

MARGADARSHAK

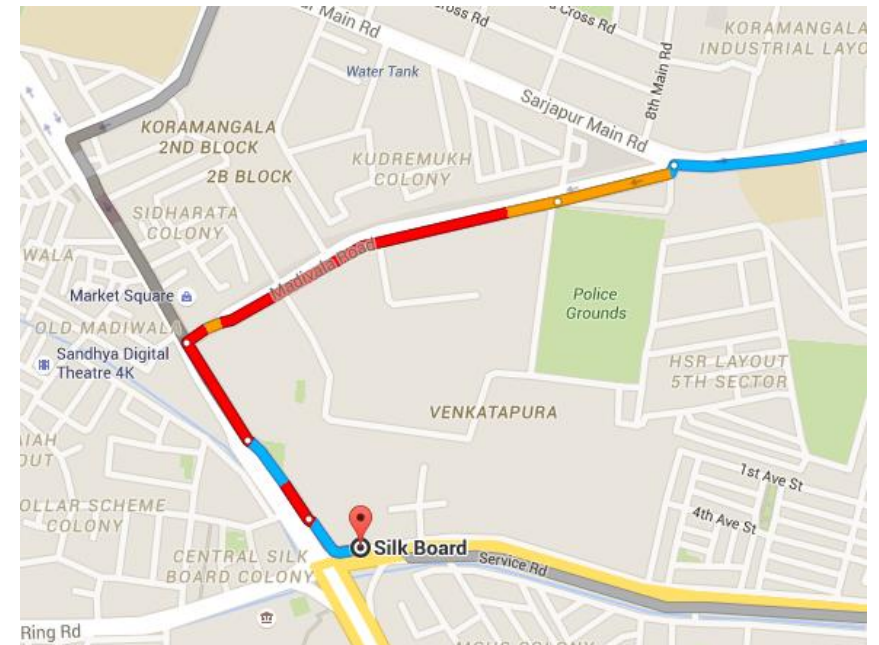
A Mobile Data Analytics based Commute Time Estimator cum Route Recommender

Rohit Verma, Aviral Shrivastava, Sandip Chakraborty, Bivas Mitra

Indian Institute of Technology, Kharagpur

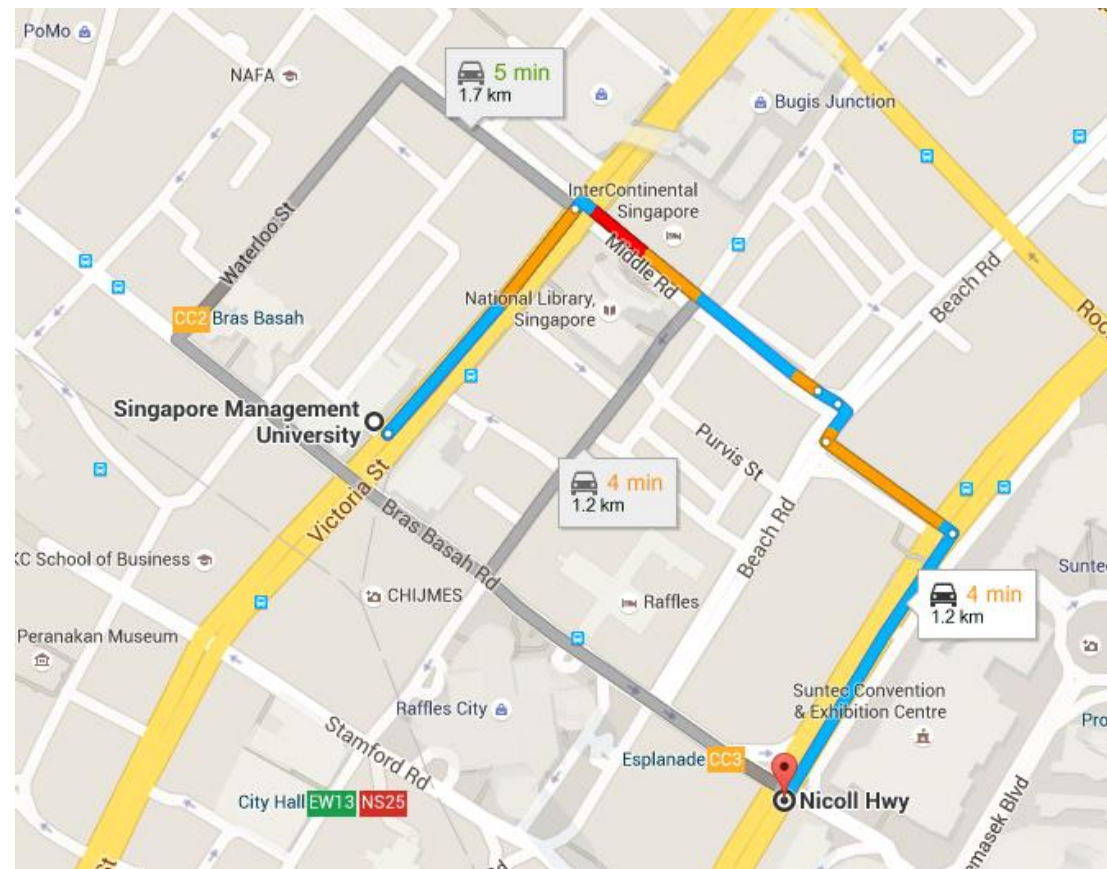
Problem of Road Traffic

- Unpredictable road congestion during busy hours
- Waiting time at traffic signals



Objective

- Develop a smartphone based application that, given a source and destination
 - Gives the fastest possible route
 - Current location of the user
 - Time to reach the destination

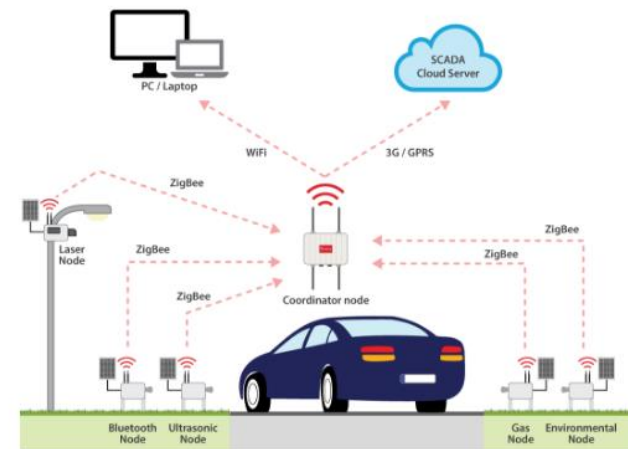


Limitations of the State of the Art

- Many systems do not consider the dynamics of wait time at traffic signals. Hence, no real time monitoring
- Existing real time monitoring systems depends on manual annotation for accurate navigation
- Some utilize off-the-shelf sensors, increasing infrastructural cost
- Cascading effect of wait time at signals and congestion not taken into account

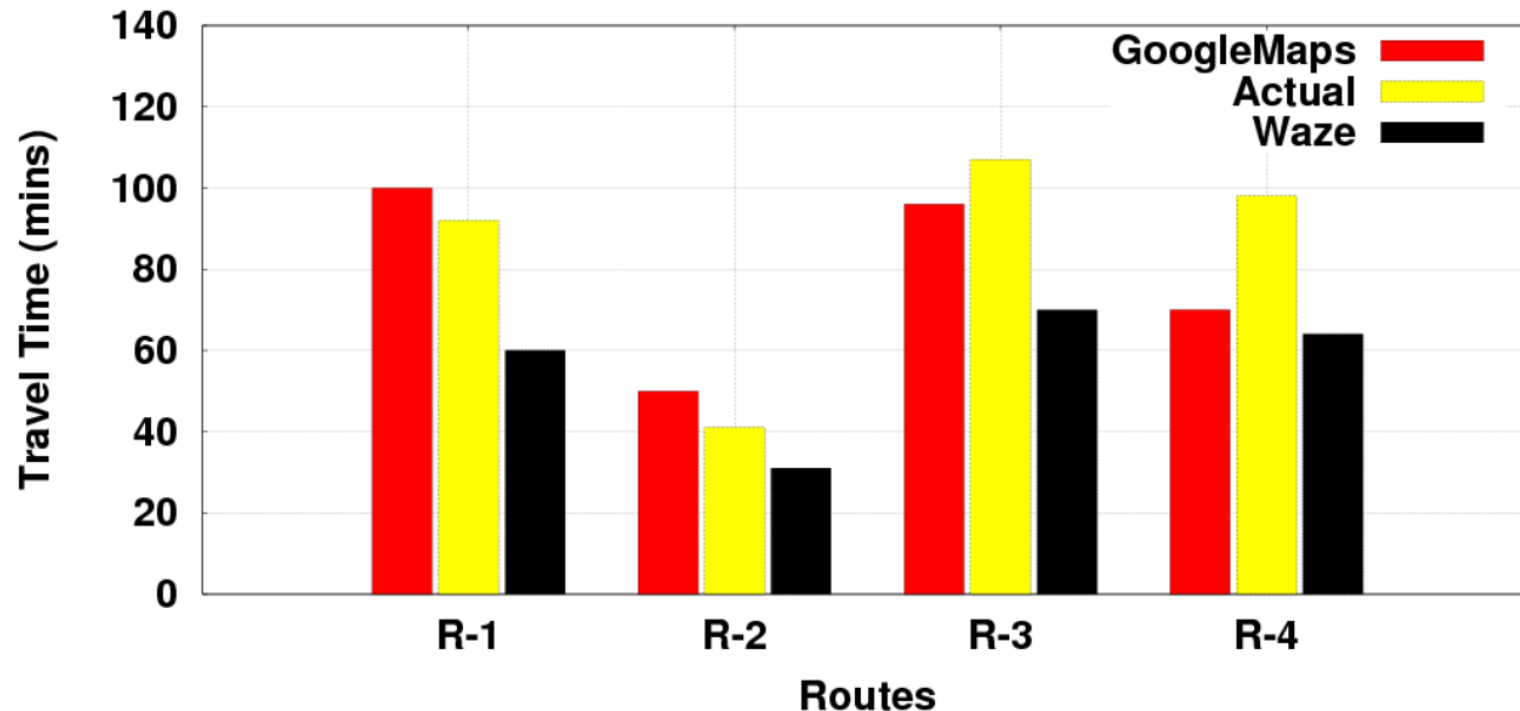


Courtesy: <https://www.waze.com/en-GB/>



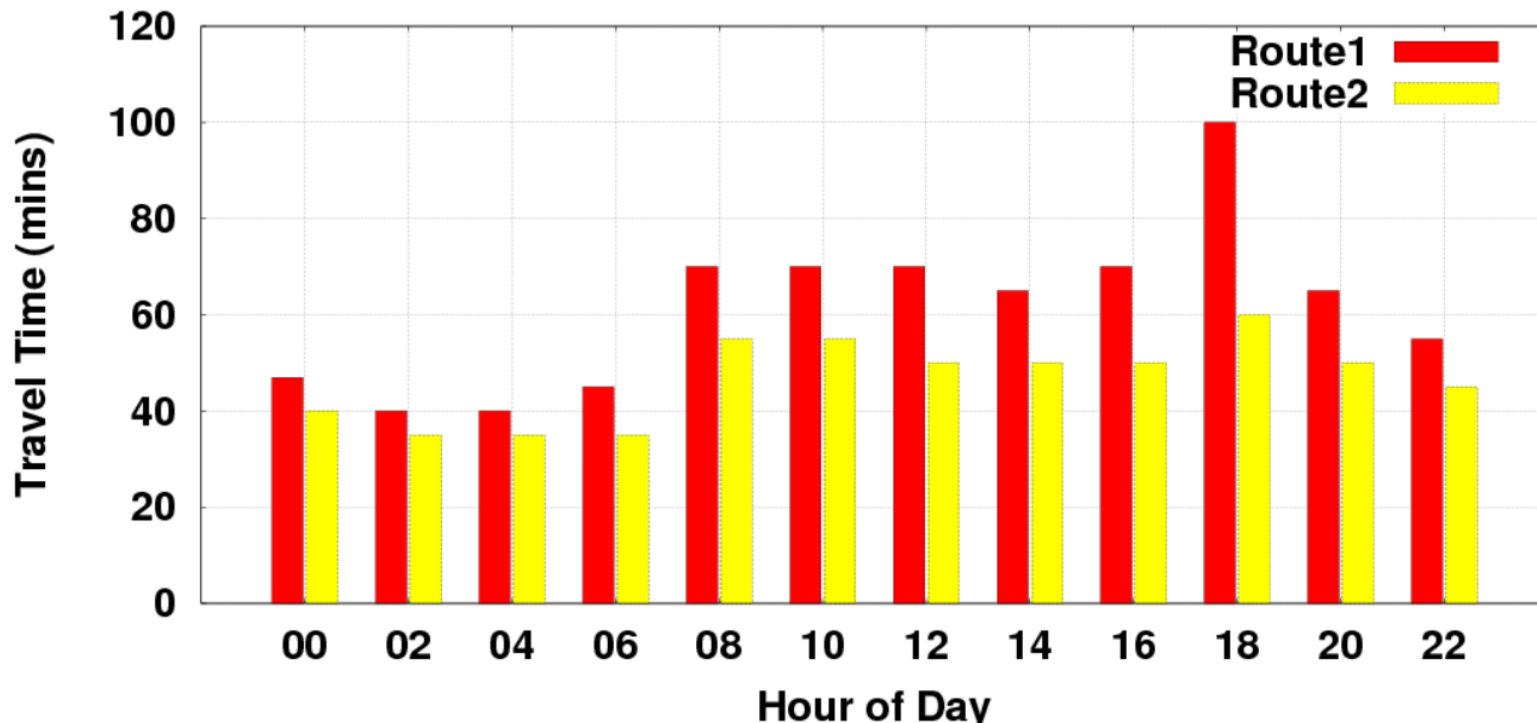
Courtesy: <http://www.libelium.com/traffic-and-road-conditions-monitoring-in-malaga/>

Motivation: How accurate are the existing tools?



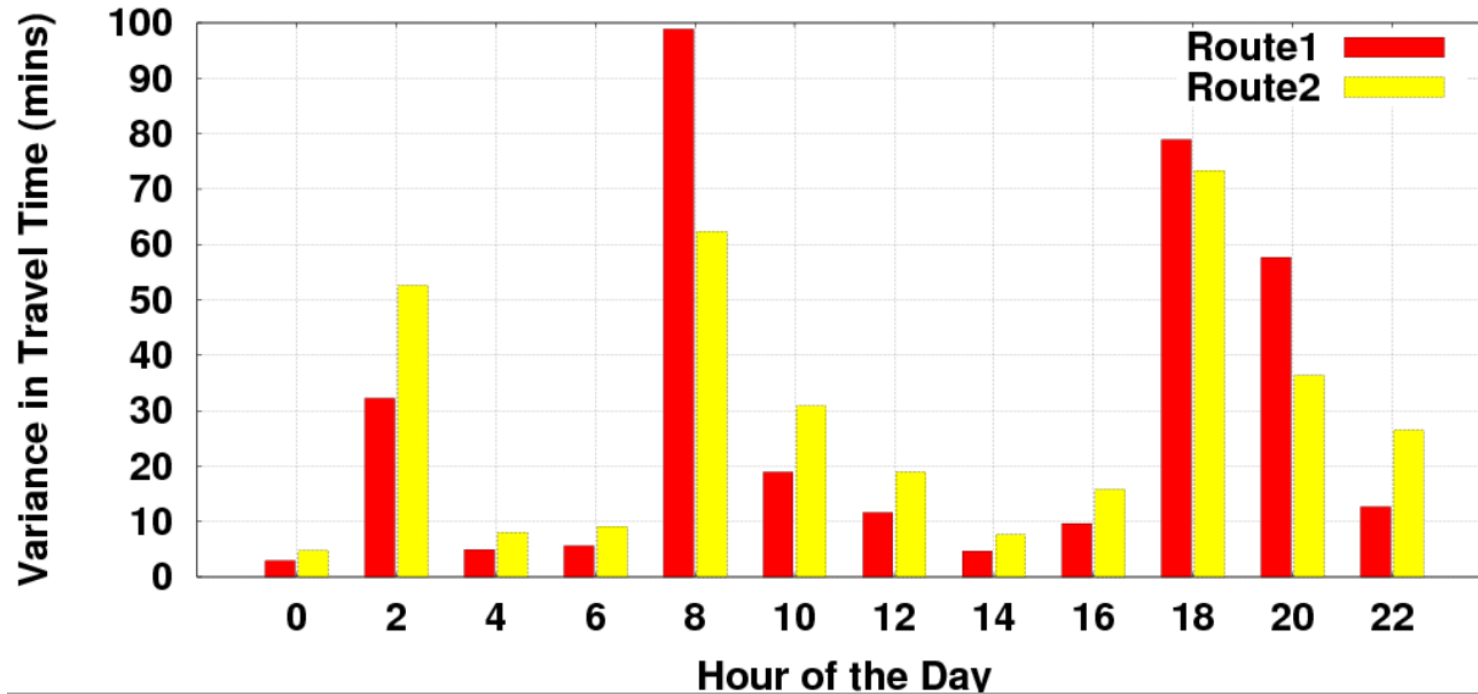
- We observe a difference of approx. 8-9 minutes with actual travel time in different routes
- Accurate waiting time estimation at different traffic signals may substantially improve the estimation of commute time.

Motivation: What is the impact of time of a day?



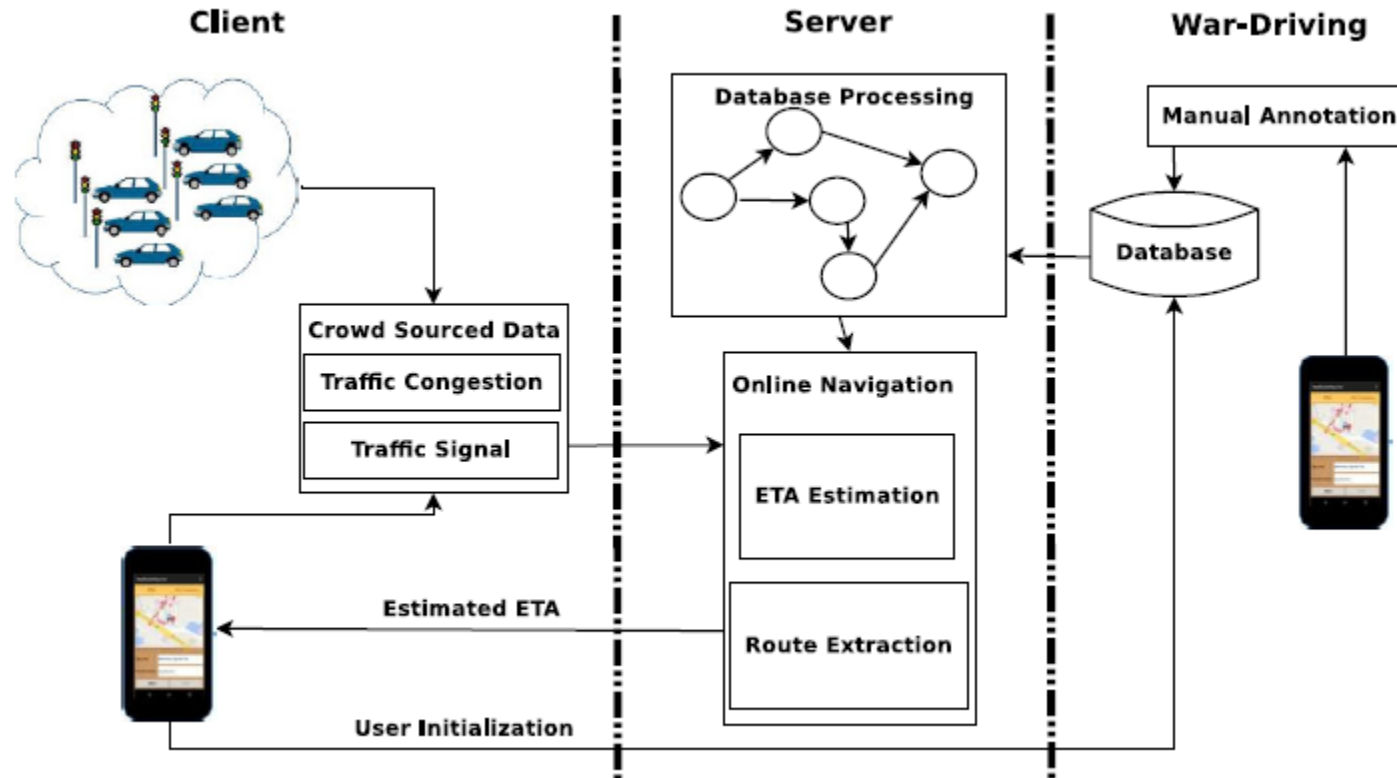
- Travel time is high in office hours, between 8 am to 6 pm, with 6 pm showing the peak.
- These times thus show most impact of congestion and delay at traffic signals resulting in incorrect estimation

Motivation: Does past data help?



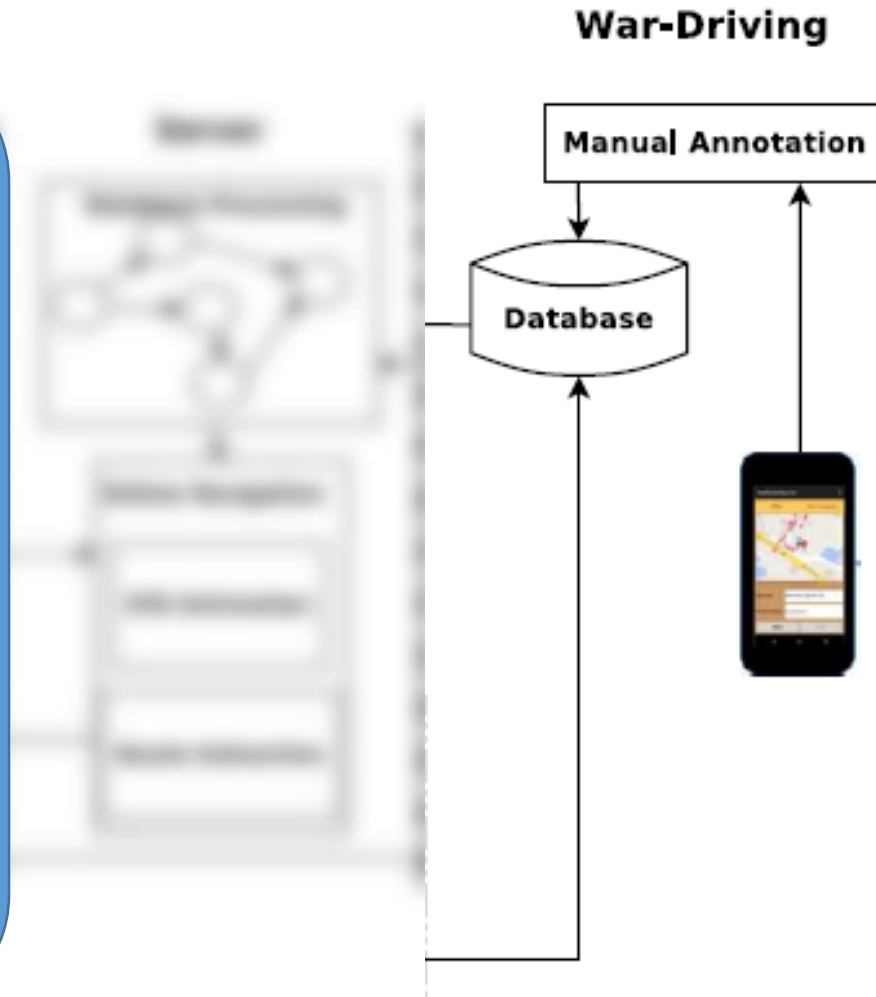
- Several existing strategies make use of past data to predict travel time.
- We observe that the travel time variance is as high as 100 minutes in the same route.
- Past data is not always useful

System Overview



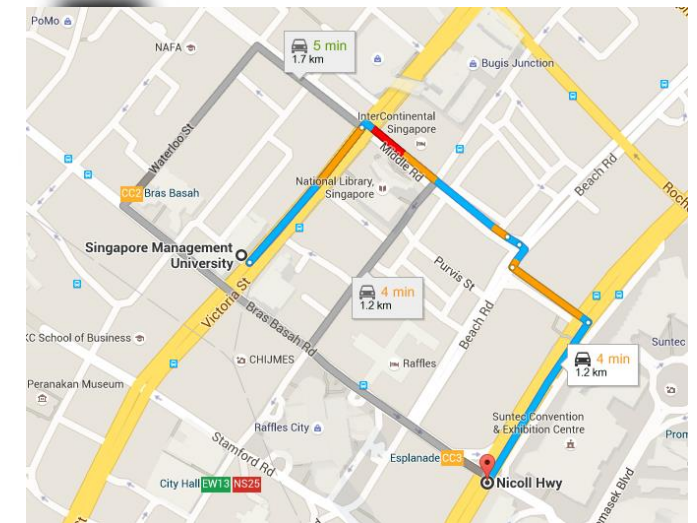
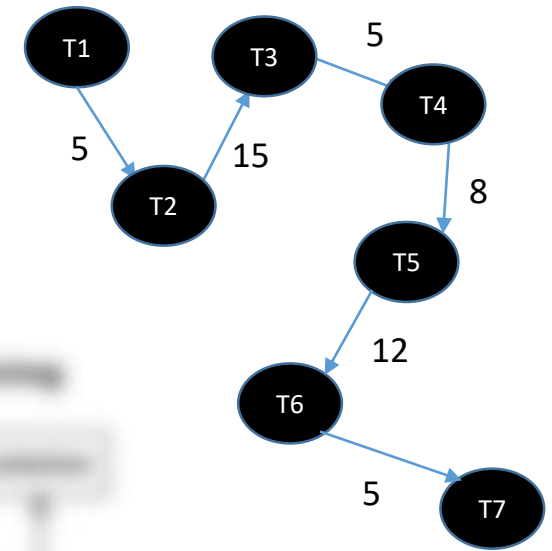
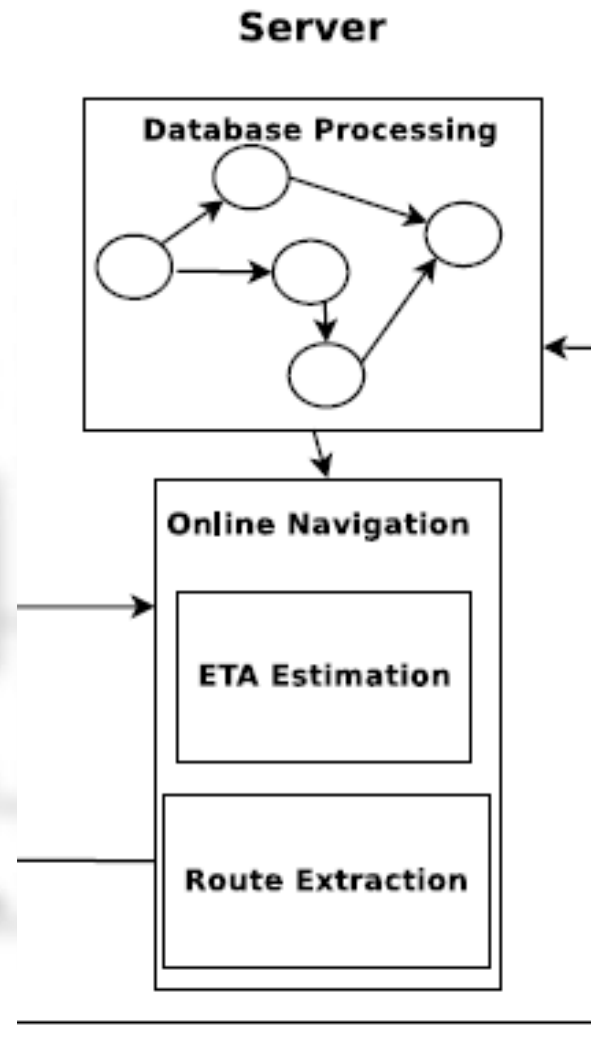
System Overview

1. Log the time-stamped GPS traces for different city routes.
2. Manually annotate the locations of the traffic signals on the route.
3. Generate Database

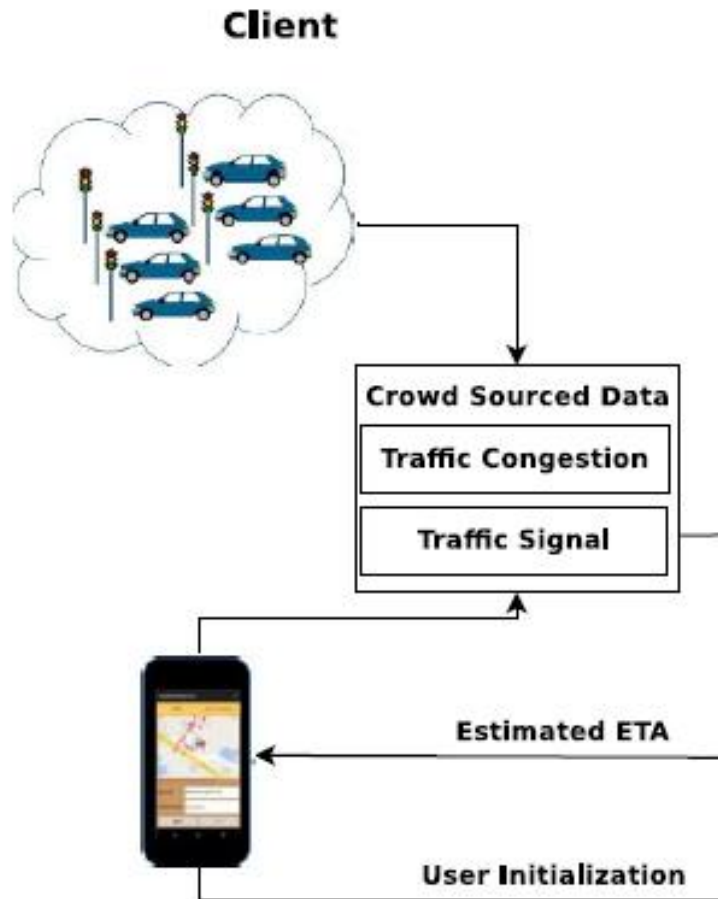


System Overview

1. Store the database in a directed weighted graph, called a Route Signal (RS) Graph.
2. Give the best route between source and destination
3. Give an estimation of ETA, which has 2 components,
 1. Fixed time component
 2. Dynamic time component



System Overview



1. Data collection module collects sensor data from the smart-phone
2. User interface:
 1. enables a user to enter her source and destination information.
 2. provides the display such that she can get the recommended route and its ETA.

User Initialization : An Issue



- Here, challenge is to locate the nearest traffic signal succeeding the source location and the nearest preceding signal of the destination location.
- If the closest signal gets selected, then **S2** will be chosen as the succeeding signal, which is wrong.

Fixed Time Component of ETA

- Computed from past history
- Utilize a bootstrapping vehicle, which helps in the initial calibration of wait-time at the signals
 - The wait time at each signal i can be given as $\Gamma + \tau_i$, where τ_i the change compared to historical data Γ
- Information collected from subsequent vehicles helps improve the accuracy

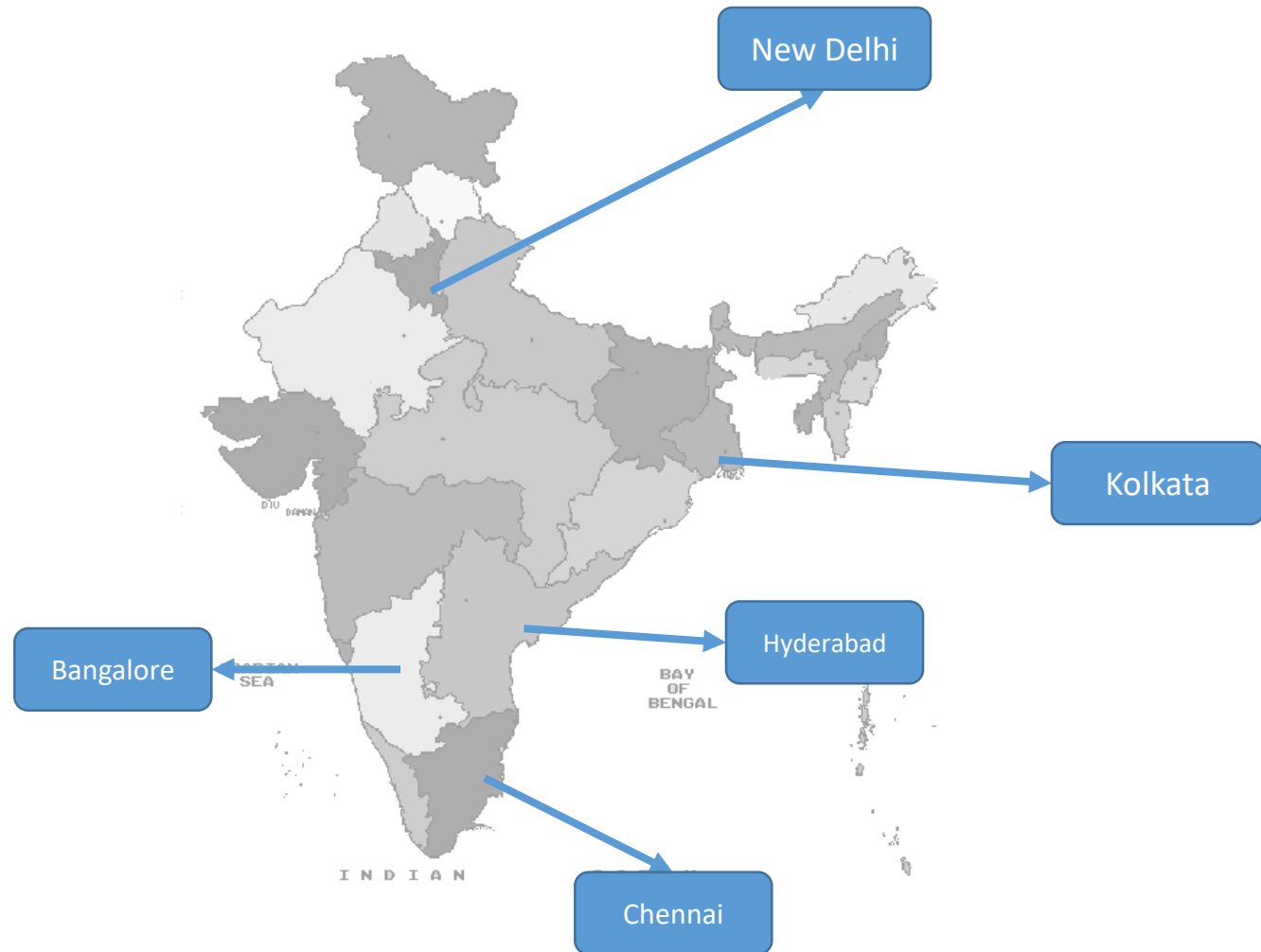
Dynamic Time Component of ETA

- Congestion is detected by observing the speed and location change of a vehicle in a small area
- Congestion at traffic signal will be taken care by the same module as discussed earlier.
- Otherwise, decrease the speed of vehicles by a factor, which would reflect on the travel time.

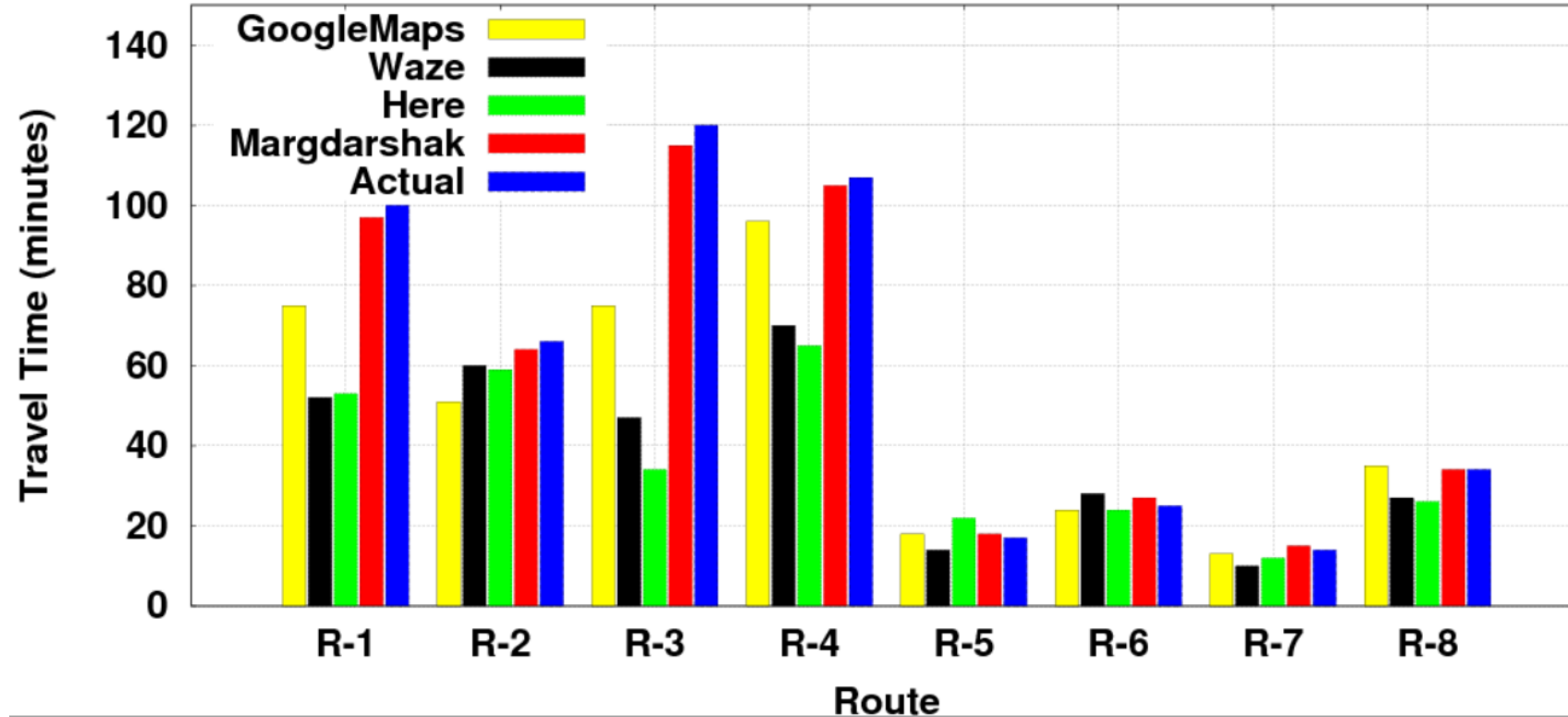
Experimental Setup



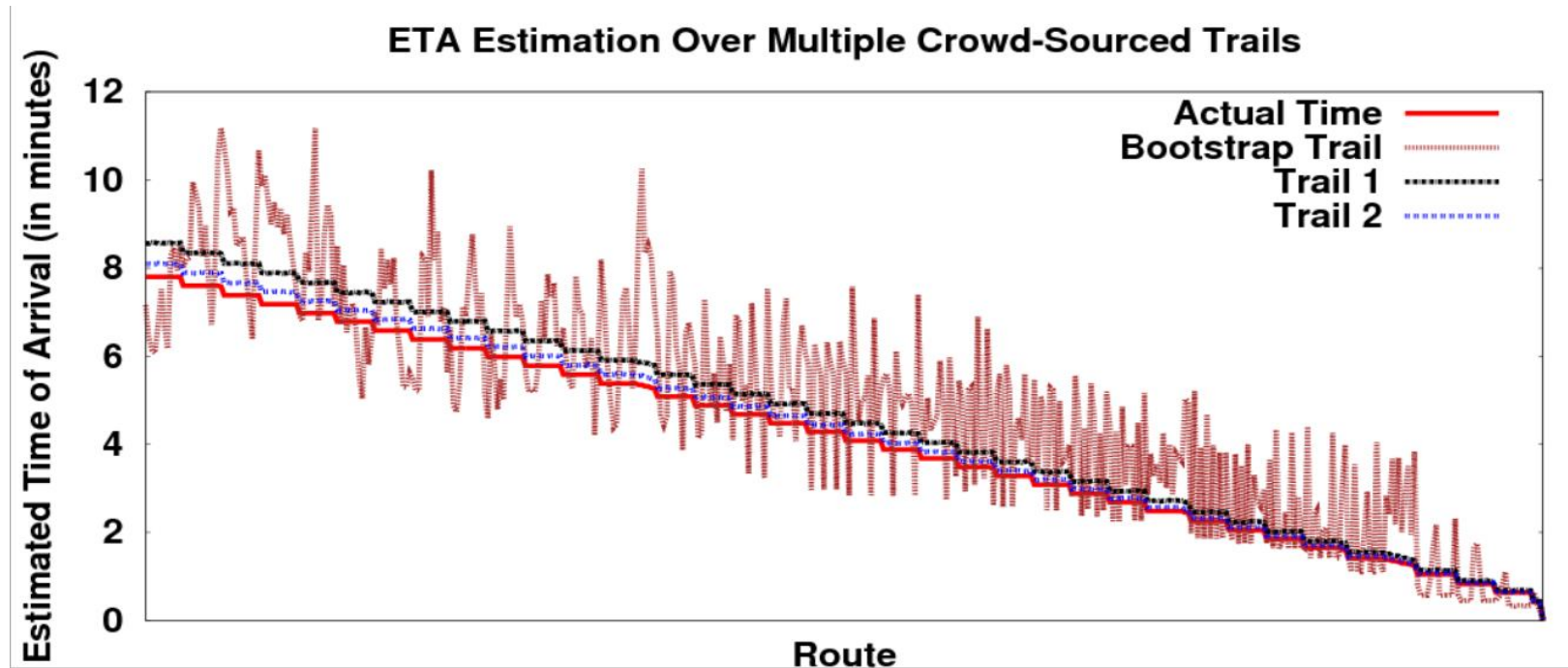
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Competing Heuristics

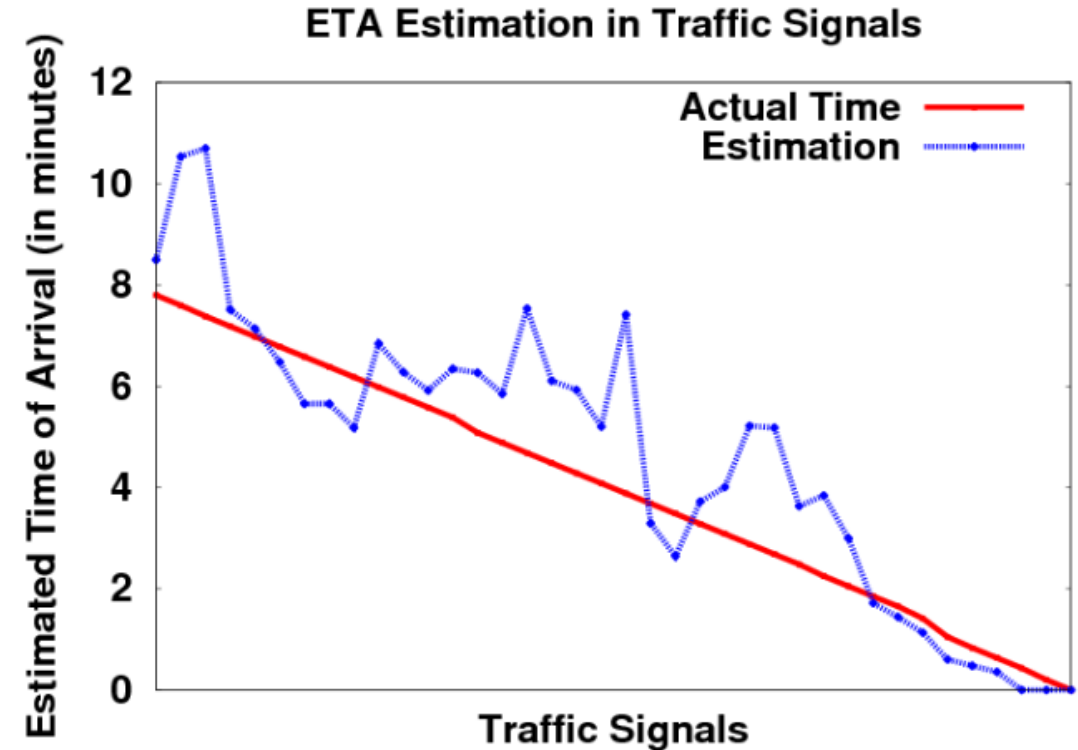
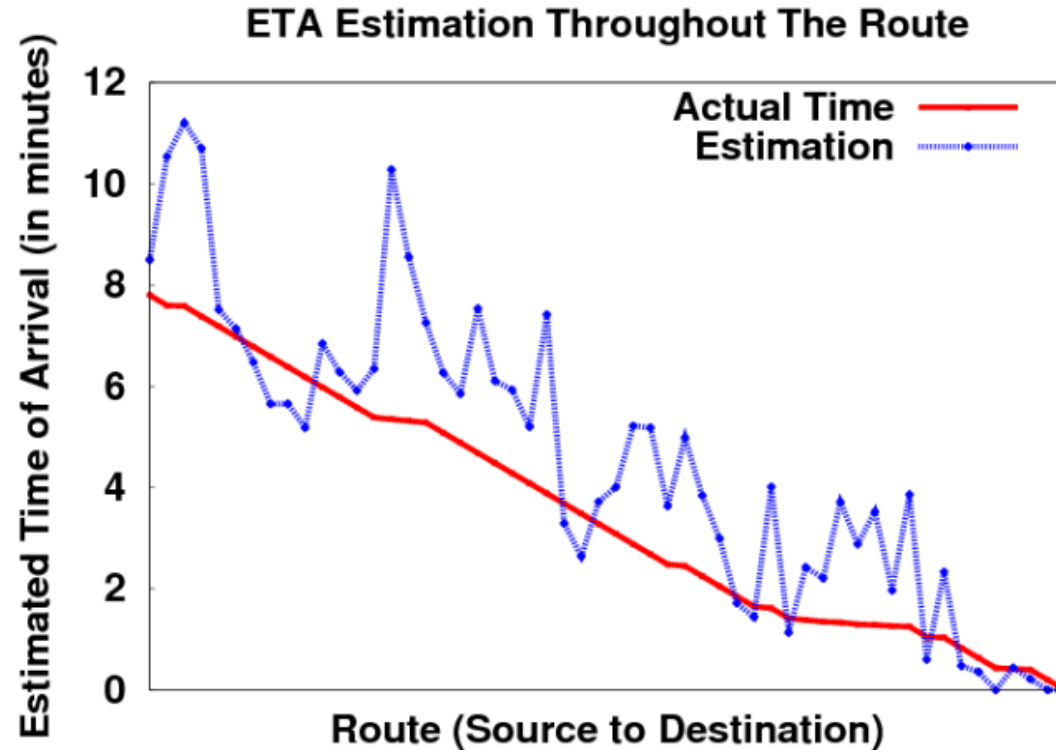


How Crowd-sourcing improves ETA estimation?



- Error rate is higher during the bootstrap
- Reduces rapidly as soon as more number of vehicles travel through the same route.

How traffic signals help?



- Mean error of travel time estimation is ± 1 min at the traffic signals and ± 1.5 min throughout the route
- ETA is recalibrated at traffic signals

Conclusion

- The core of the system is driven by two key components:
 - the accurate estimation of wait time at the traffic signals
 - delay in the road segments due to traffic congestion and its cascading effects.

Thank you!

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