A Demonstration of

QARTA: An ML-based System for Accurate Map Services

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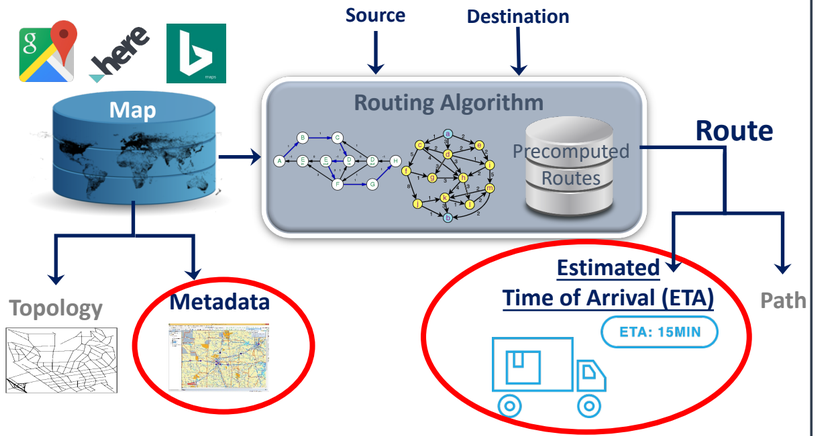
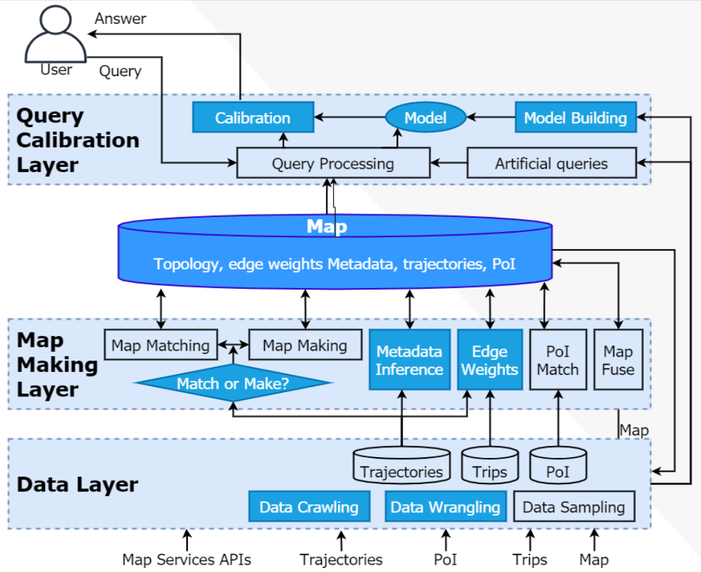
Problem

Routing…



Architecture



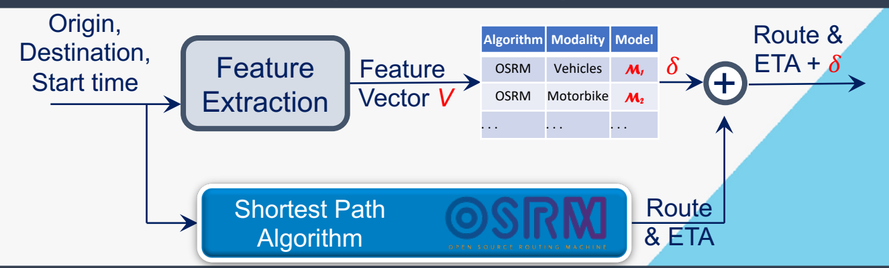
Map Making Layer – Metadata Inference

Supervised Learning Problem

- ❑ **Step 1**: Feature Engineering, e.g. road curvature, avg speed, No. of junctions.
- ❑ **Step 2**: Find the best models that maps road features to certain metadata
- ❑ **Step 3**: Use models to predict the missing metadata values

E.g. Number of Lanes

Query Calibration Layer

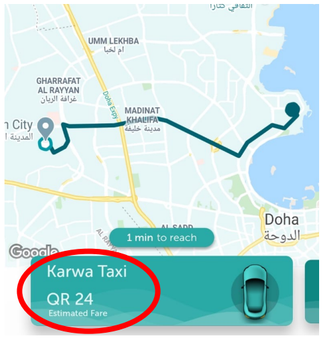


Deployment – QARTA in Numbers

Deployed in *all* Taxis in Qatar ~$4K$vehicles

A local food delivery company ~$3K$motorbiks

- QARTA receives **every day**:
  - ❑ ~$235K$ API calls
  - ❑ ~1 $Million$ GPS tracks
- APIs & Services:
  - ❑ In-traffic routes
  - ❑ Travel time estimation
  - ❑ Complex route planning
  - ❑ OD matrices
  - ❑ Search & addresses

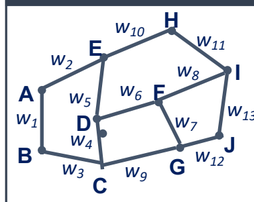


Fare estimation & Taxi dispatching

Data Layer

- **Rule based cleaning. Rules deployed in QARTA:**
  - ❑ Trajectories with a stop: Split
  - ❑ Unrealistic points: Remove
  - ❑ Missing points: Split

Map Making Layer – Edge Weights



(A, F, 15) ➔ $w_2 + w_5 + w_6 = 15$

(B, H, 28) ➔ $w_3 + w_7 + w_8 + w_9 + w_{11} = 28$

(A, I, 19) ➔ $w_1 + w_3 + w_7 + w_8 + w_9 = 19$

…

X equations in Y unknowns

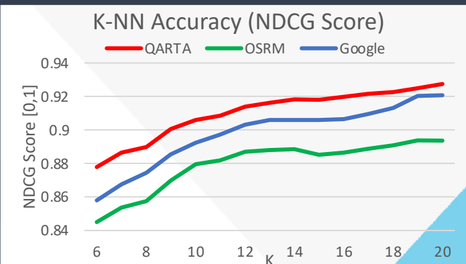
Temporal Granularity

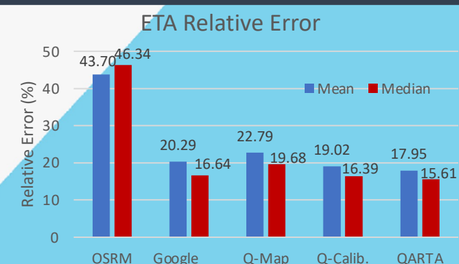
Ridge Regression Analysis

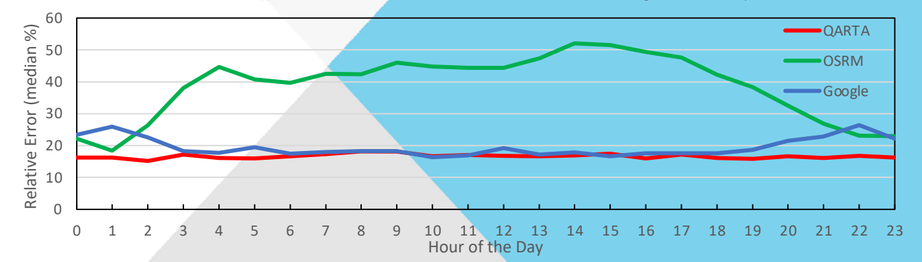
Edge weights per granularity

- **Challenges:**
  - ❑ Zero or negative weights
  - ❑ Scalability.
  - ❑ Over-fitting for unreliable edges
- **Solution:**
  - ❑ Heavy Edge inference
  - ❑ Heavy Edge detection
  - ❑ Physical Constraints

Evaluation







Dataset	Trips	Duration	Nodes	Edges
Doha	250K	1 Month	64K	148K
Porto	426K	3 Months	35K	82K
NYC	1.5M	6 Months	250K	644K

- **Other Experiments in the paper:**
  - ❑ ETA accuracy for Porto & NYC
  - ❑ Parameter setting
  - ❑ Error distribution per trip distance
  - ❑ Performance: Training & Response Time
  - ❑ KNN Precision