Mobility demand estimation in Smart Cities using mobile phone data

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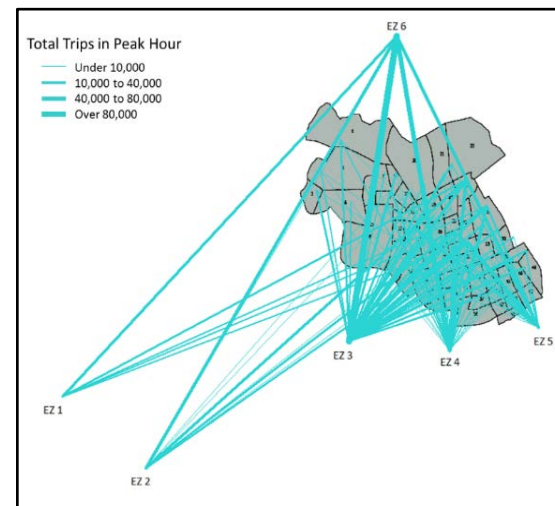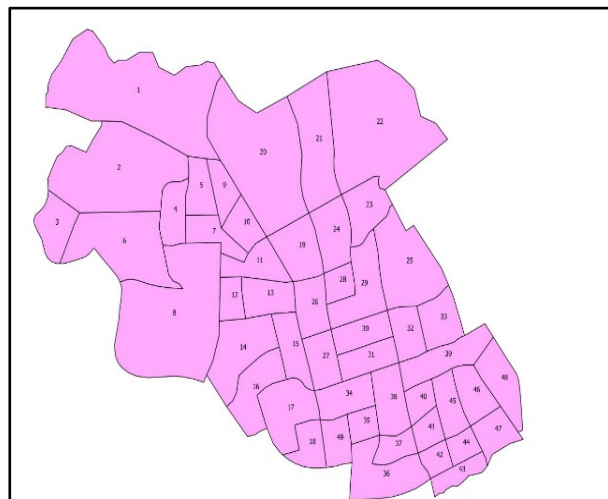
Outline

- The context
- Mobile phone data
- Methodology
- Demonstration project
- Summary

The context – travel demand

▸ Travel demand data

  ▸ Where are people coming from?

  ▸ Where are people going to?

  ▸ When do they travel?

▸ Demand data represented as Origin-Destination (OD) matrices

OD estimation – traditional approach

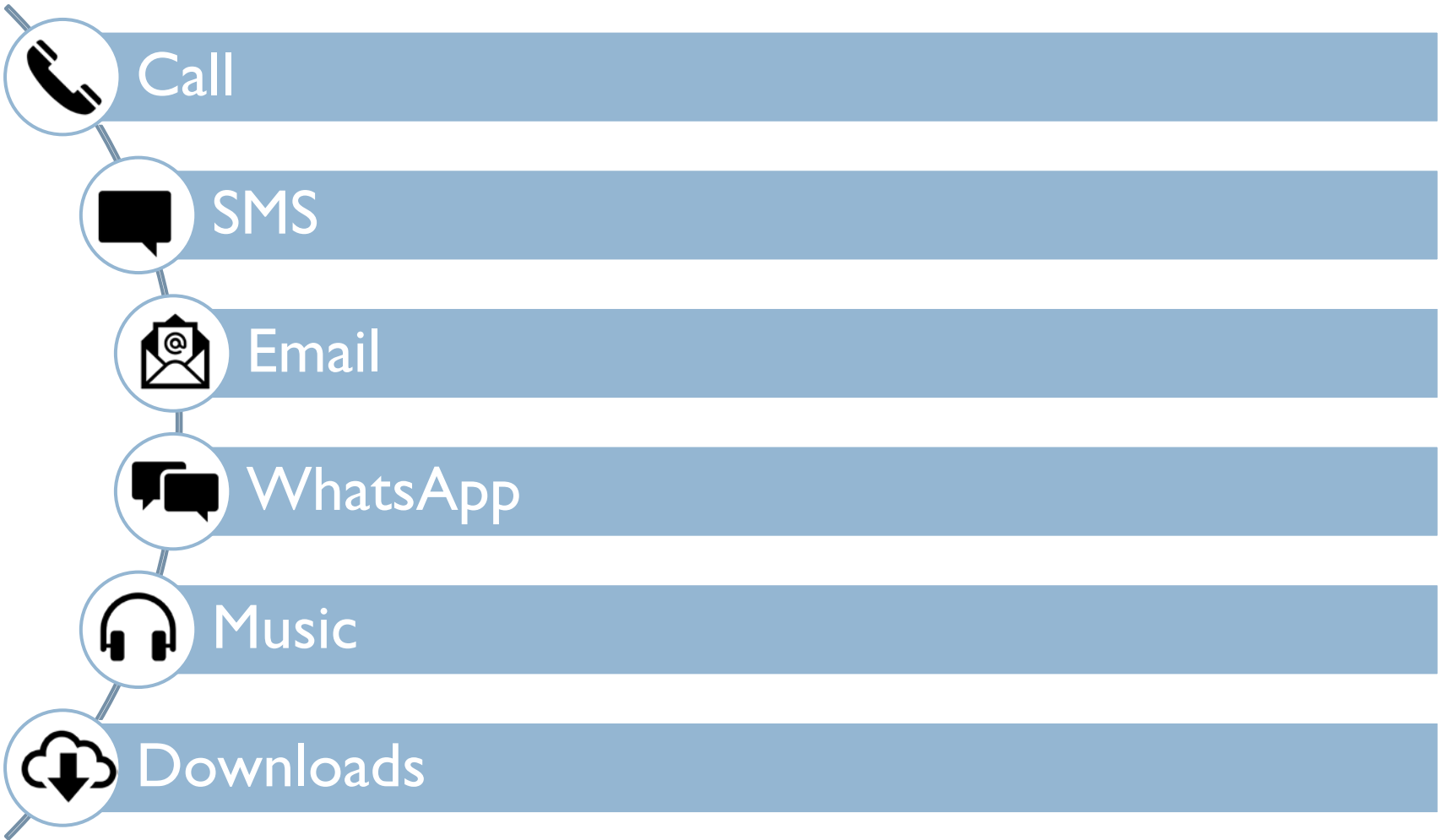| The traditional survey based approach	Time consuming
	Expensive
	Low sample size
	Crude approximation of demand variation over the course of a day
	Rapid urbanisation – data becomes out-of-date fast for operational use
	Can miss micro-patterns

OD estimation – for Smart Cities

Is there a better way?

Mobile phone data

Call

SMS

Email

WhatsApp

Music

Downloads

Mobile phone data

- Mobile phone penetration is high in developing and developed countries
  - India's mobile density in urban areas is more than 100 %
- The telecom systems needs to keep track of where each device is
  - For routing calls and data
- Anonymised Call Detail Records (CDR) and Location Based Service (LBS) data available from mobile operators contain subscriber movement patterns
- Advances in ICT enable processing of large data sets (a.k.a. big data and fast data tools)

Mobile phone data – CDR

Call Data Records	Unique id of the device (pseudonymised)
	Timestamp
	Id of the mobile tower
	(Other data)

CALL DATE TIME	CELL ID	PSEUDONYMISED IMEI
01/09/2013:00:11:14	21651	125060002848
01/09/2013:00:08:34	17541	434904788264
01/09/2013:00:10:54	38032	699404646397
01/09/2013:00:06:09	32272	620105228445
01/09/2013:00:10:58	15901	189305066902

Mobile phone data – LBS

Location Based Service (LBS) data	Unique id of the device (pseudonymised)
	Timestamp
	Latitude & Longitude
	(Other data)

| Device Number	Result Date	Latitude	Longitude
User-1	22/08/2017 11:10	19.0064	72.8383
User-2	22/08/2017 11:05	19.0074	72.8407
User-3	22/08/2017 11:01	19.0062	72.8407
User-4	22/08/2017 11:00	19.0074	72.8407
User-5	22/08/2017 10:55	19.0074	72.8407

Methodology

The problem
- Data does not cover the whole population
- Unknown sampling rate and biases

The solution
- Calibrate the naïve OD using count data
- ATCCs are deployed in most Smart Cities

OD estimation methodology
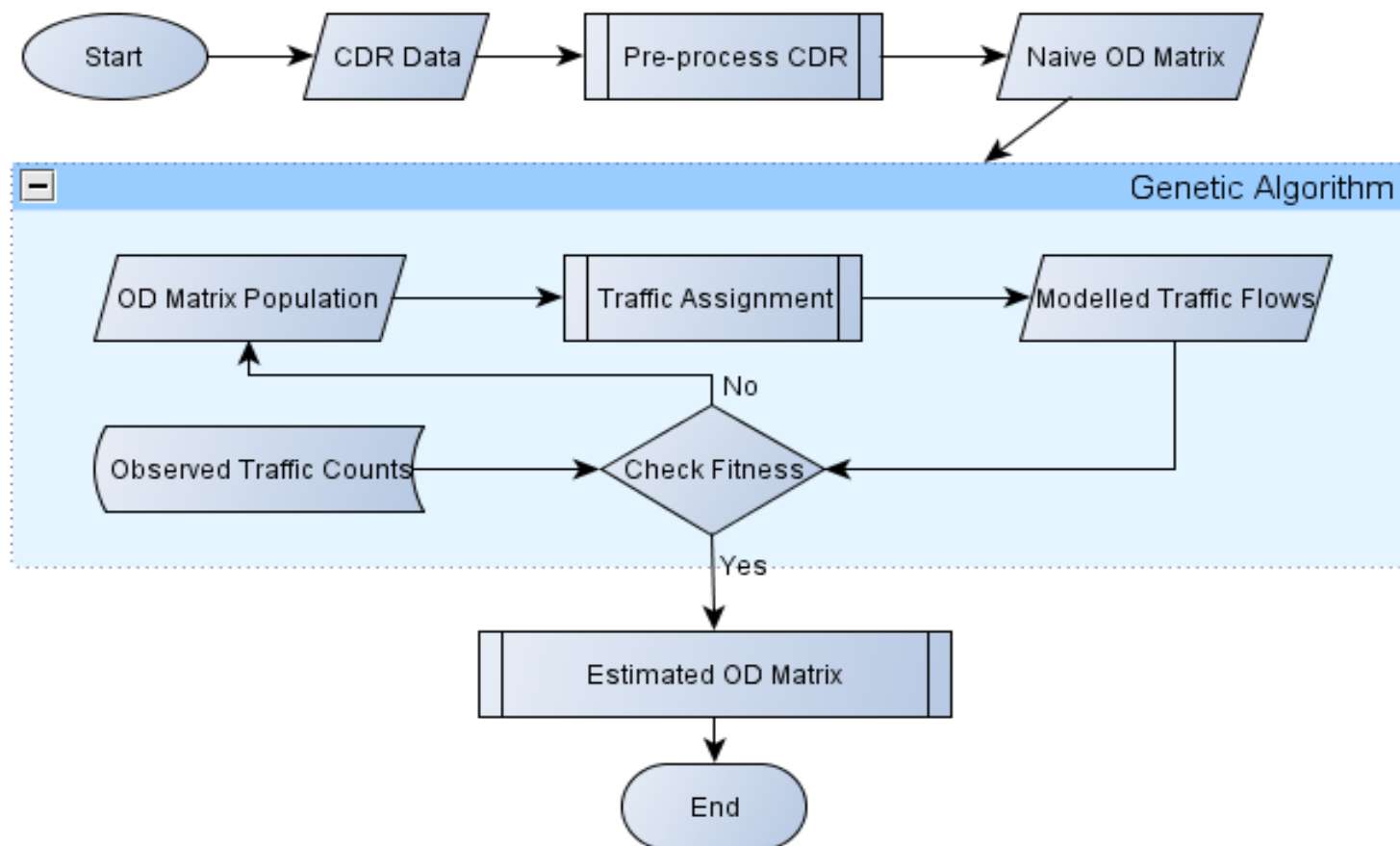
Carried out in collaboration with CDAC

OD estimation –demonstration project

- Study area
  - South Mumbai between Colaba and Dadar
  - Area of 67.7 sq.km and a population of 3.3 million
- Area divided into 36 Traffic Analysis Zones (TAZ) and 3 external zones
  - Geographic locations of cell towers were used to generate Voronoi cells
  - Voronoi cells were merged to form TAZs, roughly mapping to localities
- CDR data
  - Mobile phone data from roughly 15% of the population
  - Manual traffic surveys for calibration
- Accuracy evaluation
  - Screen-line count error (MAPE) of 9.6%
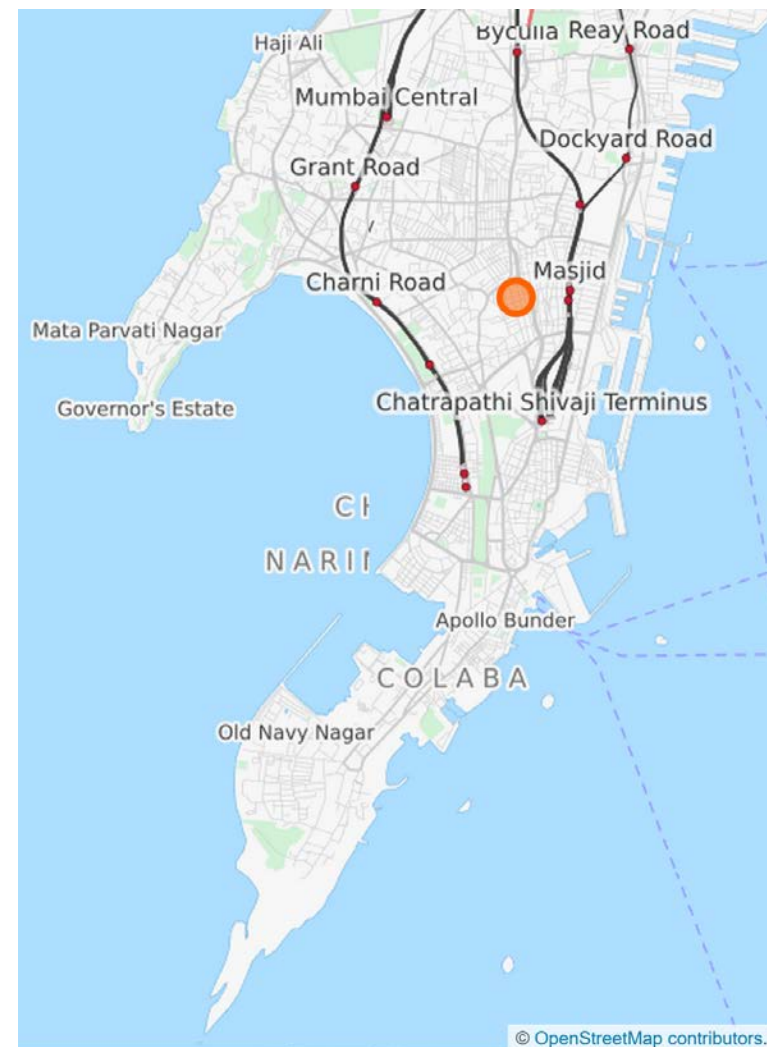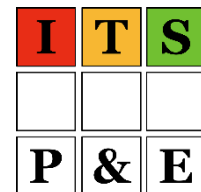
Summary

▶ The method has been in use for the past 7-8 years

▶ Methodology used by a number of transport departments across the world. E.g.
  - ▶ Department for Transport, UK
  - ▶ Transport for London

▶ We should incorporate this element in our Smart Cities
  - ▶ Understanding the problem is the first step in solving it!
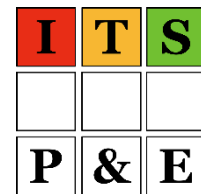
Thank you

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