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Urban Travel Time Estimation in Greater Maputo Using Mobile Phone Big Data

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Background

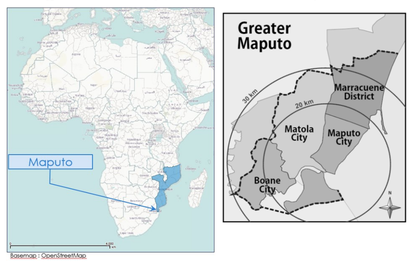
The rapid growth of urban populations may outpace the development of needed urban infrastructure, such as related to transportation, therefore, resulting to inadequacy of public transportation services and traffic congestion. In order to come up with a solution to enhance mobility, initially there is a need to acquire a better understanding of the current traffic situation. Travel time is a key component to describe traffic efficiency and has always been an important element to study and control. The wide spread of pervasive sensors allowed to capture different levels of human mobility, and to better describe the displacement of people in time and space. Call Details Records, or mobile phone data, is a good example where timestamp and corresponding approximate location are recorded with any cellular activity such as a call, a message or a data connection. In this paper, we leverage millions of these records in order to estimate urban travel time in Greater Maputo, Mozambique.

Study Area and Data

- **Mozambique**
  - Population: **28 M**illion (2015)
  - Area: **801,600 K**m^2
  - GDP: **$14.807 B**illion(2015)

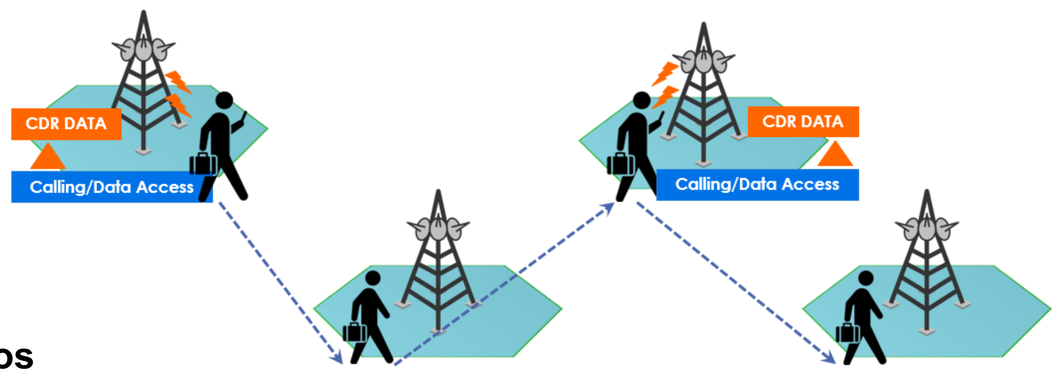
* World Bank Open Data: http://data.worldbank.org/country/mozambique

Study area, greater Maputo, Mozambique.



The number of daily trips in Greater Maputo is expected to double in the coming 20 years. This will impose challenges in governing future traffic and will require up to date traffic information for both traffic engineers and urban planners. Despite the wide spread of various travel time estimation services such as Google traffic feature in Google maps which exists in multiple countries, Greater Maputo still lack the availability of any up to date travel time information and thus stand in need for an alternative.

Call Details Records- CDR



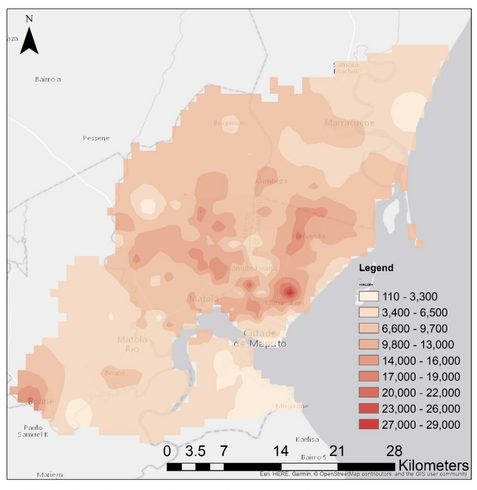
- **pros**
  - all mobile phone subscribers
  - existing data of mobile operators for billing

Data Period	2016.03.01 – 2016.03.12 (12 days)
Data size	393,326,282 records

Methodology

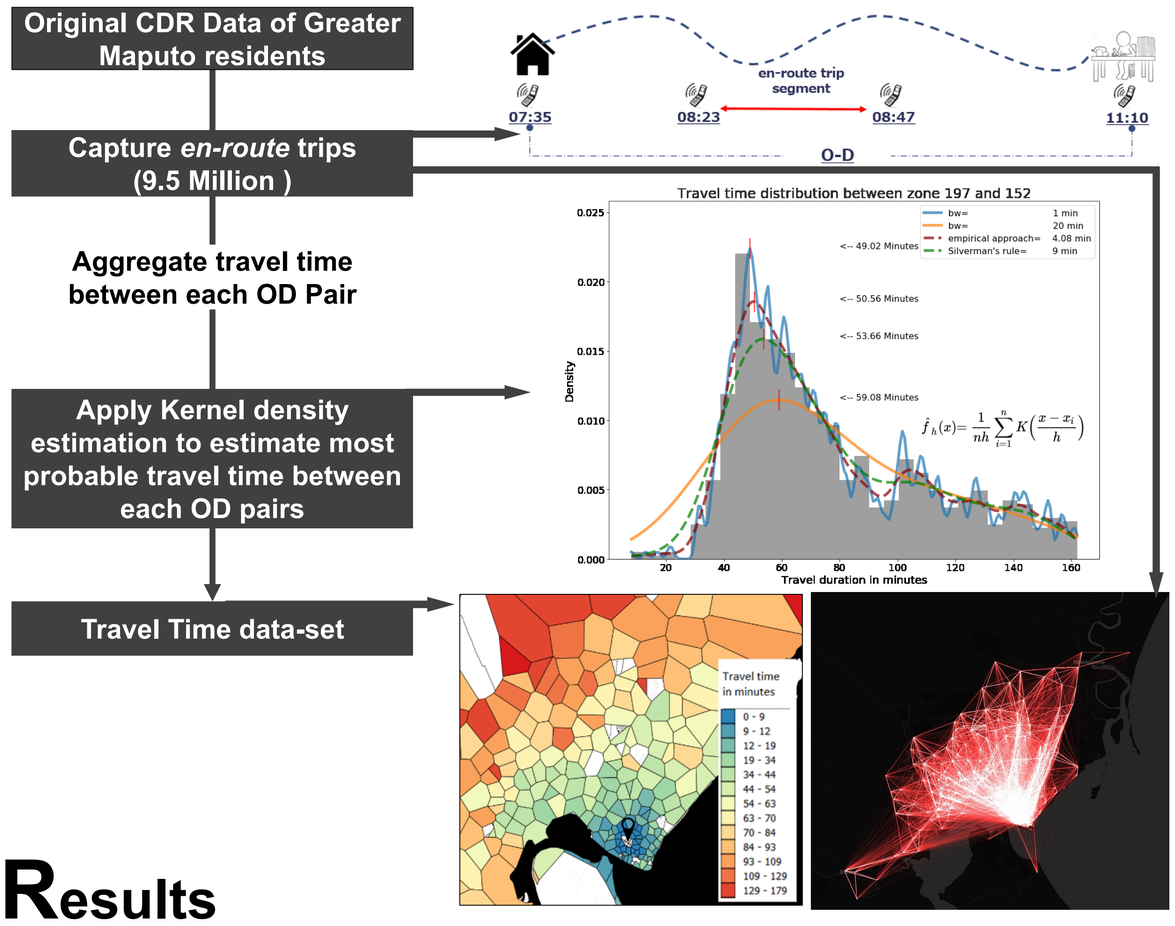
Subscriber's home zone estimation

Calling location frequency ranking based on night time and weekend records where night time between 08:00 Pm and 06:00 Am



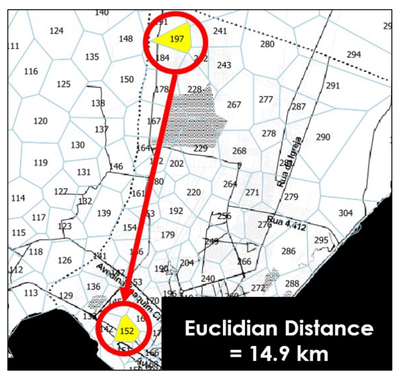
Spatial distribution of subscribers in Greater Maputo

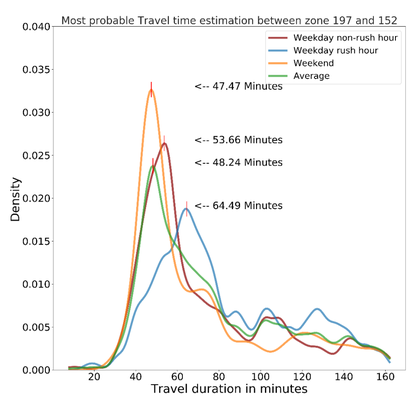
Travel Time Estimation



Results

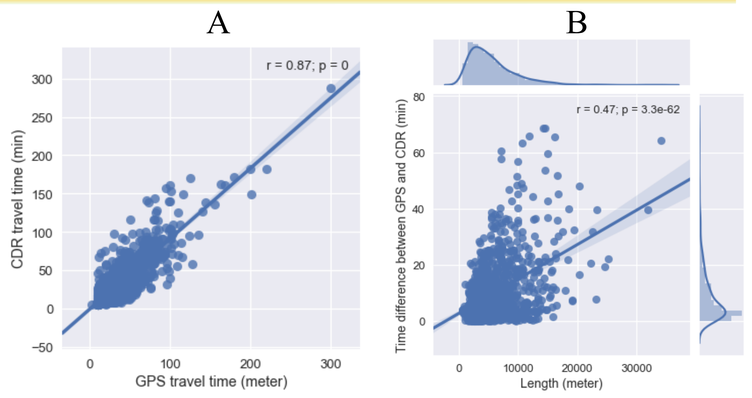
Origin Zone	Destination Zone	Avg. GPS (min)	Avg. CDR (min)	Difference (min)	Euclidian distance (m)
123	16	15.8	13.0	2.8	3456
166	152	6.8	9.7	3.2	1175





Validation

A. Linear correlation between average travel times estimated from CDR and from GPS.
B. Linear correlation between estimated time difference and the Euclidian distance for each origin and destination pairs



Conclusion

CDR to sufficiently represent travel time between various OD pairs in Greater Maputo, Mozambique. CDR was first transformed from its telecommunication form as a set of textual records into valuable transportation data by identifying possible stay points followed by trip extraction. Then en-route segments were extracted resulting into 9.5 million segments. In order to estimate the most probable travel time between each zone and another from all trips, the probability density curve was drawn using Gaussian Kernel Density Estimation and selected the peak value which corresponds to the most probable value. The very high number of segments allowed not just estimating the average travel time along the day, but captured travel time in weekday rush hours, weekday non-rush hours and weekends.