



Home and Work Identification Process Using Mobile Positioning Data

September, 27th 2021



Nowadays, mobile phones is a basic needs

JAN 2019

INDONESIA

THE ESSENTIAL HEADLINE DATA YOU NEED TO UNDERSTAND MOBILE, INTERNET, AND SOCIAL MEDIA USE



TOTAL POPULATION



268.2
MILLION

URBANISATION:
56%

MOBILE SUBSCRIPTIONS



355.5
MILLION

vs. POPULATION:
133%

INTERNET USERS



150.0
MILLION

PENETRATION:
56%

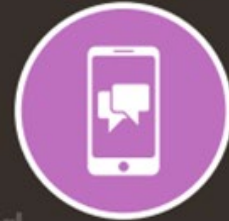
ACTIVE SOCIAL MEDIA USERS



150.0
MILLION

PENETRATION:
56%

MOBILE SOCIAL MEDIA USERS

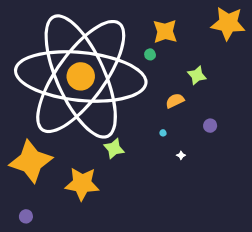


130.0
MILLION

PENETRATION:
48%

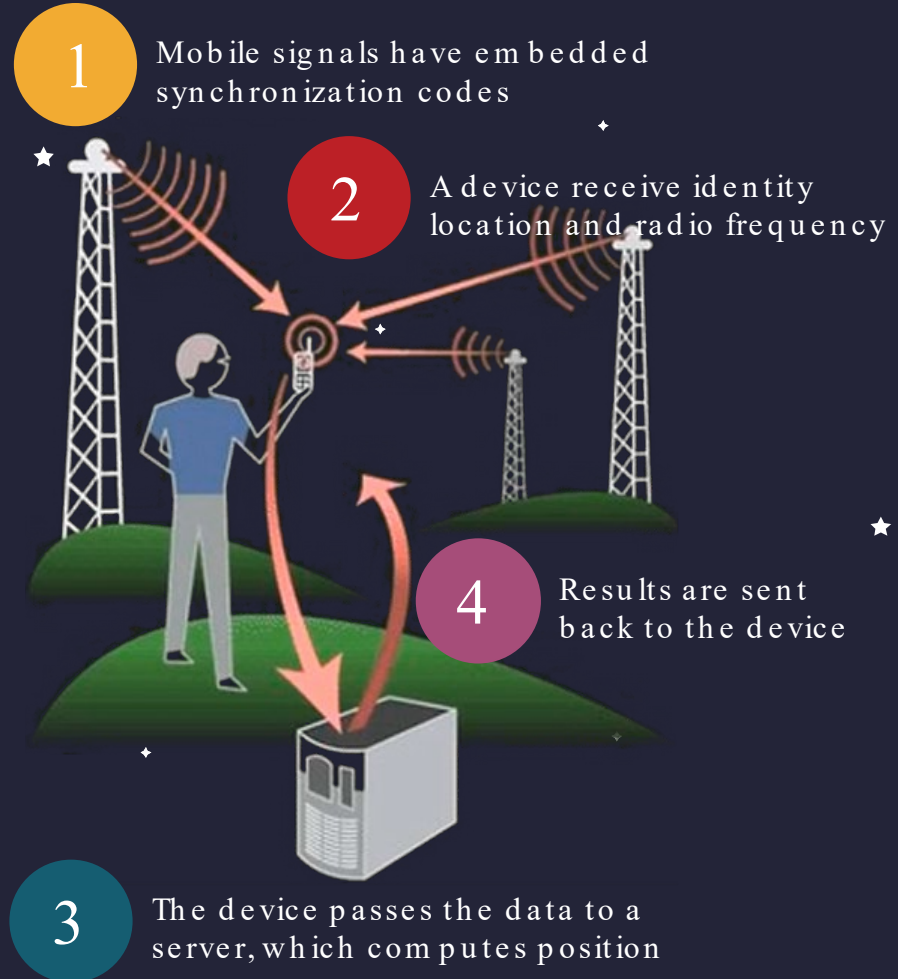
we are social

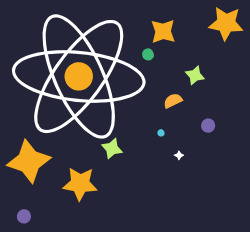
we are social



How cellular technology works

Every transaction leaves a log, and these logs create datasets





Data Sandboxing

Developer sandbox is isolated environment for experiments with untested code. BPS got the access for the sandboxing environment from **mobile network operator (MNO)** through virtual private network (VPN).

Big data sandboxes are where you develop the all -important intellectual property - advanced analytic models - that extract intelligence from otherwise inchoate gobs of content.

Source : <https://www.ibmbigdatahub.com/blog/data-scientists-how-big-your-big-data-sandbox>



Mobile Phone Log Dataset Example

msisdn	datetime	source	lat	lon
bscjgug54a	20171202171409	LBA_ALL	-6.24839	106.9108
bscjgug54a	20171202211454	LBA_ALL	-6.24839	106.9108
bscjgug54a	20171203011443	CHG_POST	-6.24511	106.9055



msisdn

Hashed MSISDN



Source

Type of data stored (CDR, signalling)



Datetime

Transaction timestamp



Lat & Lon

BTS coordinates



Coordinate (Lon, Lat) matching to Local Administrative Units (LAU) Master

msisdn char	datetime timestamp	source char	bts_lat char	bts_lon char	prov char	kab char	kec char	desa char	trx_date date
6281 ...	2018-02-08 13:33:03	LBA_ALL	-4.54691	120.35833	SULAWESI SELATAN	BONE	TANETTE	CELLU	2018-02-08
6281 ...	2018-02-08 13:51:39	CHG_POST	-4.54051	120.30777	SULAWESI SELATAN	BONE	TANETTE	MACANANG	2018-02-08
6281 ...	2018-02-08 14:00:39	CHG_POST	-4.53591	120.30377	SULAWESI SELATAN	BONE	TANETTE	MACANANG	2018-02-08



Data Cleansing

lat	lon
-6.24839	106.9108
-6.24839	106.9108
-6.24511	106.9055

Using coordinate data, we can measure distances of origin and destination

datetime
20171202171409
20171202211454
20171203011443

Using latitude longitude data, we can measure distances of origin and destination



Fast Movers



Overlapping Stays



Resetting stays at midnight



Faulty stay locations



Pattern of Mobility

propinsi	kabupaten	kecamatan	kelurahan
DKI JAKARTA	JAKARTA TIMUR	MAKASSAR	CIPINANG MELAYU
DKI JAKARTA	JAKARTA TIMUR	MAKASSAR	CIPINANG MELAYU
DKI JAKARTA	JAKARTA TIMUR	DUREN SAWIT	PONDOK BAMBU

Using LAU, we can know the movements between regions.

1

Travel refers to the activity of someone who moves between different geographic locations for any purpose and any duration

2

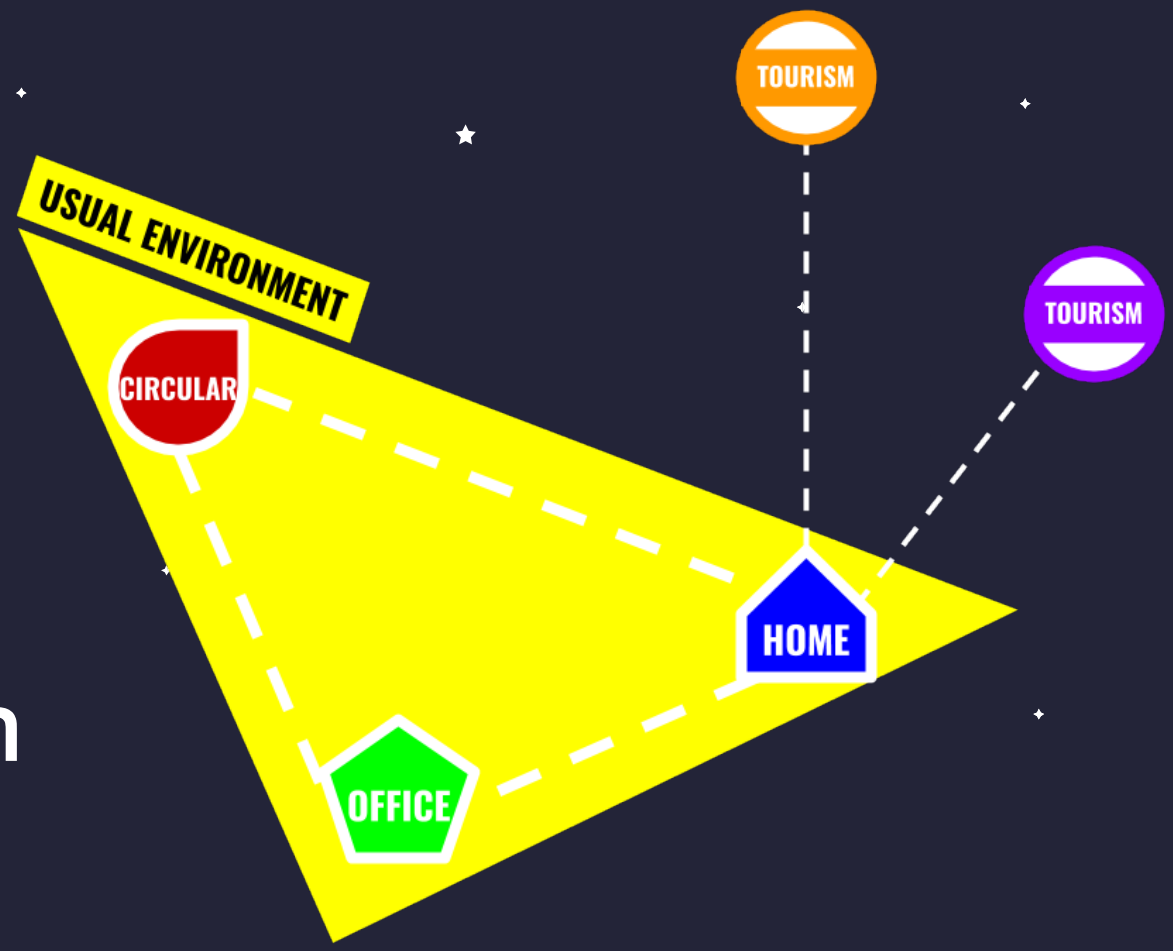
Group of travel to various places produce a trip

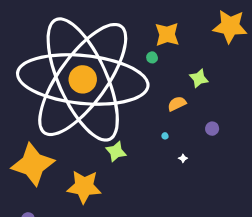
3

A trip is defined as the travel by a person from the time of departure from his usual environment until he returns



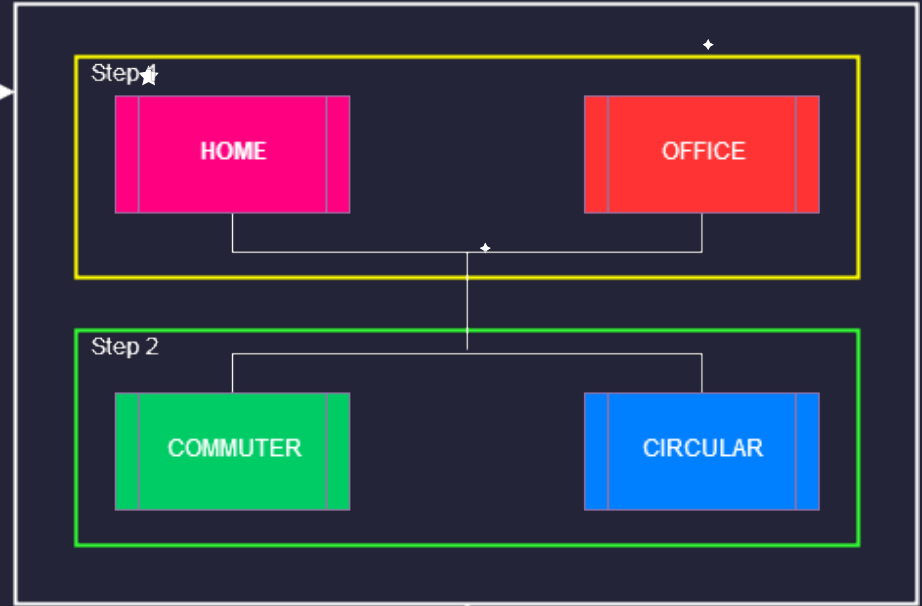
Origin Destination Model





Staypoint

USUAL ENVIRONMENT



Domestic Tourism

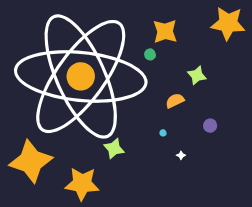
Calculation Flow



Accuracy

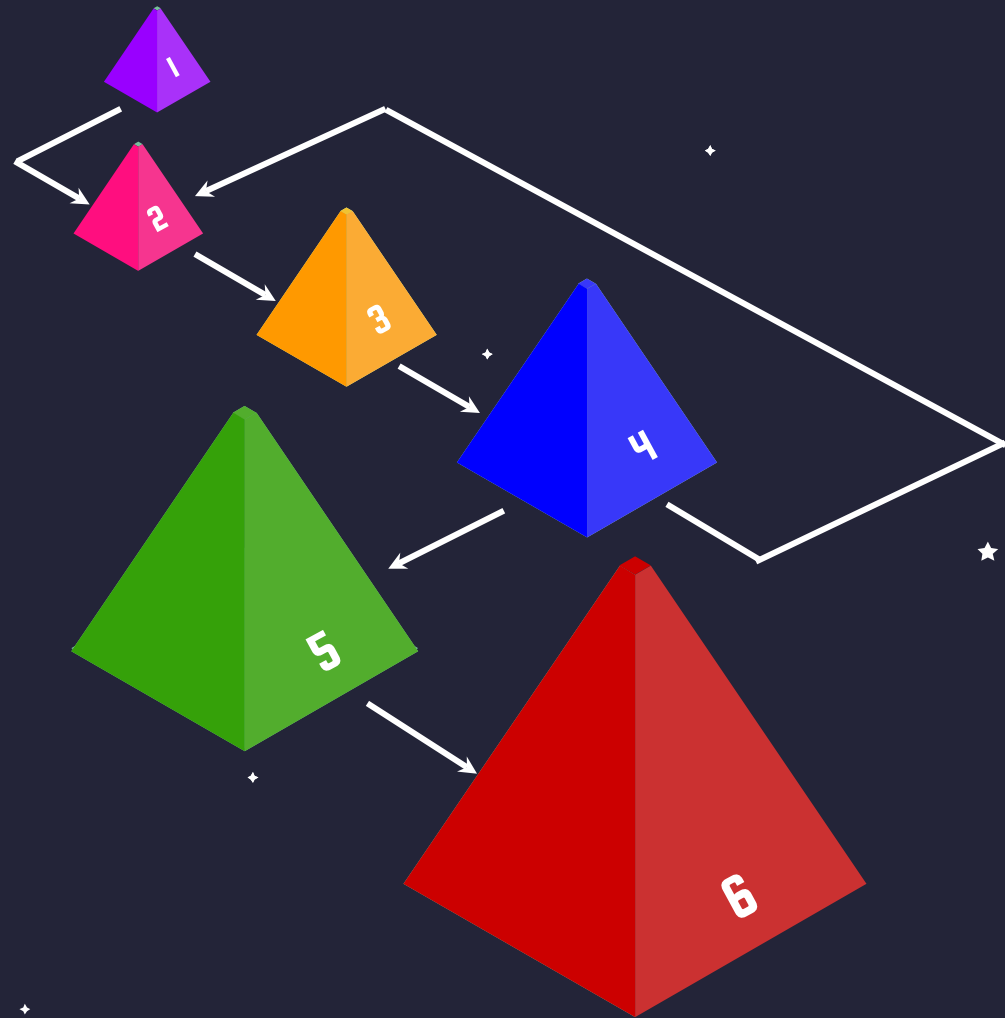
the quality or state of being correct
or precise of a trip





Algorithm Development Cycle

1. Data Exploration
2. Develop Algorithm
3. Implementation
4. Validate
5. Improve Algorithm
6. Results





65
volunteers



Characteristics of 65 volunteers

- Statistics Indonesia's Officer
- Telkomsel subscriber
- Traveling outside their home district
in December 2017 - Maret 2018 period
- Sign the consent form for personal data access





Consent Form

PERNYATAAN PERSETUJUAN

YANG BERTANDA TANGAN DI BAWAH INI, SAYA SEBAGAI PELANGGAN TELKOMSEL MENYETUJUI SYARAT DAN KETENTUAN DI BAWAH INI TERKAIT DENGAN PENGGUNAAN DATA PADA ANALISIS POLA MOBILITAS WISATAWAN NUSANTARA YANG DISELENGGARAKAN OLEH TELKOM GROUP (TELKOMSEL) DAN BADAN PUSAT STATISTIK.

1. Saya dengan ini mengetahui, menyetujui, dan memahami bahwa Telkomsel yang bekerja sama dengan Badan Pusat Statistik akan melakukan pengolahan data/informasi saya yang berada di Telkomsel sebagai bagian dari proses analisis mobilitas wisatawan nusantara.
2. Saya akan membebaskan Telkomsel yang bekerja sama dengan Badan Pusat Statistik dari segala tuntutan atas hasil analisis data/informasi yang dilakukan terhadap data saya.
3. Apabila terdapat pengolahan, penyimpanan, pengiriman, penyebarluasan data selain data-data/informasi tersebut dan/atau penggunaannya selain untuk keperluan proses analisis pola mobilitas wisatawan nusantara, saya mengetahui dan dapat dipastikan bahwa tindakan tersebut bukan merupakan tindakan yang dilakukan oleh Telkomsel yang bekerjasama dengan Badan Pusat Statistik, kecuali tindakan tersebut secara tegas disetujui oleh saya, saya dengan ini membebaskan Telkomsel dan/atau Badan Pusat Statistik atas kerugian apapun yang dialami oleh saya sehubungan dengan penyalahgunaan data dan/atau pelanggaran kerahasiaan data tersebut.
4. Dengan menandatangani flyer/dokumen ini, saya menyetujui ketentuan-ketentuan yang ada pada Syarat & Ketentuan ini.

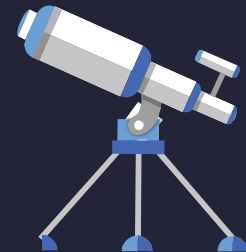
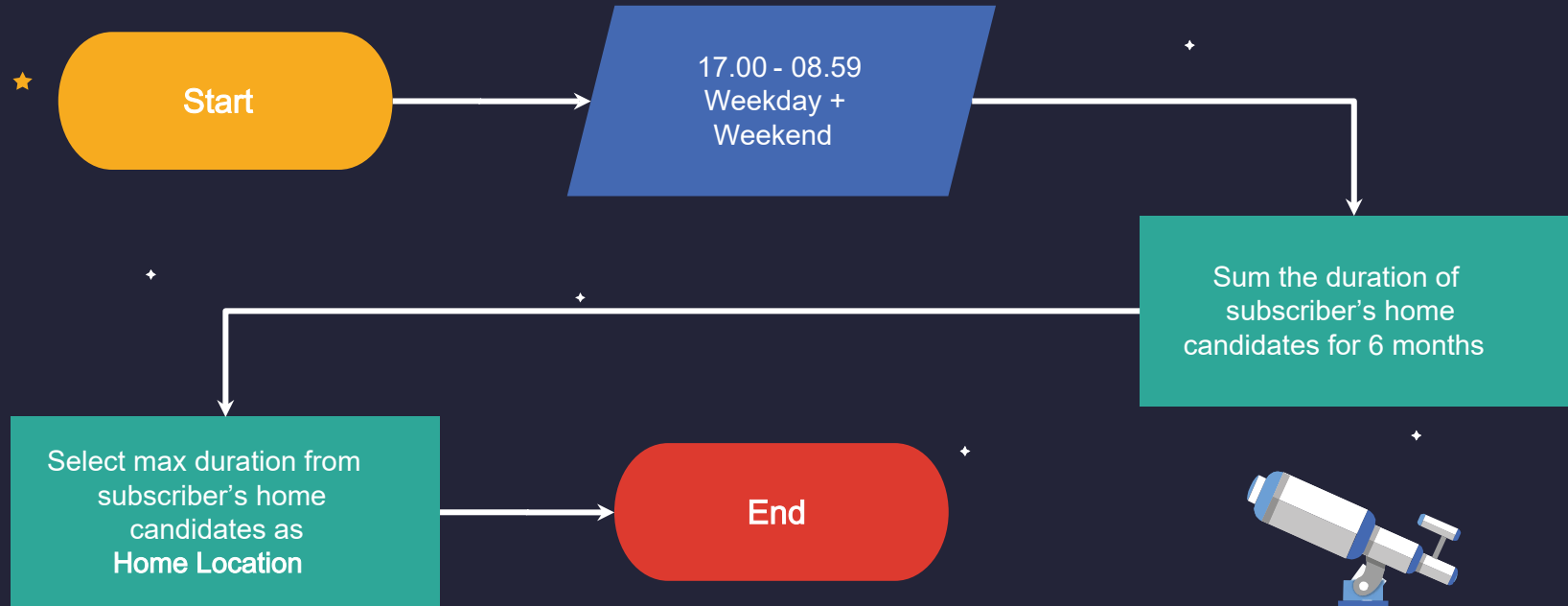
Materai
Rp 6000

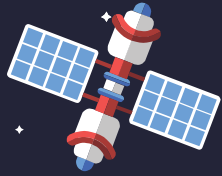
Nama & TTD Pemohon

Nomor Telkomsel : _____

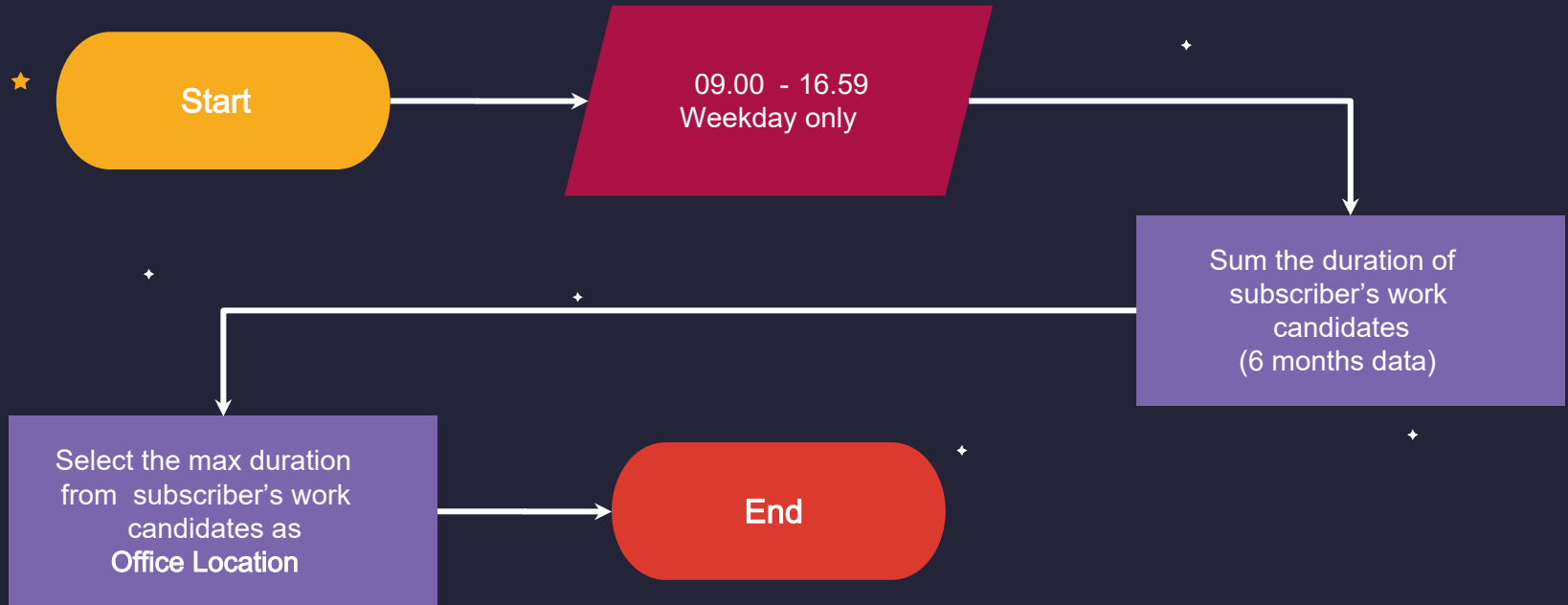


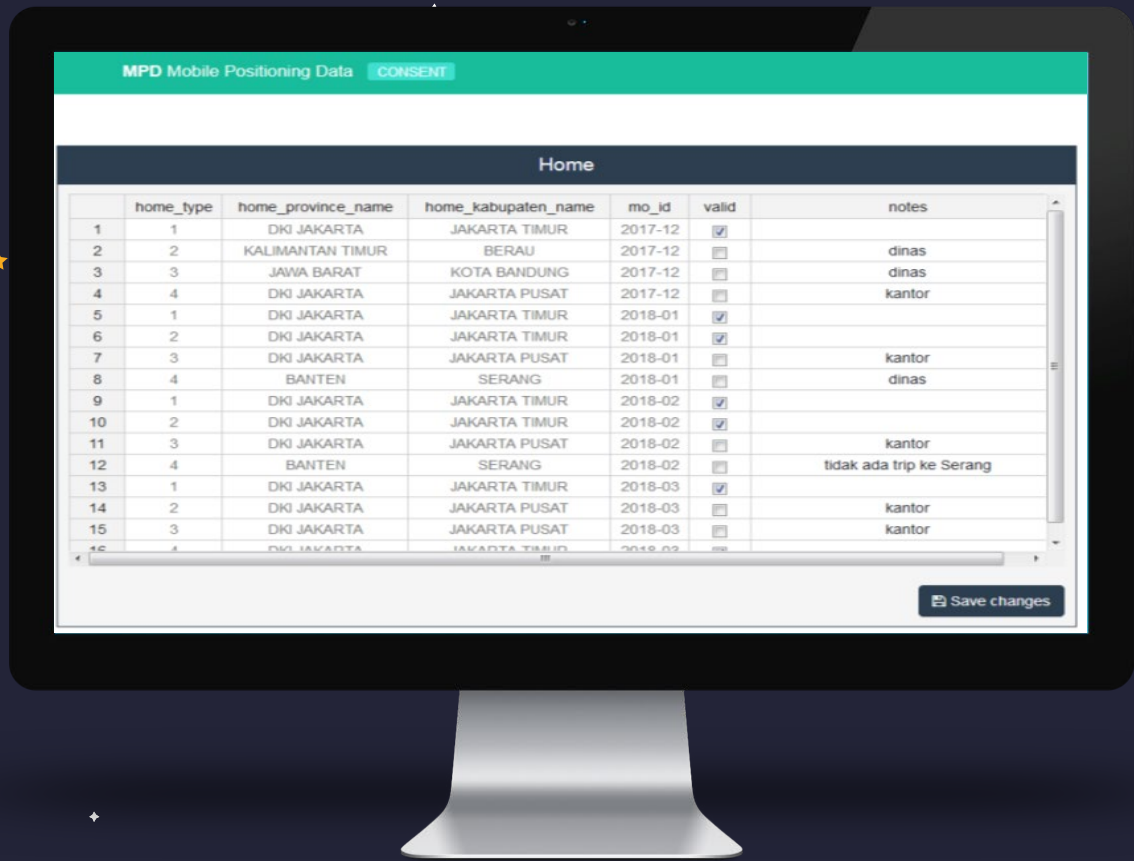
Home Determination





Office Determination





Validate Home



Validate Office

MPD Mobile Positioning Data **CONSENT**

Logout (628111012582)

Work

	work_type	work_province_name	work_kabupaten_name	mo_id	valid	notes
1	1	KALIMANTAN TIMUR	BERAU	2017-12	<input type="checkbox"/>	dinas
2	2	JAWA BARAT	KOTA BANDUNG	2017-12	<input type="checkbox"/>	dinas
3	3	DKI JAKARTA	JAKARTA TIMUR	2017-12	<input type="checkbox"/>	rumah
4	4	DKI JAKARTA	JAKARTA PUSAT	2017-12	<input checked="" type="checkbox"/>	
5	1	DKI JAKARTA	JAKARTA TIMUR	2018-01	<input type="checkbox"/>	dinas
6	2	BANTEN	SERANG	2018-01	<input type="checkbox"/>	dinas
7	3	DKI JAKARTA	JAKARTA PUSAT	2018-01	<input checked="" type="checkbox"/>	
8	4	DKI JAKARTA	JAKARTA TIMUR	2018-01	<input type="checkbox"/>	rumah
9	1	DKI JAKARTA	JAKARTA TIMUR	2018-02	<input type="checkbox"/>	rumah
10	2	DKI JAKARTA	JAKARTA PUSAT	2018-02	<input checked="" type="checkbox"/>	
11	3	BANTEN	KOTA TANGERANG	2018-02	<input type="checkbox"/>	tidak ada trip ke Tangerang
12	4	DKI JAKARTA	JAKARTA TIMUR	2018-02	<input type="checkbox"/>	rumah
13	1	DKI JAKARTA	JAKARTA TIMUR	2018-03	<input type="checkbox"/>	rumah
14	2	DKI JAKARTA	JAKARTA PUSAT	2018-03	<input checked="" type="checkbox"/>	
15	3	DKI JAKARTA	JAKARTA TIMUR	2018-03	<input type="checkbox"/>	rumah
16	4	DKI JAKARTA	JAKARTA PUSAT	2018-03	<input checked="" type="checkbox"/>	

Save changes

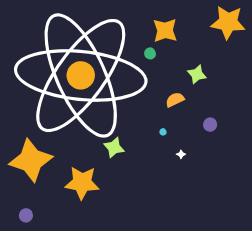
Staypoint

	tanggal_lokasi	waktu_mulai	waktu_selesai	provinsi	kabupaten	kecamatan	valid	notes
1	2017-12-02	2017-12-02T17:14:00Z	2017-12-02T23:59:50Z	DKI_JAKARTA	JAKARTA_TIMUR	MAKASAR	<input type="checkbox"/>	
2	2017-12-03	2017-12-03T01:14:43Z	2017-12-03T23:37:19Z	DKI_JAKARTA	JAKARTA_TIMUR	DUREN_SAWIT	<input type="checkbox"/>	
3	2017-12-04	2017-12-04T19:08:57Z	2017-12-04T23:59:50Z	JAWA_BARAT	KOTA_BANDUNG	COBLONG	<input type="checkbox"/>	
4	2017-12-05	2017-12-05T15:00:20Z	2017-12-05T23:59:50Z	JAWA_BARAT	KOTA_BANDUNG	SUKASARI	<input type="checkbox"/>	
5	2017-12-06	2017-12-06T08:41:14Z	2017-12-06T16:42:48Z	JAWA_BARAT	KOTA_BANDUNG	SUKASARI	<input type="checkbox"/>	
6	2017-12-07	2017-12-07T08:29:06Z	2017-12-07T16:09:14Z	JAWA_BARAT	KOTA_BANDUNG	SUKASARI	<input type="checkbox"/>	
7	2017-12-07	2017-12-07T18:07:29Z	2017-12-07T23:59:50Z	JAWA_BARAT	KOTA_BANDUNG	SUKASARI	<input type="checkbox"/>	
8	2017-12-08	2017-12-08T13:10:32Z	2017-12-08T23:17:08Z	DKI_JAKARTA	JAKARTA_TIMUR	DUREN_SAWIT	<input type="checkbox"/>	
9	2017-12-10	2017-12-10T09:45:42Z	2017-12-10T18:07:36Z	KALIMANTAN_UTARA	NUNUKAN	SEBATIK	<input type="checkbox"/>	
10	2017-12-10	2017-12-10T21:31:26Z	2017-12-10T23:59:50Z	JAWA_BARAT	KOTA_BEKASI	BEKASI_BARAT	<input type="checkbox"/>	
11	2017-12-11	2017-12-11T07:34:17Z	2017-12-11T12:23:51Z	KALIMANTAN_UTARA	NUNUKAN	NUNUKAN_SELATAN	<input type="checkbox"/>	
12	2017-12-11	2017-12-11T12:24:48Z	2017-12-11T12:50:01Z	KALIMANTAN_UTARA	NUNUKAN	NUNUKAN	<input type="checkbox"/>	
13	2017-12-11	2017-12-11T20:31:10Z	2017-12-11T23:59:50Z	KALIMANTAN_TIMUR	KUTA_TIMUR	SANGGATA_SELATAN	<input type="checkbox"/>	
14	2017-12-12	2017-12-12T13:10:24Z	2017-12-12T14:26:50Z	KALIMANTAN_UTARA	NUNUKAN	SEBATIK_TIMUR	<input type="checkbox"/>	
15	2017-12-12	2017-12-12T14:56:04Z	2017-12-12T16:41:10Z	KALIMANTAN_UTARA	NUNUKAN	SEBATIK_UTARA	<input type="checkbox"/>	
16	2017-12-12	2017-12-12T17:12:01Z	2017-12-12T17:44:36Z	KALIMANTAN_UTARA	NUNUKAN	SEBATIK_BARAT	<input type="checkbox"/>	

Save changes

Validate Staypoint





Staypoint Accuracy: Improvement on algorithm (2018)

1st trial:
define 4 candidates
of home location,
and ask volunteers
for accuracy.

85,83%

Results for Kabupaten level:

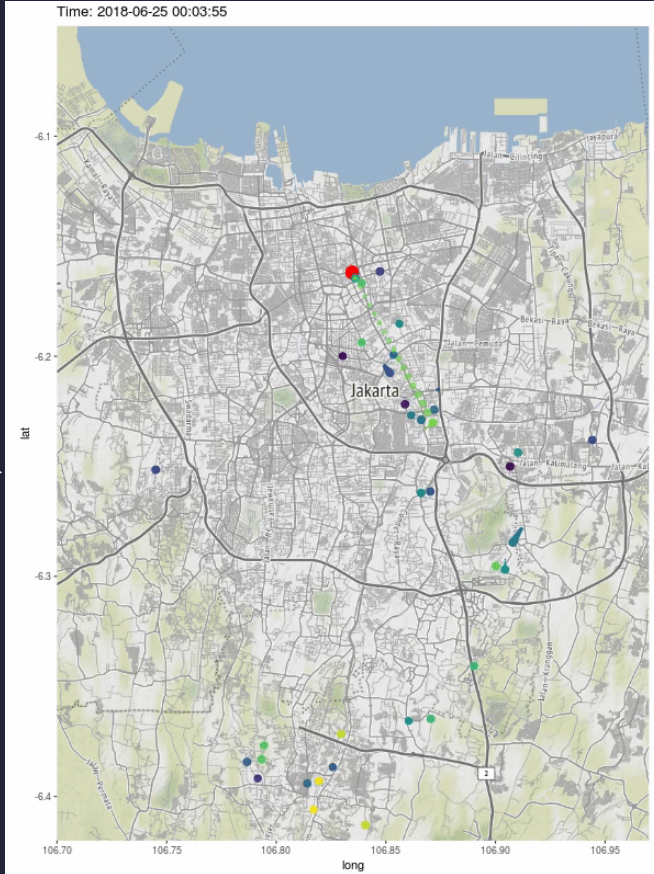
- Rank 1 85,83%
- Rank 2 58,92%
- Rank 3 58,02%
- Rank 4 51,50%

2nd trial:
take the number of
transaction per days,
build a weighting
factors for every
Kelurahan. Re -apply
to the home
algorithm.

94,33%

3rd trial:
add duration and
days spent to the
weighting factor.

96,23%



Examples of subscriber mobilities



Event Analysis

in collaboration with
Ministry of National Development Planning



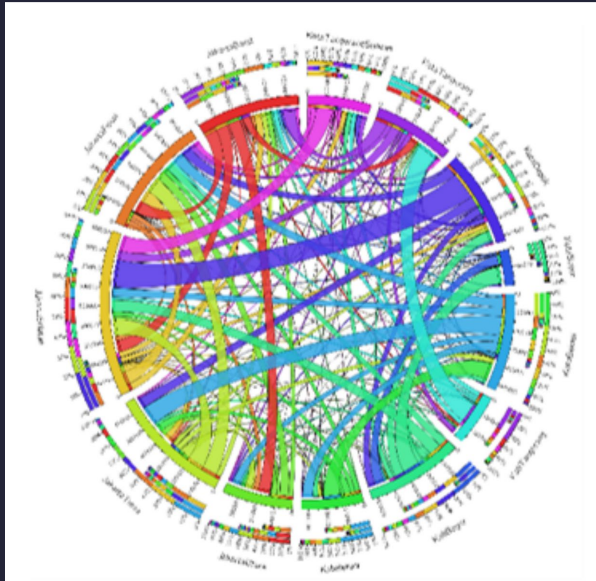
18th ASIAN GAMES
Jakarta
Palembang | **2018**



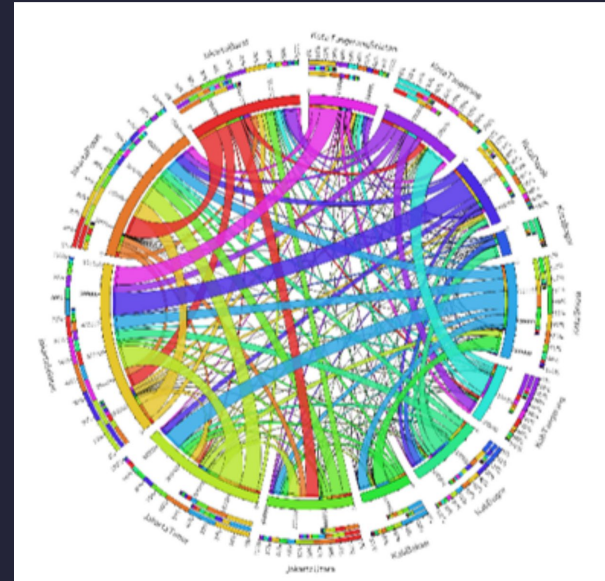
ANNUAL MEETINGS
2018 | indonesia
INTERNATIONAL MONETARY FUND
WORLD BANK GROUP



Commuter Statistics in Jabodetabek Metropolitan Area



Commuter
Household Survey
2019

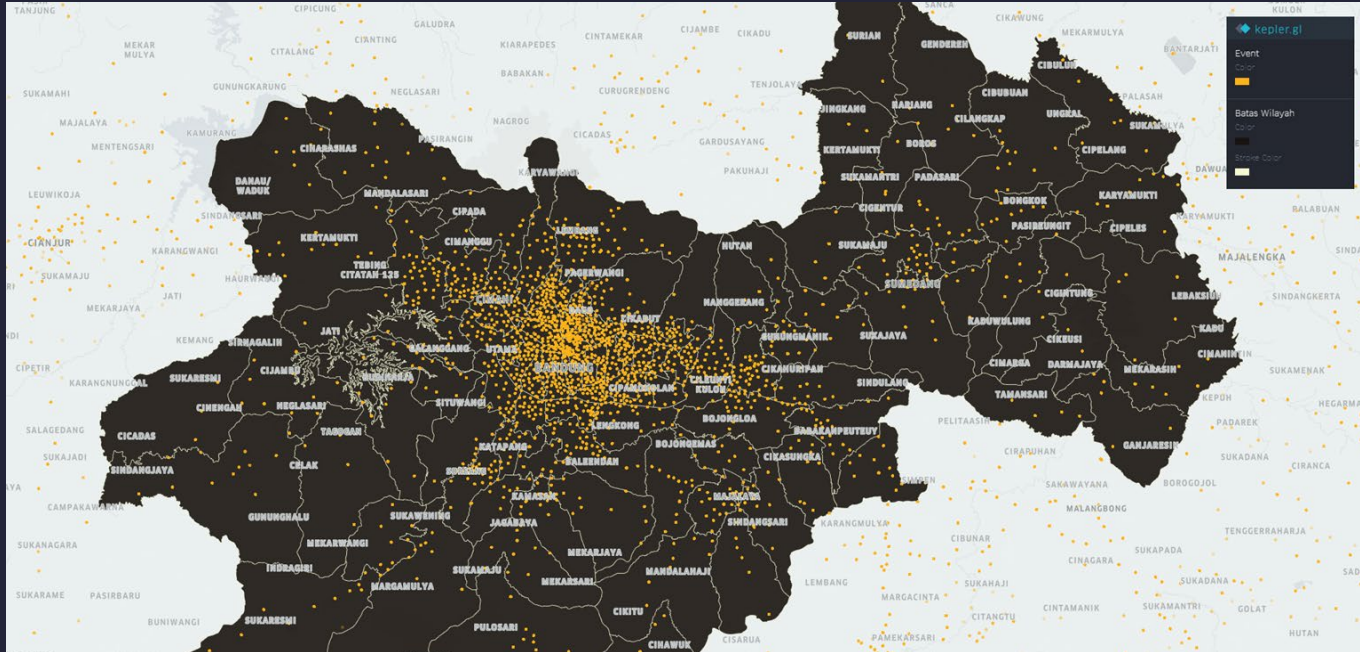


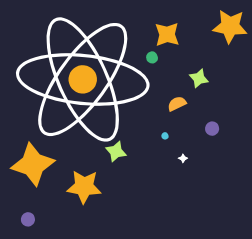
Commuter
from Mobile Positioning Data
2019



Metropolitan Statistical Area

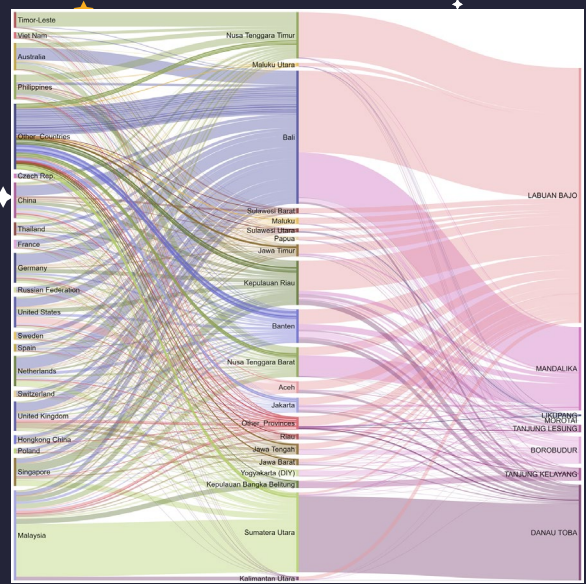
in collaboration with
Ministry of National Development Planning





Inbound Tourism to Super Priority Destination

in collaboration with
Ministry of Tourism and Creative Economy

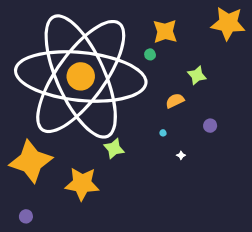


Inbound Tourism to Super-Priority Destination Indonesia with Mobile Positioning Data

February 2020 | Borobudur

	October 2.	November.	December.	January 2.	February 2.	March 2020
Malaysia	21	10	392	294	236	126
Singapore	23	18	342	310	171	146
Netherlands	35	3	202	184	124	59
Guam	9	4	136	109	57	20
United Kingdom..	5	8	127	127	78	56
China	25	3	115	261	68	12
Thailand	4		88	77	75	12
Australia	1		79	80	27	14
Philippines			61	23	10	9
Germany	10	3	58	49	39	26
Japan	2	7	57	73	33	13
India	4		44	23	24	6
Denmark	2		41	2	5	5
Spain	11		32	39	9	14
Saudi Arabia	5	1	27	24	24	20
France			25	35	32	20
Switzerland	2		19	20	15	4
Sweden	4		13	13	11	9
Belgium	4	3	13	7	16	12
New Zealand	1		10	11	2	
Austria	2		10	12	6	5





Improvement

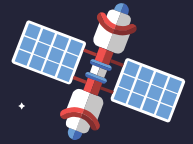
Since Then (2019)

Anchor Mobility Data Analytic (AMDA) is proposed for Home-Work Location Determination from Mobile Positioning Data, where this algorithm uses clockwise reversal to make it easier to classify someone in their usual environment. Only about 80% of the raw data can be used for the establishment of ordinary environments, the remaining 20% do not have sufficient data history. In this study, it was found that the accuracy of AMDA in determining monthly home location was 98.8% at the provincial level, and 88.7% at the regency level. As for the determination of monthly work locations, 98.9% at the provincial level, and 70.4% at the regency level.



Challenges

01	DEPENDENCY	There is a dependency on MNO, this is also experienced by several countries in the world. Data confidentiality issues make MNO unable to provide raw data to NSO.
02	PROCUREMENT	Complicated procurement, for each case to be analyzed, MNO establishes new cooperation, with the consequence of additional costs.
03	OTHER MNO's	BPS only cooperates with one MNO, communication to be able to work with Telkomsel as a research partner takes ± 2 years.



Amin Rois Sinung
Nugroho



Ignatius Aditya
Setyadi



Alfatihah Reno
MNSPM



Amanda Pratama
Putra



Wa Ode Zuhayeni
Madjida

Thank You

mpd@bps.go.id

