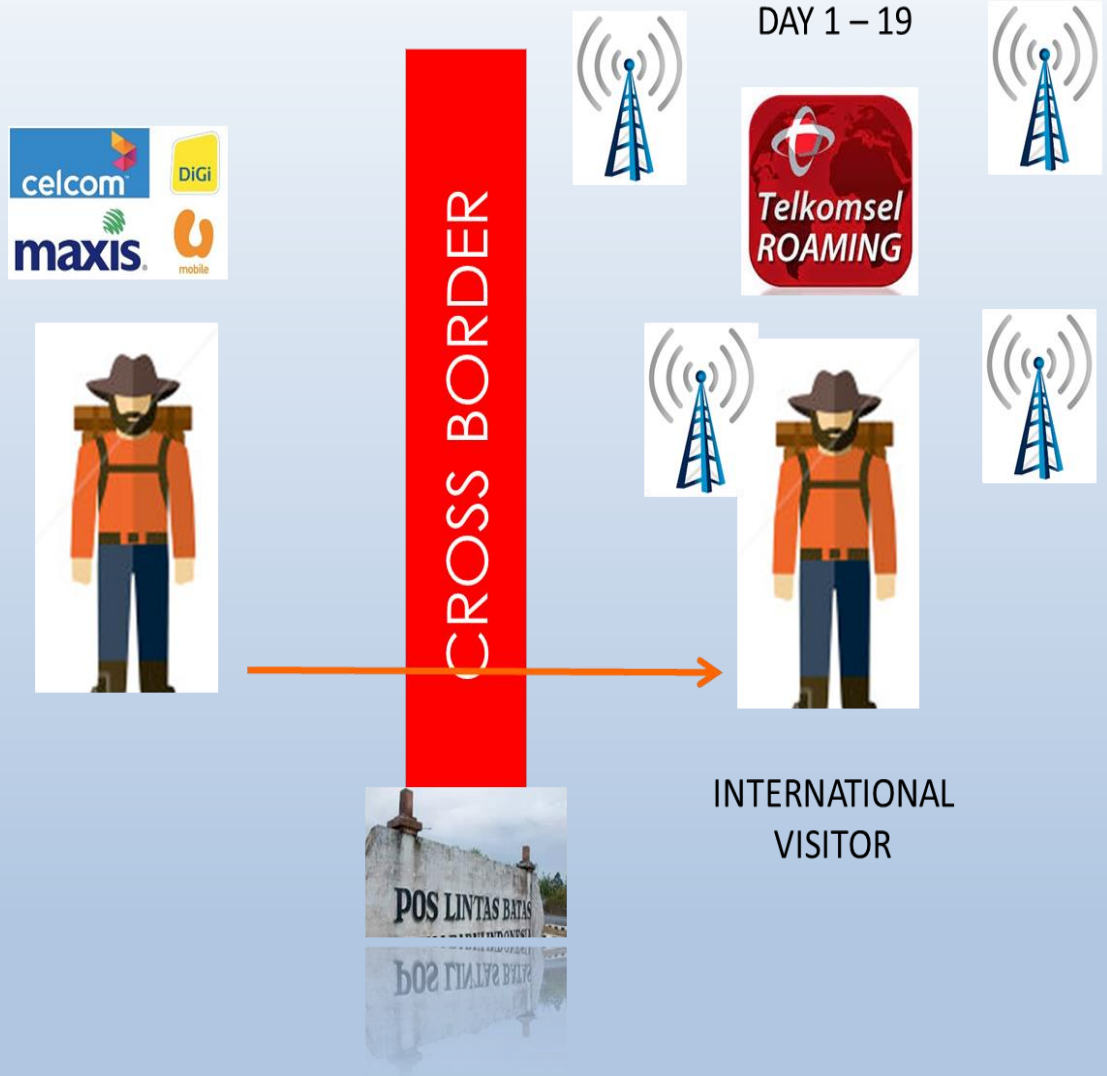
- |   |  |
|---|--|
| 1. Aceh/Sumatera Utara - Thailand/India/Malaysia                      | 6. Papua - Papua New Guinea                    |
| 2. Riau/Kepulauan Riau - Malaysia/Vietnam/Singapore                   | 7. Papua/Maluku - Australia/Timor Leste        |
| 3. Kalimantan Barat/Kalimantan Timur - Malaysia                       | 8. Nusa Tenggara Timur - Timor Leste           |
| 4. Kalimantan/Sulawesi Tenggara/Sulawesi Utara - Malaysia/Philippines | 9. Nusa Tenggara Timur - Timor Leste/Australia |
| 5. Maluku Utara/Papua Barat/Papua - Palau                             | 10. Outermost Islands - High seas              |

# Comparison: Indonesia on State/Continent

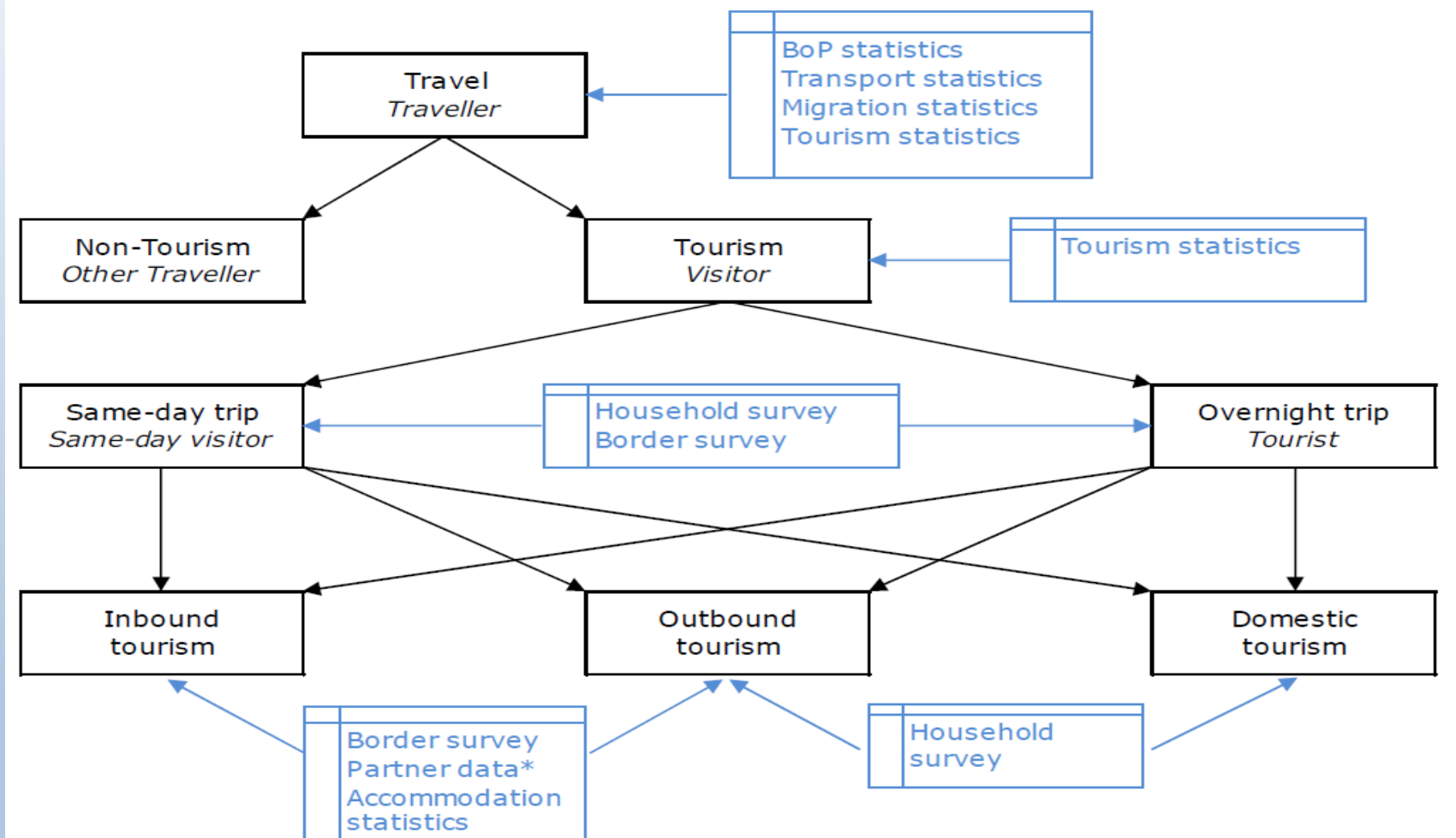
Indonesia (1,860,360 km<sup>2</sup>).



- MPD as a new Data Source
- Mobile Network Operator (MNO) record mobile phone activity 24/7
- some belong to tourists



# Linking Tourism Concepts to MPD



\* Other countries' outbound or inbound tourism data

# The Use of Mobile Positioning Data for Tourism in Indonesia

- Implement MPD Data since October 2016.
- Data provided by MNO → aggregate table.
- Oct-Dec 2016 : MPD was applied to 19 districts, since January 2017 became **25 districts**.
- Filtering using 7/20 formula (until Dec 2017), LOS1 filter, also neighbouring countries (reg).
- **Since January 2018**, Filtering MPD has already been using a **new formula**
- Now BPS has an MoU with the biggest MNO in Indonesia, so we can have a **sandbox** to process MPD

# Cross-border Tourism out of Total

Before to MPD use

Indonesia	Estonia	Other countries
7%	60%	30-60%

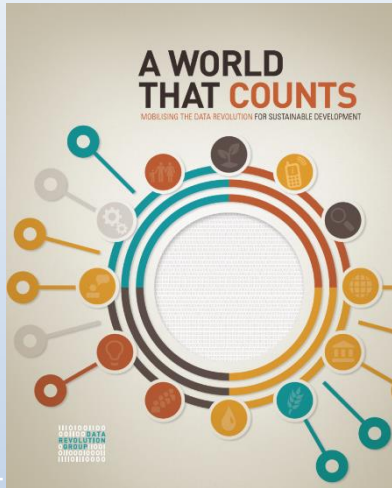
After MPD use

Indonesia	Estonia	Other countries
<del>7%</del> 30%	60%	30-60%



# Introduction

## In line with UN Recommendation “A World that Count”



### Big Data

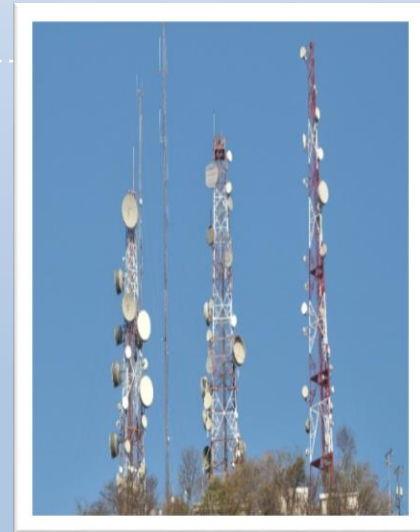
- Can be compile automatically,
- Real Time
- Less Manual Labour

## Data Revolution For Sustainable Development

The integration of these new data with traditional data to produce high-quality information that is more detailed, timely, and relevant for many purposes and users, especially to foster and monitor sustainable development.

## MPD as one of the Most Promising ICT Data Sources

To measure the mobility of people, including mobility of tourists. The digital footprint left by the users is very sensitive, but also highly valuable, as it provides new possibilities to measure and monitor the spatio-temporal activities of the population.



# Limitation of Big Data Including MPD

- Lack of Qualitative Data (such as purpose of visits, accommodation type).
- Expenditure.
- Non roamers data.

# Cross Border Survey

**We surveyed Crosser Border to find out:**

- Mobile phone Usage During Crossing Border
- Purpose of Traveling
- Expenditure
- Length of Stay



Survey was conducted in 25 Kabupaten cover 76 gates, July & October 2017

# Questionnaire



VMPD-17



**PENDATAAN WISMAN BERBASIS *MOBILE POSITIONING DATA*  
DI WILAYAH PERBATASAN INDONESIA 2017  
KEMENTERIAN PARIWISATA DAN BADAN PUSAT STATISTIK**

Lingkari atau isilah jawaban yang sesuai

Nama Pos Lintas Batas:

No. Kuesioner :

1. Nama : .....  
Umur : ..... tahun  
Jenis Kelamin : .....

2. Pekerjaan utama:

- |                          |    |                   |    |                          |
|--------------------------|----|-------------------|----|--------------------------|
| Profesional              | -1 | Ibu Rumah tangga  | -6 | <input type="checkbox"/> |
| Bisnis manager/Eksekutif | -2 | Pelajar/Mahasiswa | -7 |                          |
| Pegawai Pemerintah       | -3 | Pensiunan         | -8 |                          |
| Militer                  | -4 | Lainnya, sebutkan | -9 |                          |
| Karyawan Swasta          | -5 | (.....)           |    |                          |

3. a. Jumlah HP yang anda gunakan saat ini ..... buah  
b. Jumlah Sim Card yang anda gunakan dan aktif saat ini ..... buah

Sebutkan nama providernya:

- Sim card 1 : ..... Sim card 3 : .....  
Sim card 2 : ..... Sim card 4 : .....

4. Apa yang anda lakukan ketika di Indonesia?

- |                                     |    |                          |
|-------------------------------------|----|--------------------------|
| Menggunakan SIM Card asal (roaming) | -1 | <input type="checkbox"/> |
| Mengganti dengan Sim Card Lokal     | -2 |                          |
| Mematikan Mode Roaming              | -3 |                          |
| Mematikan HP                        | -4 |                          |

5. a. Maksud utama mengunjungi Indonesia:

- |                               |    |                        |                          |
|-------------------------------|----|------------------------|--------------------------|
| Bekerja mendapat gaji/sekolah | -1 | → STOP                 | <input type="checkbox"/> |
| Berlibur/rekreasi             | -2 | Keagamaan/ziarah       | -7                       |
| Bisnis/usaha                  | -3 | Kesehatan & kecantikan | -8                       |
| Dinas                         | -4 | Pendidikan/Pelatihan   | -9                       |
| Mengunjungi teman/keluarga    | -5 | Misi OR/budaya         | -10                      |
| MICE/rapat                    | -6 | Lainnya, sebutkan:     | -11                      |
|                               |    | (.....)                |                          |

b. Rencana lama tinggal di Indonesia ..... hari ☐

6. Frekuensi mengunjungi Indonesia dalam satu bulan terakhir:

- |                 |    |                |    |                          |
|-----------------|----|----------------|----|--------------------------|
| Setiap hari     | -1 | Sebulan sekali | -3 | <input type="checkbox"/> |
| Seminggu sekali | -2 | Tidak tentu    | -4 |                          |

7. Negara tempat tinggal .....

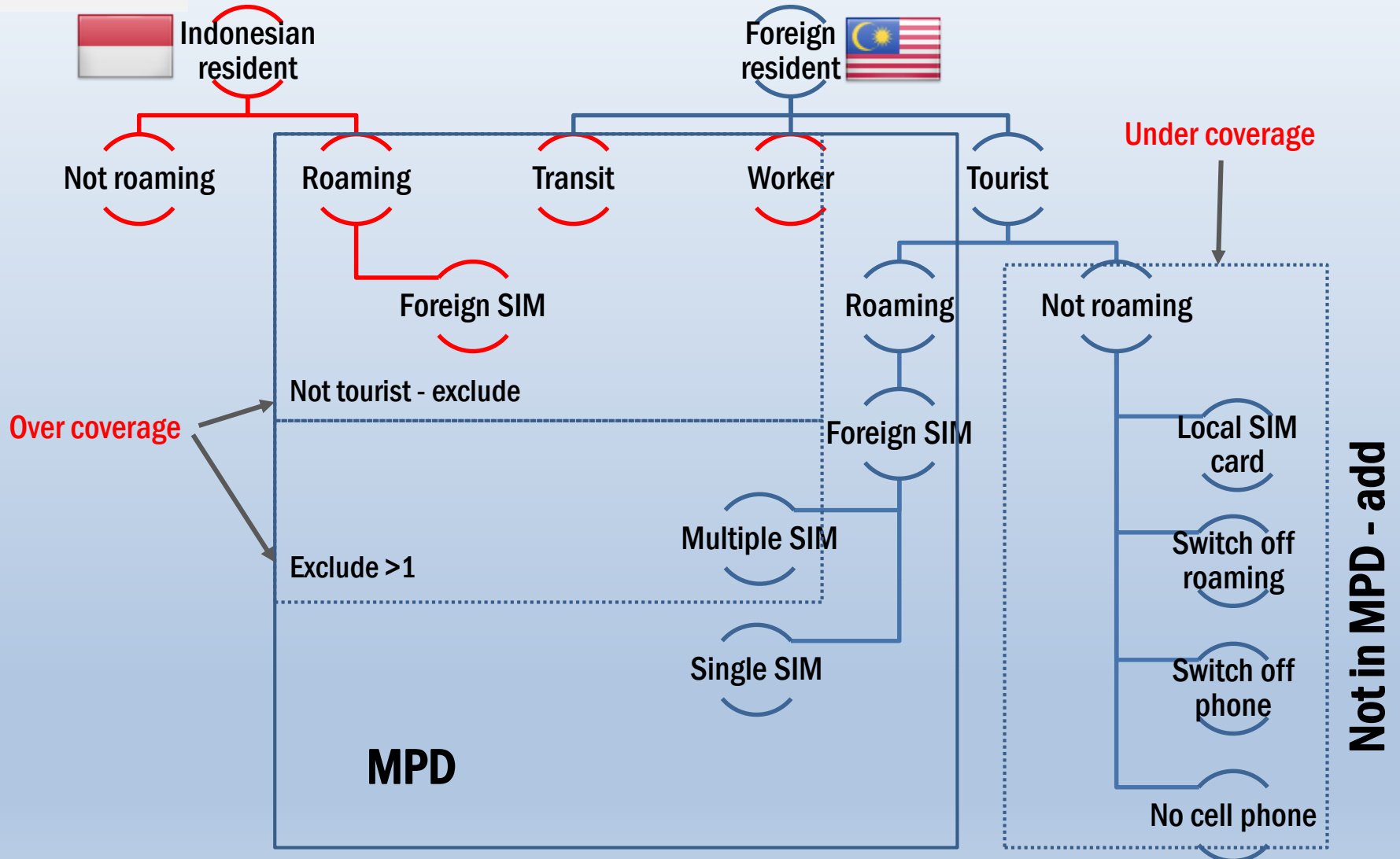
8. Kewarganegaraan .....

9. Berapa uang yang akan dibelanjakan di Indonesia?

- Mata uang : .....  
Nilai : .....

10. Dalam perjalanan ini, dari pintu mana anda masuk ke Indonesia .....

# What is MPD? Data Over- and Undercoverage

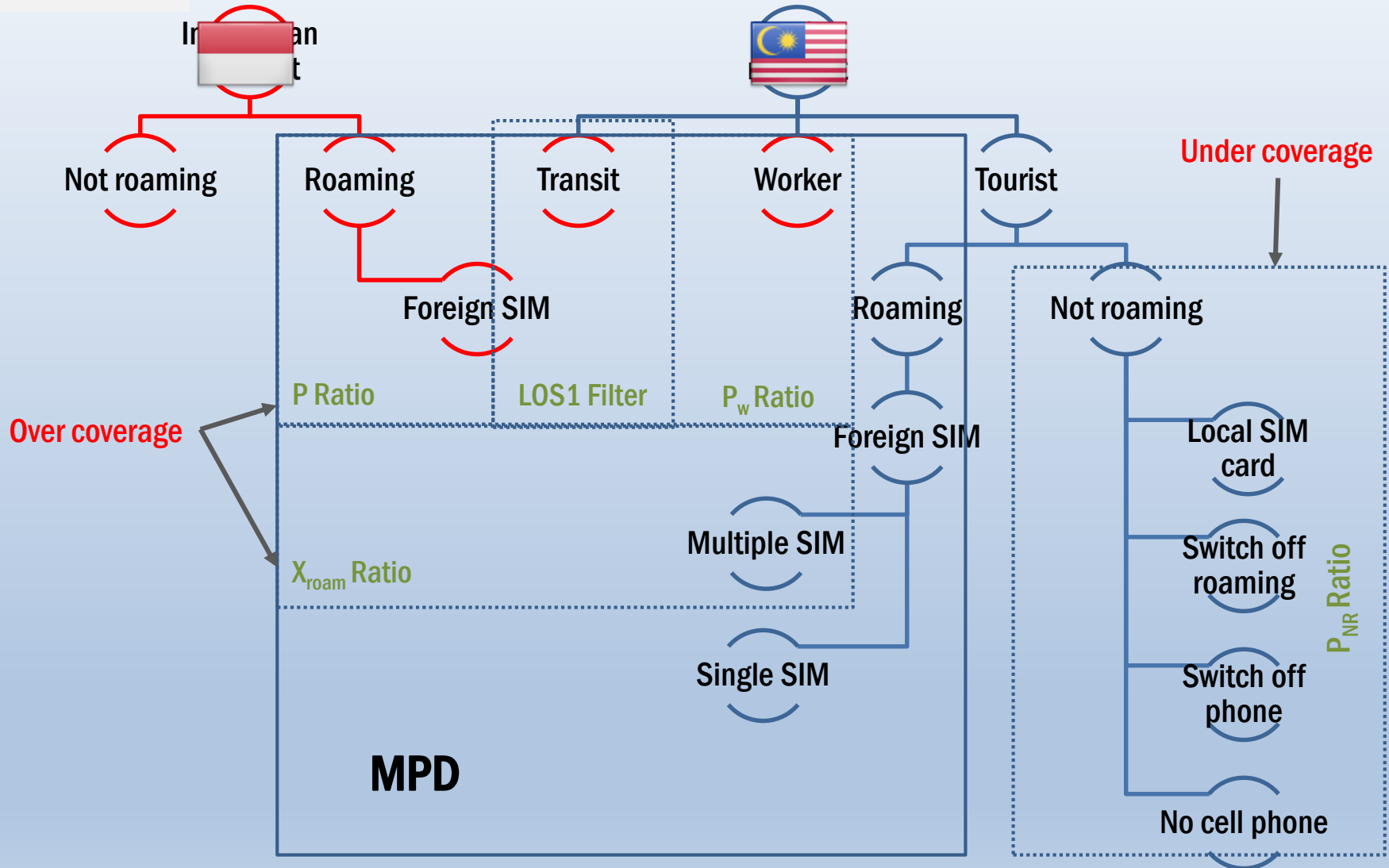


# Formula for Additional Tourism

$$AT = \frac{MPD}{X_{roam}} \times P \times (1 - P_w) \times \frac{1}{1 - P_{NR}} - WCI$$

- $AT$  = Additional Tourism
- $MPD$  = Number of SIM cards detected by MNO (Telkomsel) in the border area
- $X_{roam}$  = The ratio of foreign SIM cards per person that actively roaming;
- $P$  = The ratio of foreign residents with foreign SIM cards to total number of foreign SIM cards;
- $P_w$  = The ratio of foreign residents with foreign SIM card that come for work to total number of foreign residents with foreign SIM cards;
- $P_{NR}$  = The ratio of foreign residents with foreign SIM cards who turn off their phone, roaming or switch to local SIM card to total number of foreign residents with foreign SIM cards.
- $WCI$  = Number of tourists entering through Immigration Post

# What is MPD? Data Over- and Under coverage





# Empirical Study

Ratio for the formula based on mobile usage survey result

Regency	Xroam	P	1-Pw	1/(1-Pnr)	Result
	Proportion of active roaming SIM cards	Proportion of foreign residents	Proportion who do not come for the purpose of work	Proportion of non-roamers	Final coefficient as a product of all ratios
BELU	0,83	0,88	0,96	1,12	0,78
BENGKALIS	0,98	1,00	1,00	1,10	1,08
BENGKAYANG	0,91	0,54	0,91	1,08	0,48
BOVEN DIGOEL	0,92	1,00	1,00	2,80	2,58
KAPUAS HULU	0,99	0,48	0,98	1,10	0,51
KARIMUN	0,84	1,00	0,95	1,06	0,85
KEEROM	1,00	1,00	1,00	2,01	2,01
KUPANG	0,94	0,90	1,00	1,52	1,28
LINGGA	1,00	1,00	1,00	1,00	1,00
MALAKA	0,91	0,89	0,98	1,19	0,94
NUNUKAN	0,94	0,80	0,98	1,06	0,78
PEGUNUNGAN BINTANG	0,85	1,00	0,94	2,79	2,23
SAMBAS	0,94	0,97	0,97	1,20	1,04
SANGGAU	0,94	0,68	0,89	1,03	0,58
SANGIHE	1,00	0,85	0,96	2,80	2,29
SINTANG	0,85	0,60	1,00	1,24	0,63
TALAUD	1,00	1,00	1,00	2,00	2,00
TIMOR TENGAH UTARA	0,75	0,81	0,97	1,19	0,71
MERAUKE	0,92	1,00	1,00	2,80	2,58
JAYAPURA	1,00	1,00	1,00	2,01	2,01

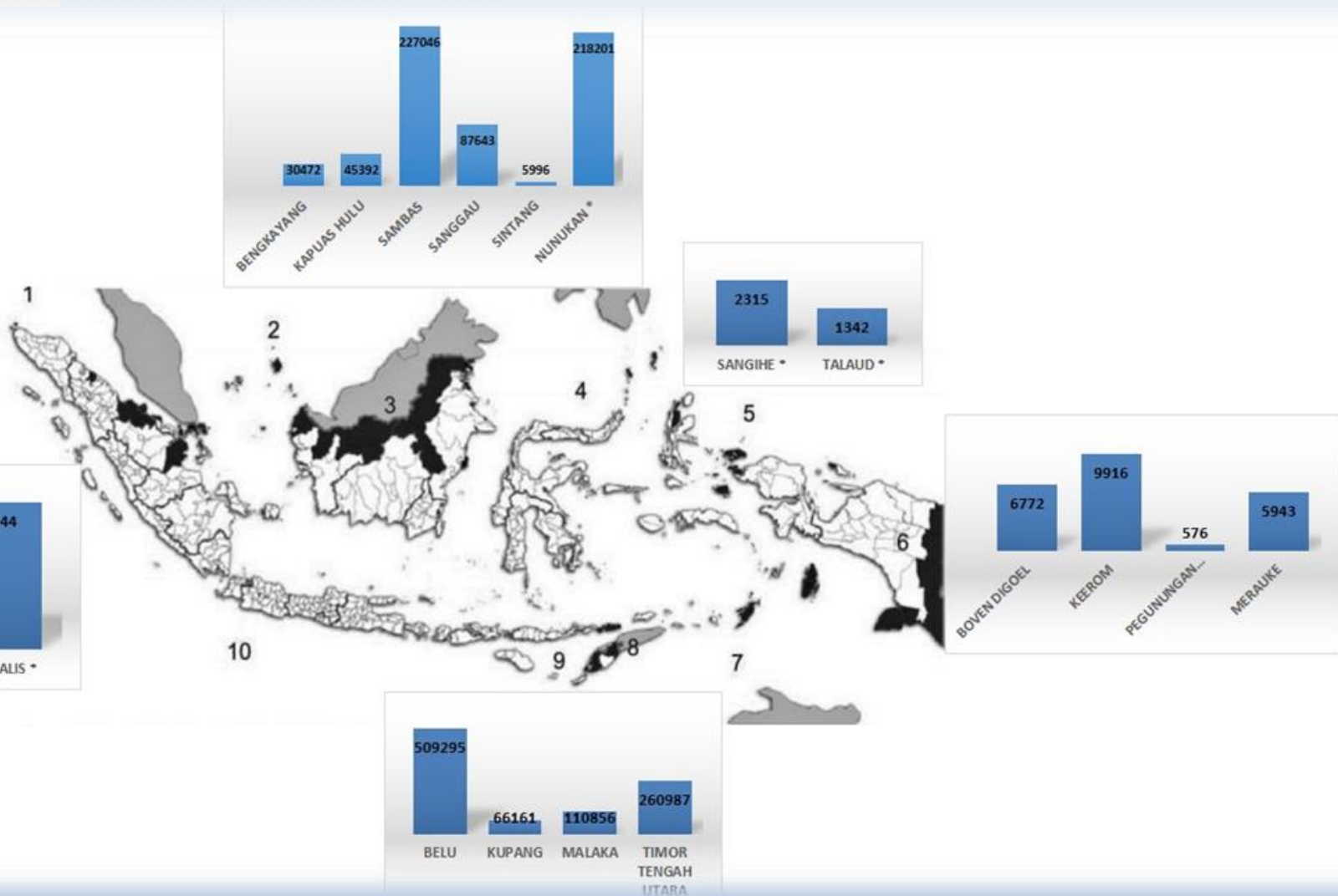
Result

=

Final coefficient as a product of all ratios



## Number of additional Tourists Jan-July 2018



Number of additional tourism in border area prove that use the MPD capture significantly and increase the coverage of inbound tourism in Indonesia.

# Lesson Learnt

MPD is useful, it gives more accurate and coverage compare to cross border survey. However, there also limitation of MPD.

Survey is also useful to obtain ground truth and qualitative and quantitative data that can not be obtain from MPD

So, there is no data source that is superior to other data source. All of data source could complete each other

# Conclusion

- 1 Combining mobile positioning data (big data) and survey (small data) provide the best result



MPD



survey

- 2 Propose formula for additional tourism

$$AT = \frac{MPD}{X_{roam}} \times P \times (1 - P_w) \times \frac{1}{1 - P_{NR}} - WCI$$

- 3 In the future, we will replace some ratios with algorithms to counter bias at the raw data level

# Thank You

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