VIVACITY

Transforming Transport Infrastructure with GPU-Accelerated Machine Learning

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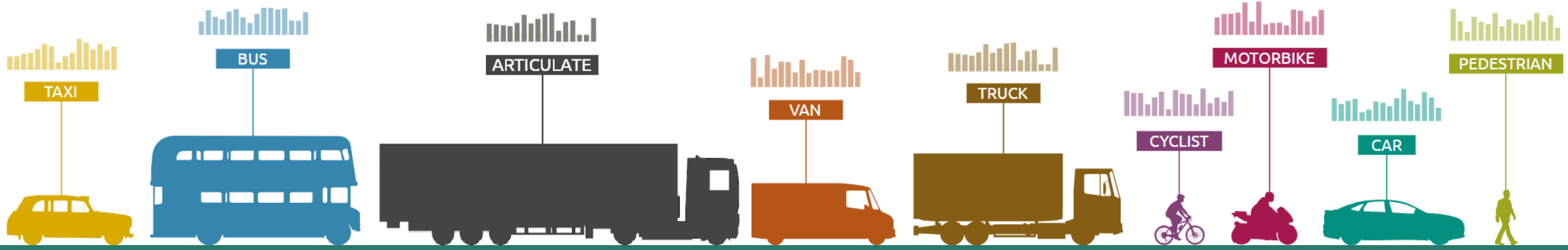
11th Oct 2018

Contents

Our Vision of Smarter Transport



Vivacity Introduction

1 SENSOR

Our Sensor captures video for local processing

2 DETECTION

Road users are Detected and Classified

3 TRACKING

Within the field of view of the camera, we can track road users to produce paths

4 ANONYMOUS DATA OUT

The system can produce classified counts, path analysis, speed profile assessment and road space heat maps

5 ANALYTICS

We use Machine Learning on the data feeds to predict future traffic volumes

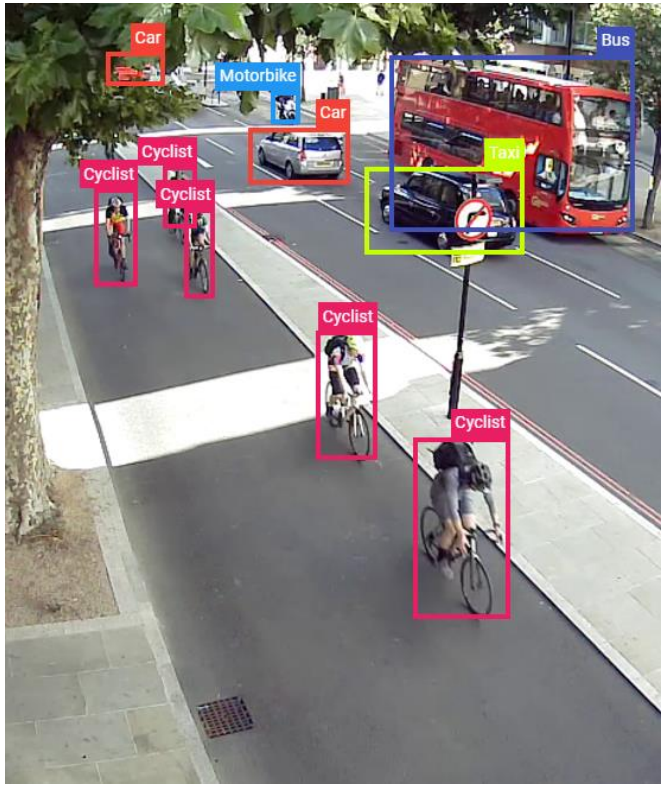
6 INSIGHT

The data and analytics can be used to improve everything from transport planning to enabling a proactive approach to incident management

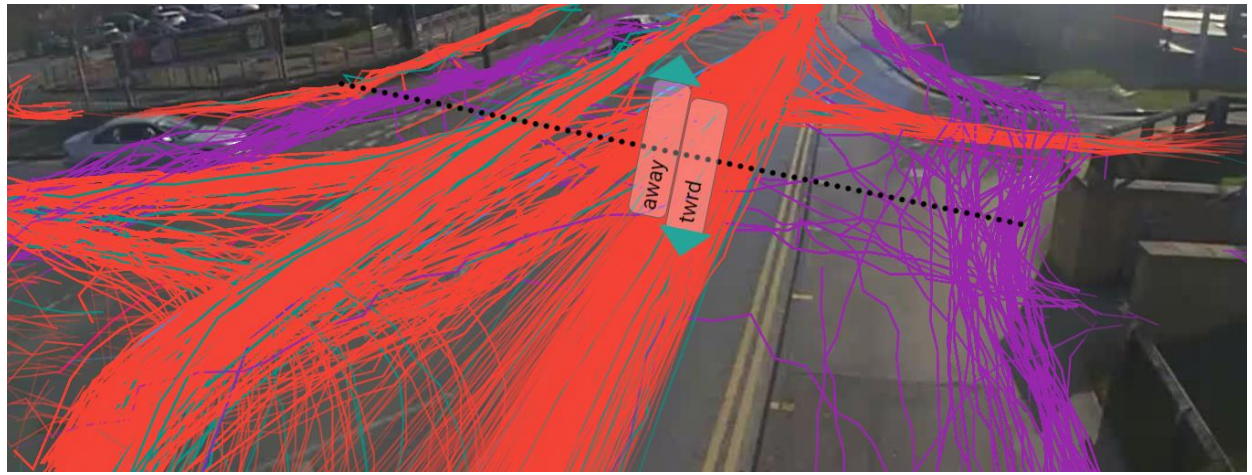
Advanced GPU accelerated traffic sensors

- Nvidia Jetson powered sensors
- All video processed by Vivacity's GPU accelerated video analysis software on device
- Real time data on the classification, location and path of all vehicles and objects on the road
- Anonymised data – GDPR compliant
- Multi-interface communications, supporting Ethernet, 3G/4G, WiFi, Bluetooth, V2X (802.11p)

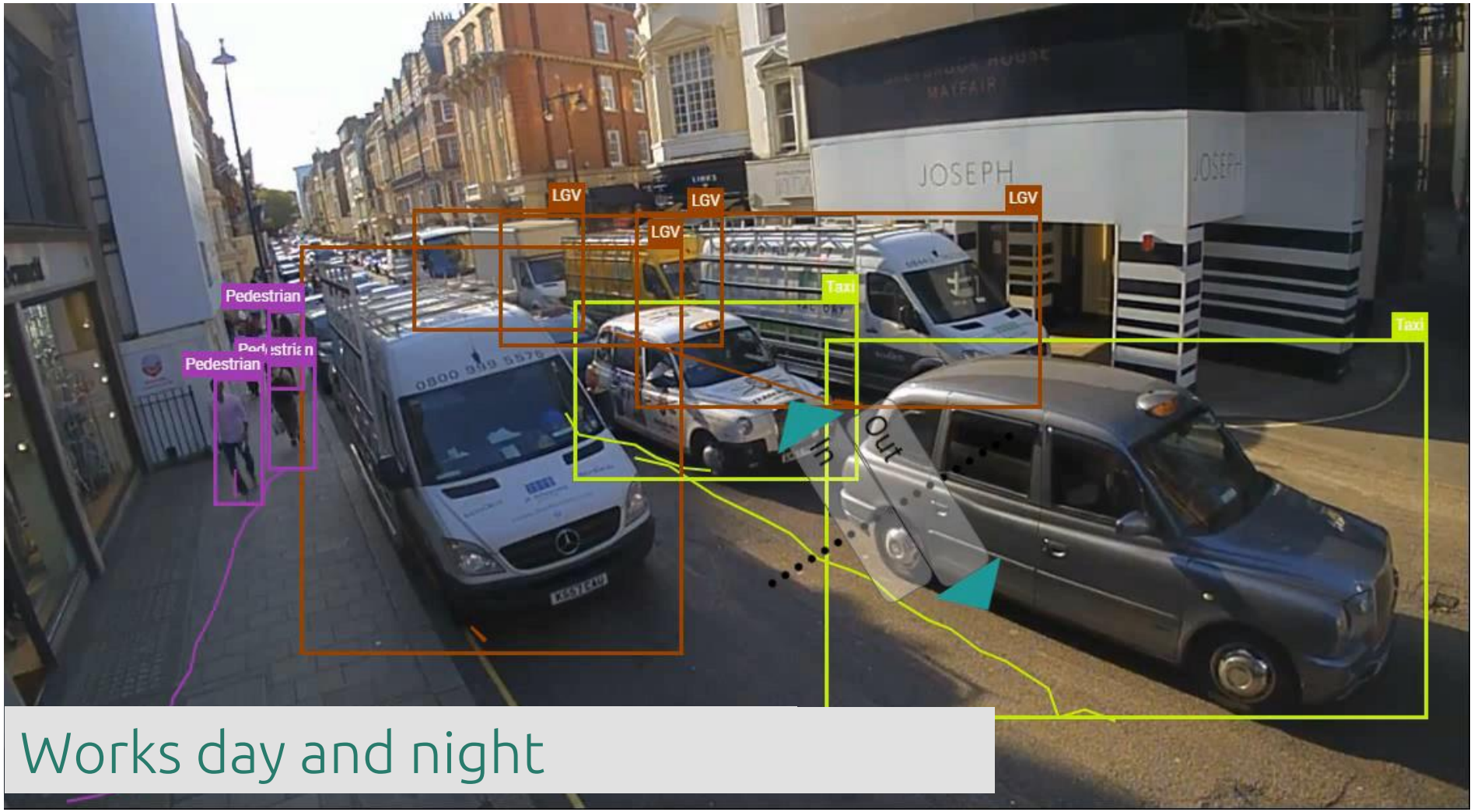
Detection and Tracking



Vivacity's on-device real-time, multi-class, multi-object tracking technology enables us to gather an extremely rich dataset



Benchmarked at 93 - 97% accuracy compared to human counting



Works day and night

Data Output

- Classified Count
- Speed
- Path
- Queue Count
- Headway
- Journey Times

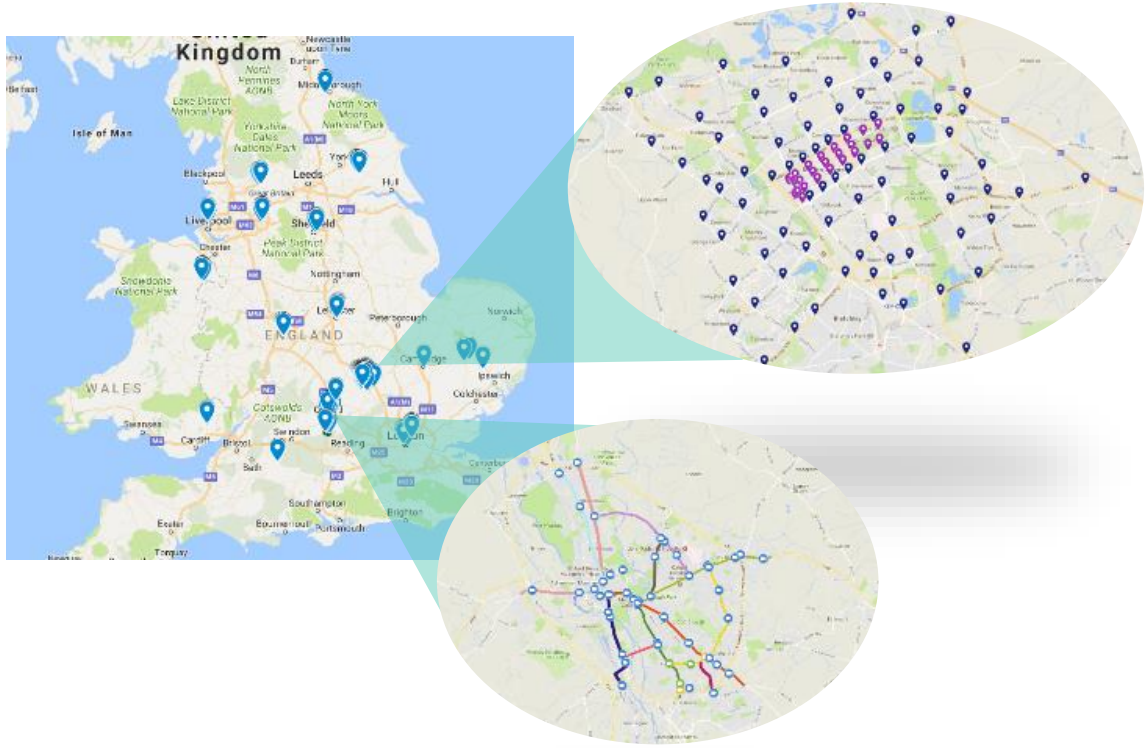
API

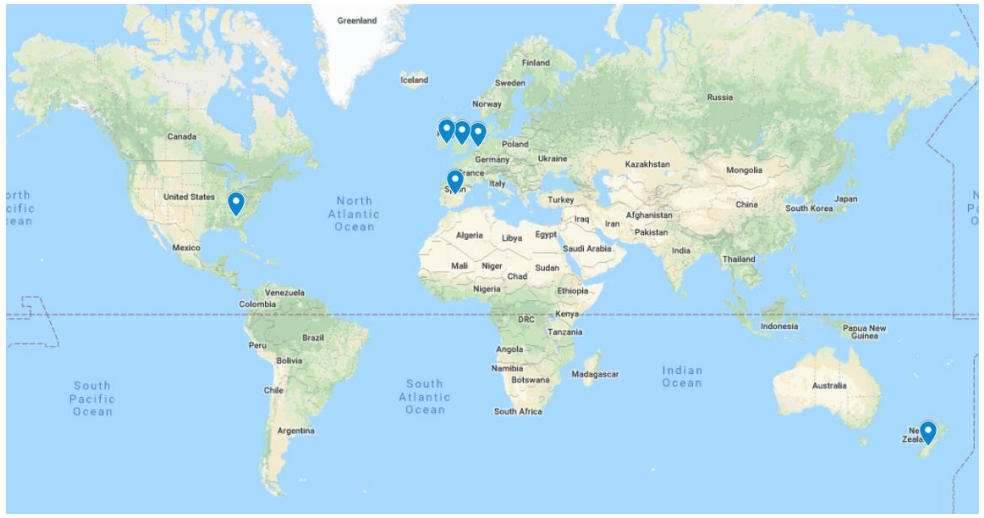
Cloud Data Access Portal

Enables integration with 3rd party data platforms

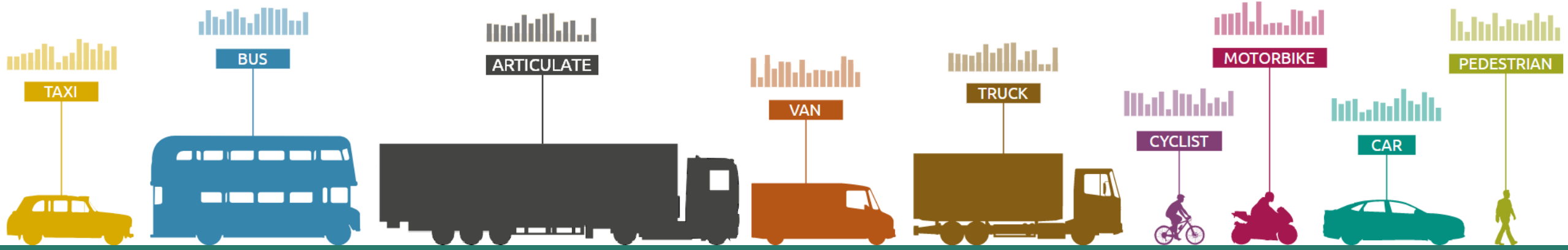
Deployments

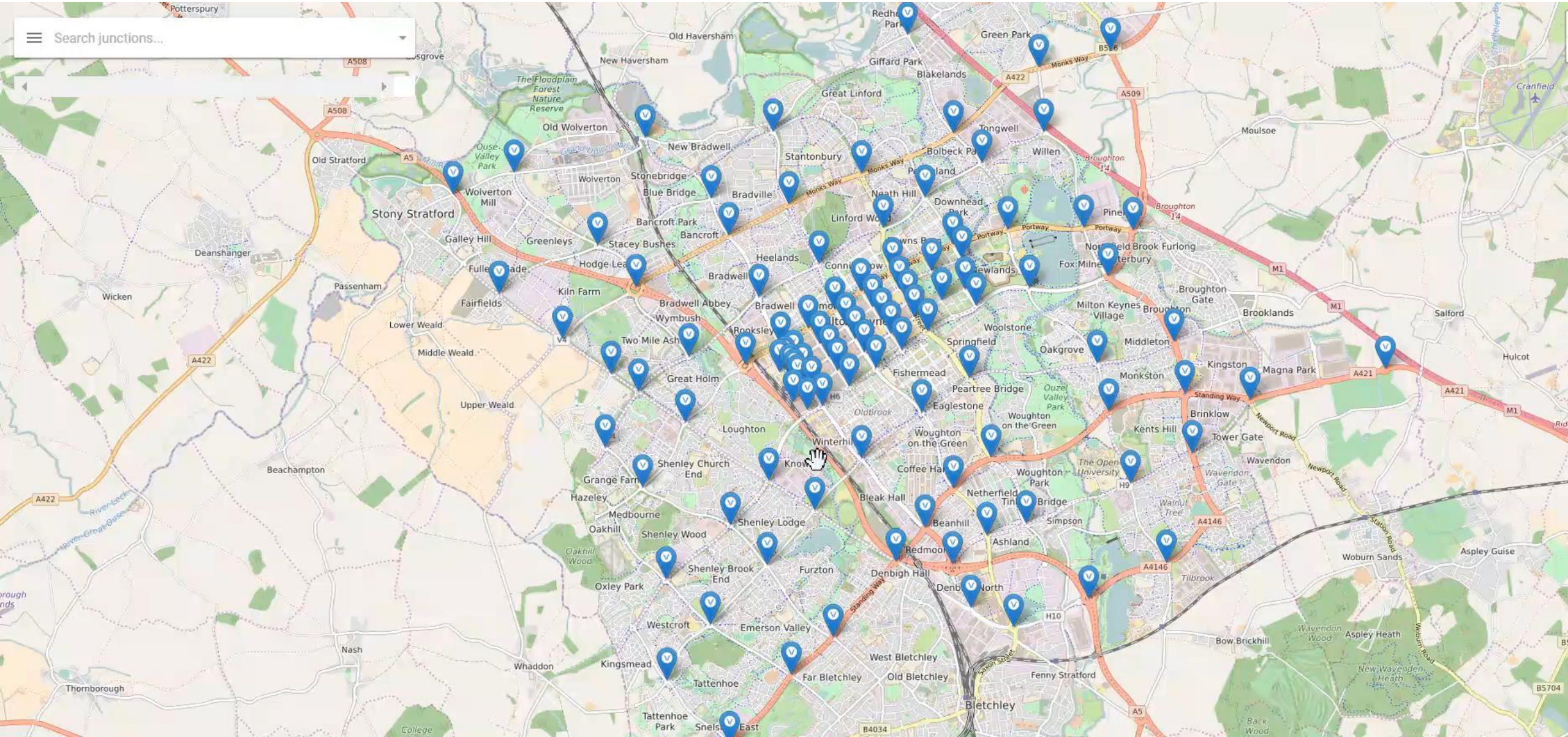
Over 1000 units deployed in the UK with public and private sector clients, and a growing reach of international projects



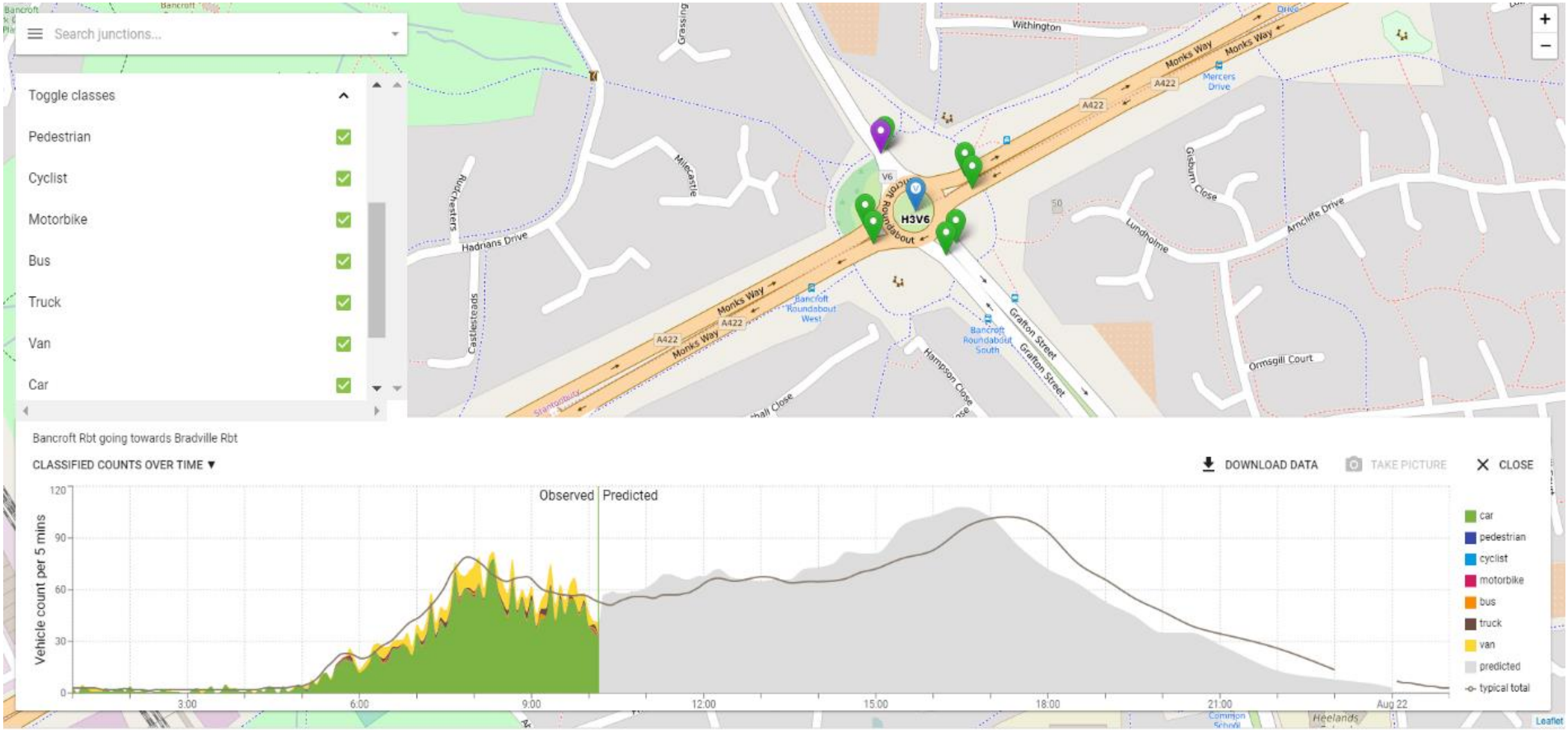


City-scale Sensing Network Milton Keynes UK

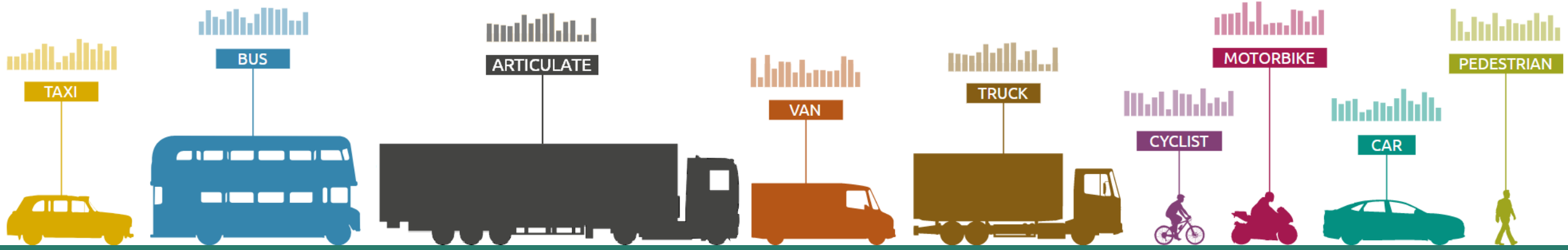



Search junctions...
Potterspury
Old Haversham
New Haversham
Giffard Park
Blakelands
Green Park
Great Linford
Old Wolverton
New Bradwell
Stantonbury
Tongwell
Willen
Moulsoe
Cranfield
Old Stratford
Wolverton
Stonebridge
Blue Bridge
Bradville
Neath Hill
Downhead Park
Linford Wood
Stony Stratford
Wolverton Mill
Bancroft Park
Bancroft
Stacey Bushes
Galley Hill
Greenleys
Deanshanger
Heelands
Bradwell
Fox Milne
Newlands
Passenham
Kiln Farm
Fairfields
Wicken
Bradwell Abbey
Wymbush
Lower Weald
Two Mile Ash
Middle Weald
Great Holm
Upper Weald
Fishermead
Peartree Bridge
Eaglestone
Woolstone
Springfield
Oakgrove
Milton Keynes Village
Middleton
Monkston
Kingston
Magna Park
Brooklands
Broughton Gate
Salford
Hulcot
Brinklow
Kents Hill
Tower Gate
Wavendon
Wavendon Gate
Woughton on the Green
Woughton Park
Loughton
Shenley Church End
Grange Farm
Hazeley
Medbourne
Oakhill
Shenley Wood
Shenley Lodge
Beachampton
Bleak Hall
Coffee Hall
Netherfield
Bridge
Simpson
Beanhill
Ashland
Redmoor
Denbigh Hall
Furzton
Shenley Brook End
Oxley Park
Westcroft
Emerson Valley
Kingsmead
Tattenhoe
Tattenhoe Park
Nash
Whaddon
Thornborough
West Bletchley
Far Bletchley
Old Bletchley
Fenny Stratford
Bletchley
Bow Brickhill
Aspley Heath
Woburn Sands
Aspley Guise
Tilbrook
Walnut Tree
The Open University
Ouzel Valley Park
Ouse Valley Park
The Floodplain Forest Nature Reserve
River Great Ouse
River Lock
Monks Way
Portway
Standing Way
Newport Road
Station Road
Savon Street
Watling Street
Broughton
A508
A5
A422
A509
A421
A4146
M1
B5704
B4034
H6
H9
H10
V4

Over 2 billion data points to date

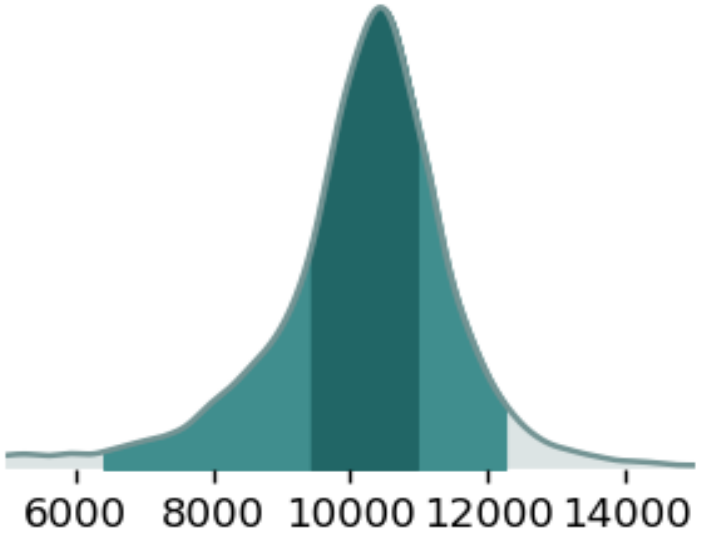


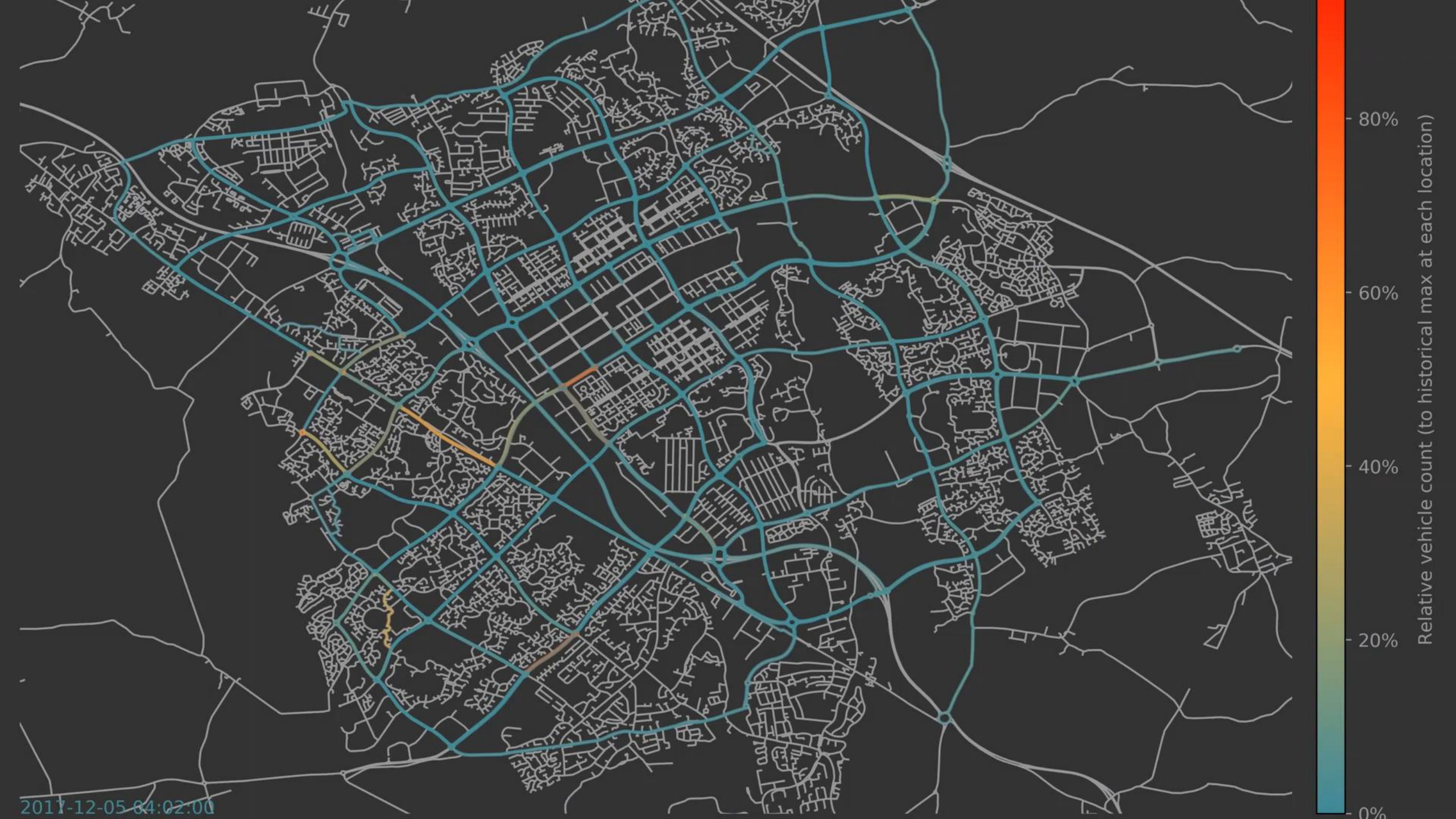
Value for Practitioners



Transport planning: Better demand data

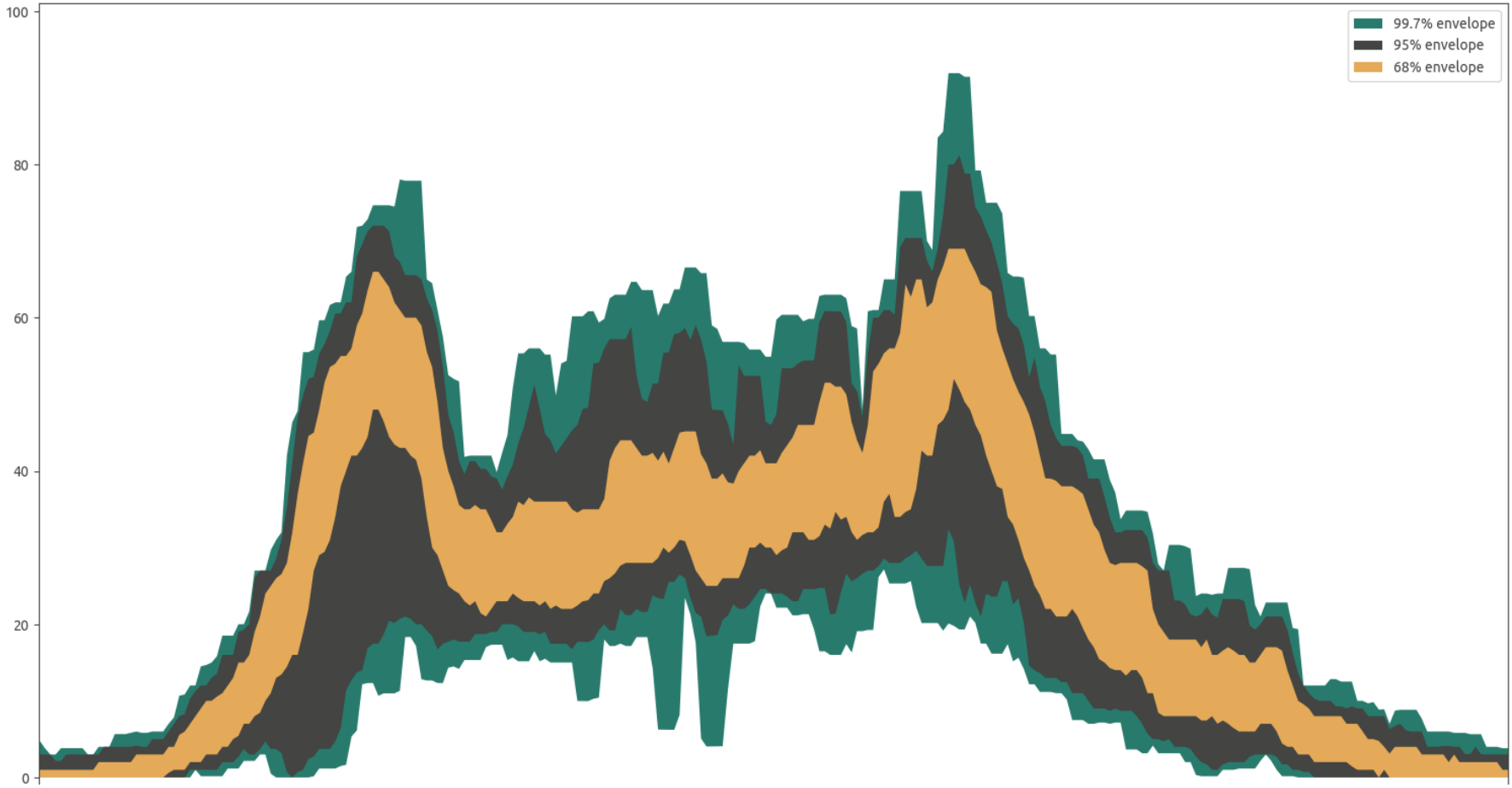
- Before: manual, or temporary ATC
- Demand varies significantly
- **10% chance of misrepresenting typical demand by ~30%**
- Now: full picture of frequency curves and geographic distribution



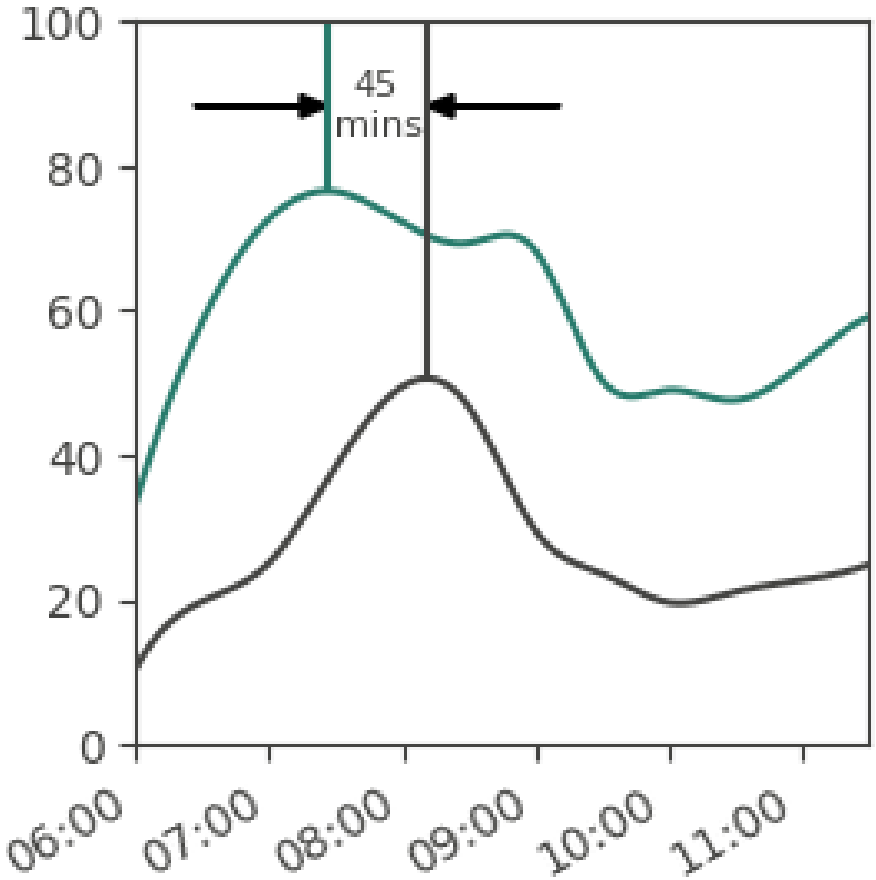

2017-12-05 04:02:00
80%
60%
40%
20%
0%
Relative vehicle count (to historical max at each location)

Anomaly Detection

- Probability envelope
- 68%, 95%, 97.5%
- Alert if consistently outside
- In alert state, show propagation



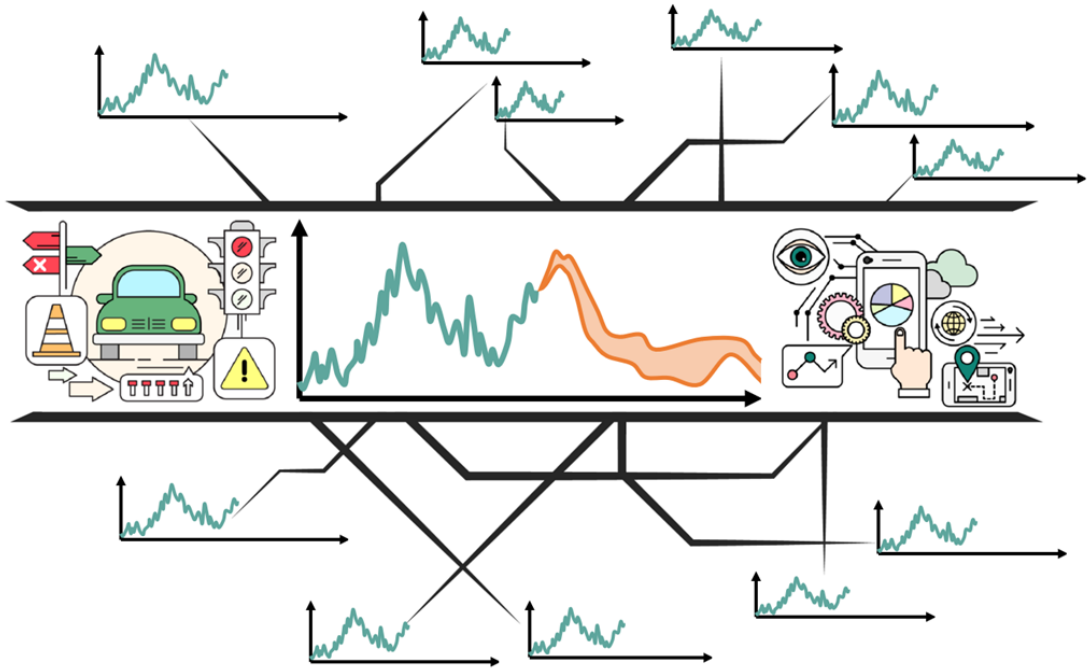
Route Time Lag



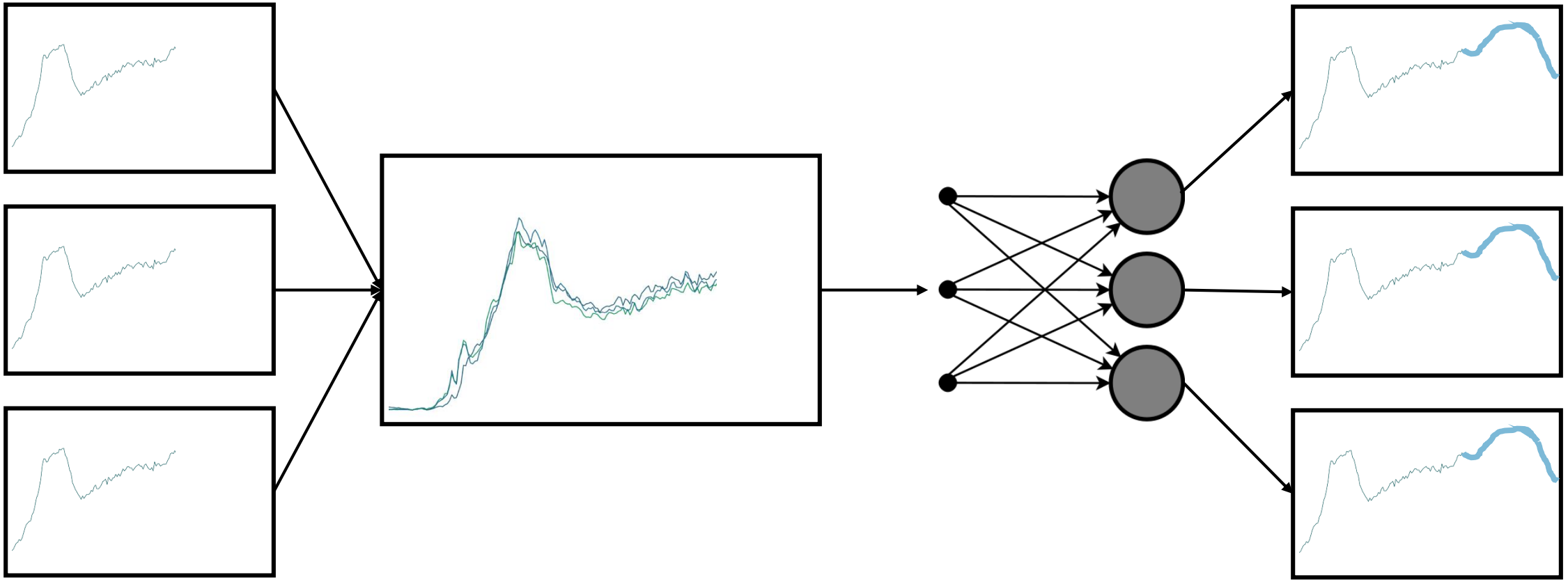
- Drivers only switch when green route congested
- SatNav data is too slow
- Predict this event, raise alert
- Use VMS to redirect drivers much earlier

-> Reduce congestion on green road

Traffic Prediction



Prediction overview



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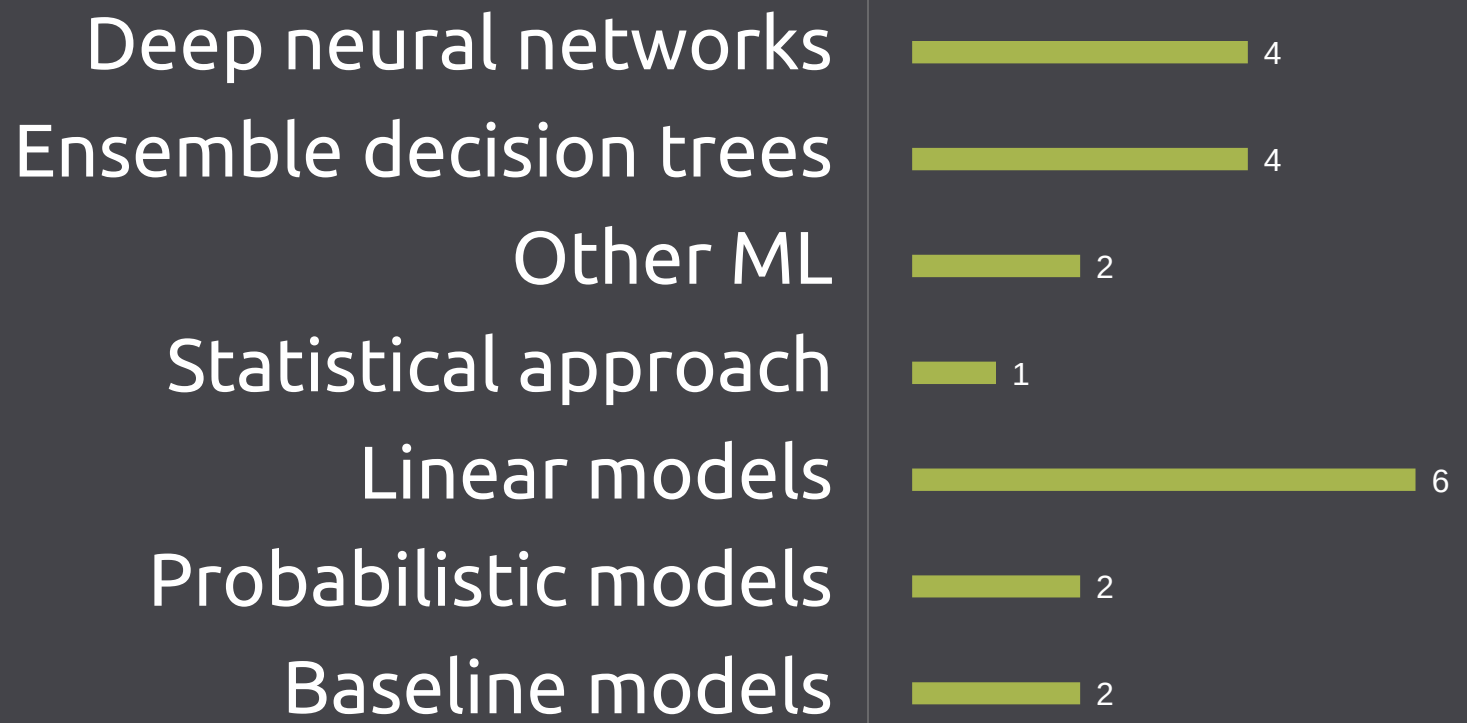
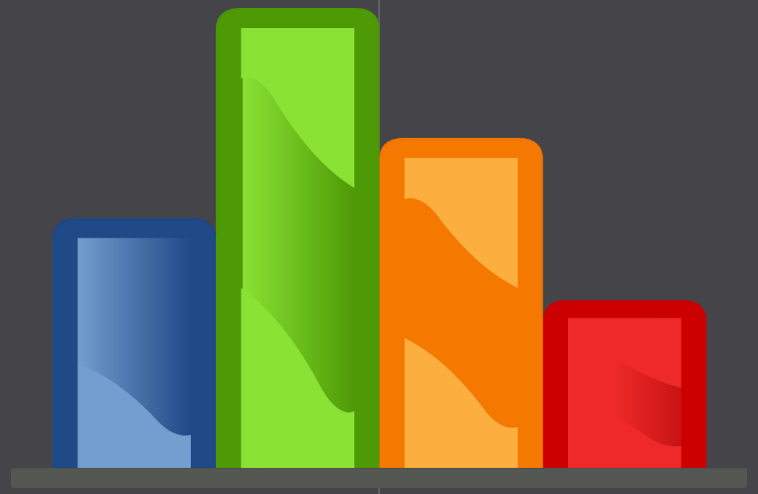
Compared Model Types



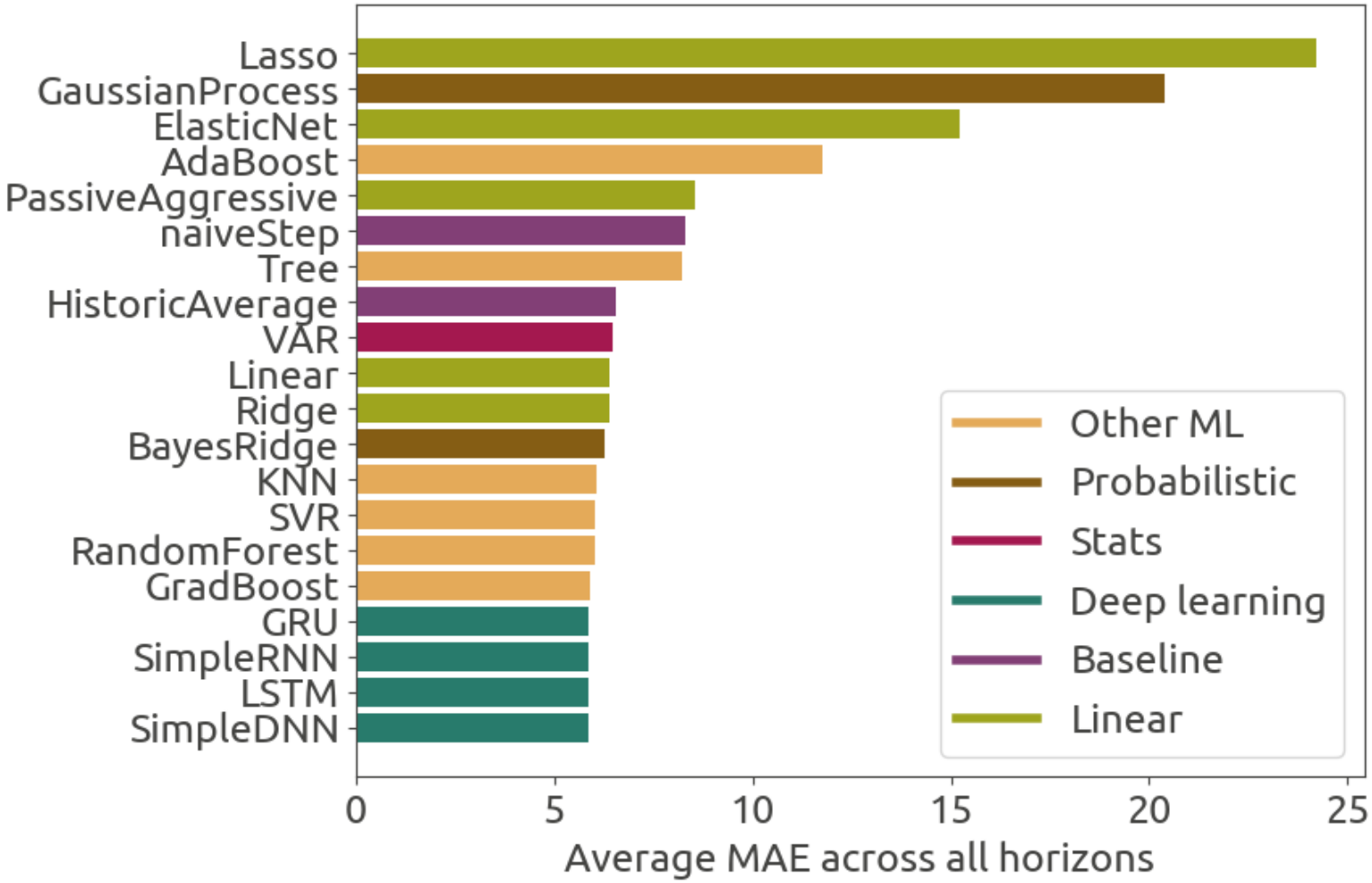


Draw Conclusions

- Best model accuracy on unseen data
- Comparison across metrics and horizons
- Sensitivity to hyperparameter tuning
- Training and predicting speed

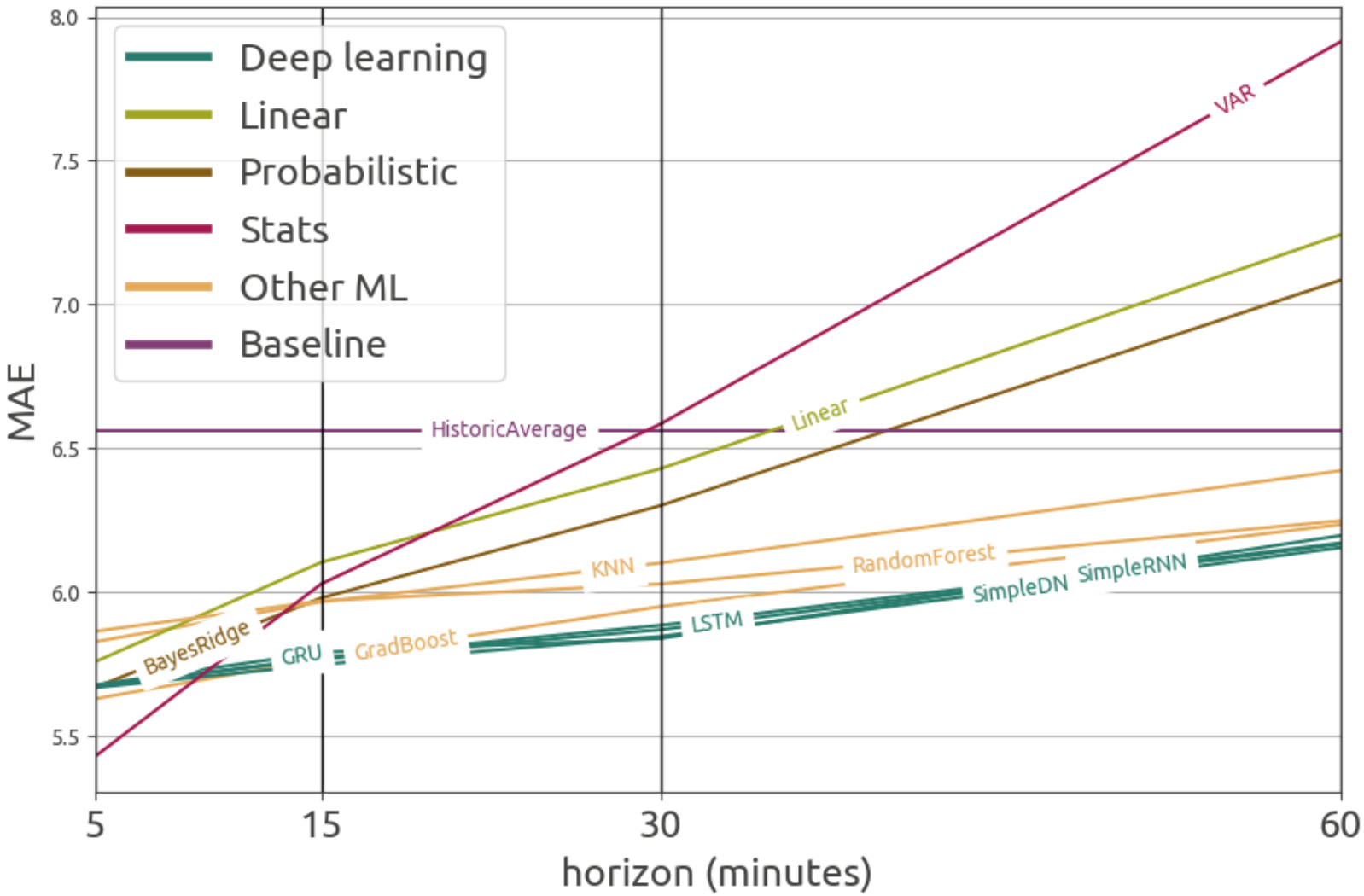
Accuracy Comparison

- Overview



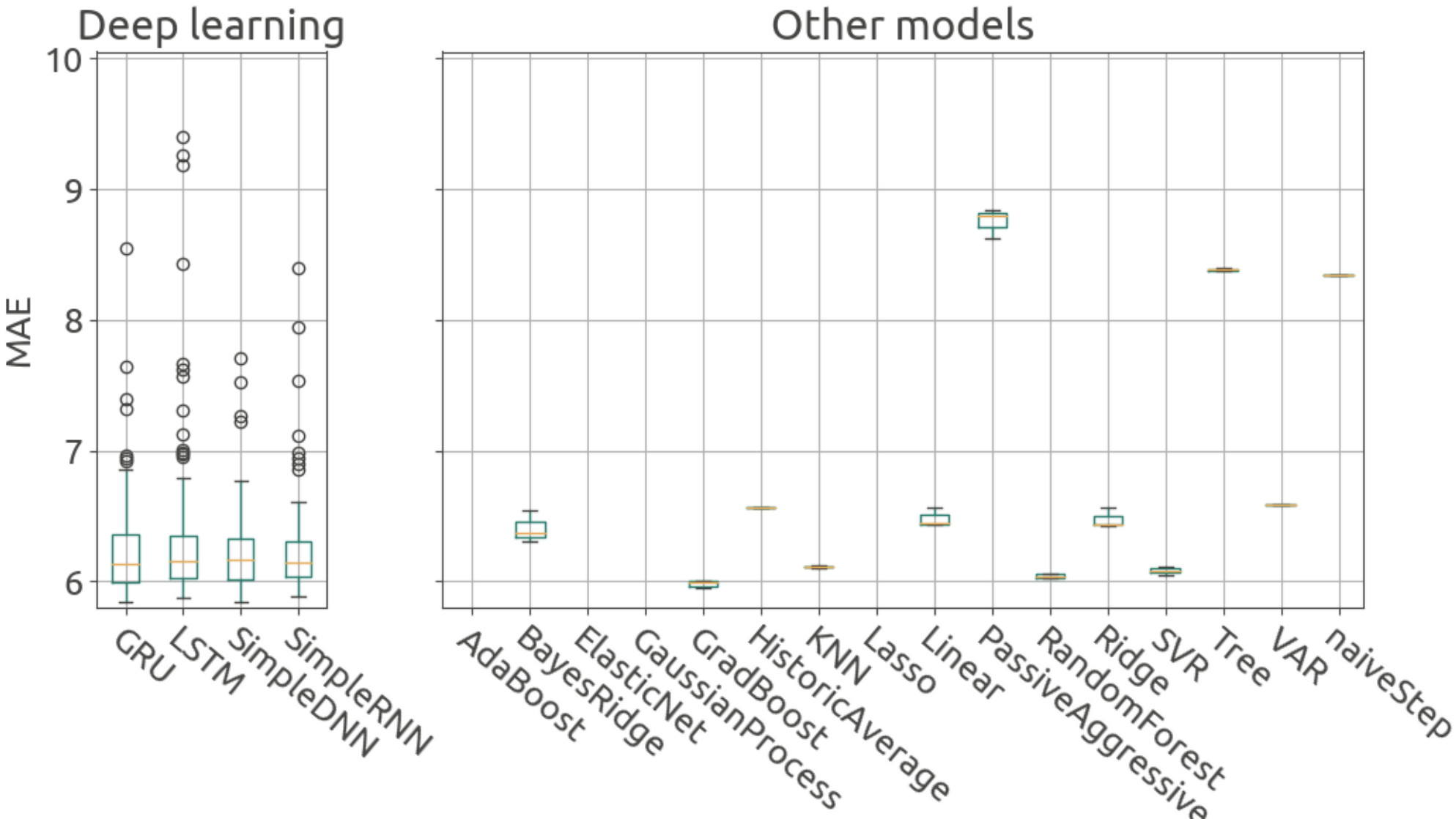
Accuracy Comparison

- Across horizons



Model Tuning Comparison

- Accuracy variation (30 minutes ahead)



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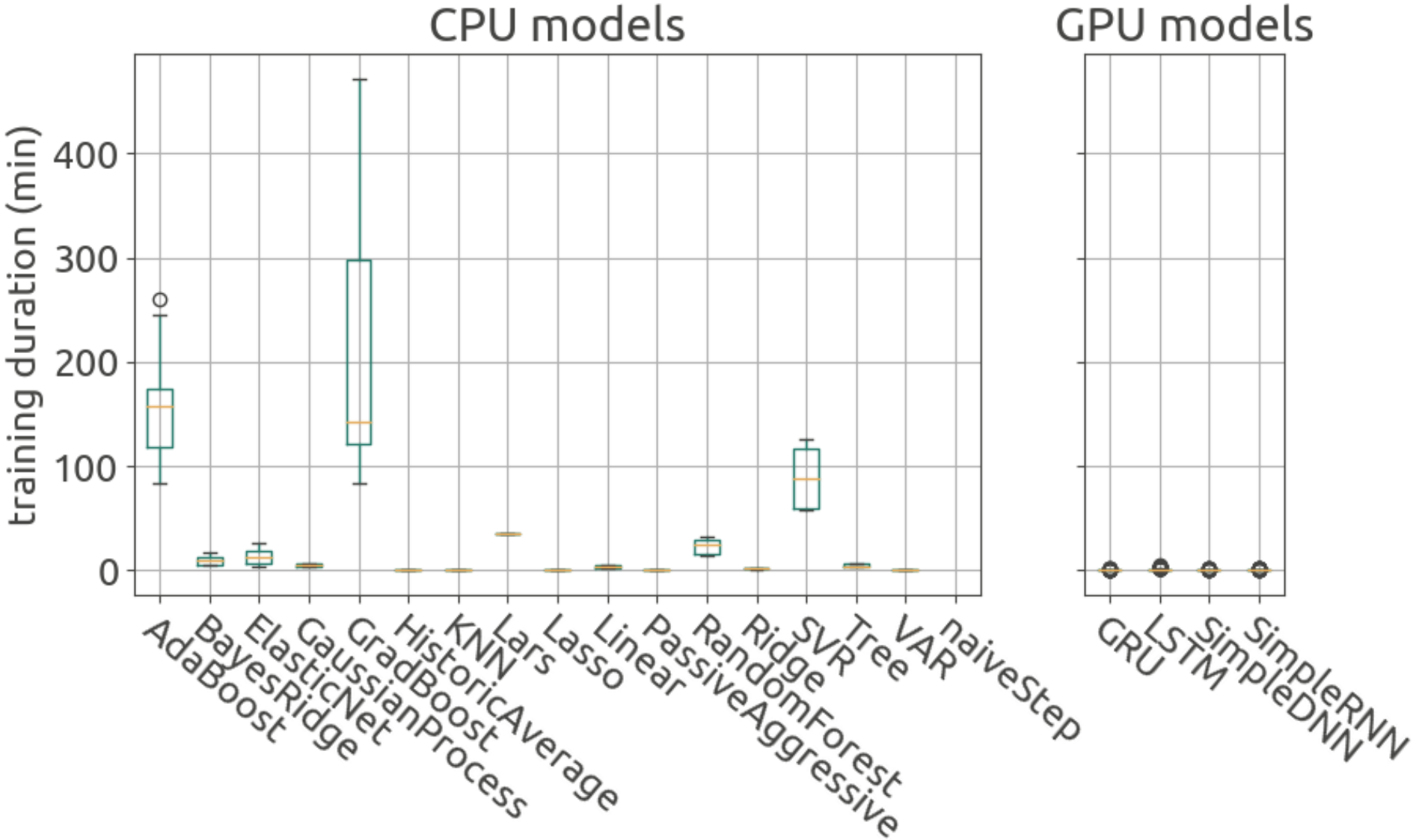
Model Tuning Comparison

- Deep learning can give the best accuracy
- But also some of the worst
- And it has the most parameters to tune
- Gradient boosting is much more stable
- Best choice depends on use case and constraints

Model Speed Comparison



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Model Speed Comparison

- Deep learning was fast (GPU)
- XGBoost or LGBM: probably comparable
- And more tuning -> more models -> longer training

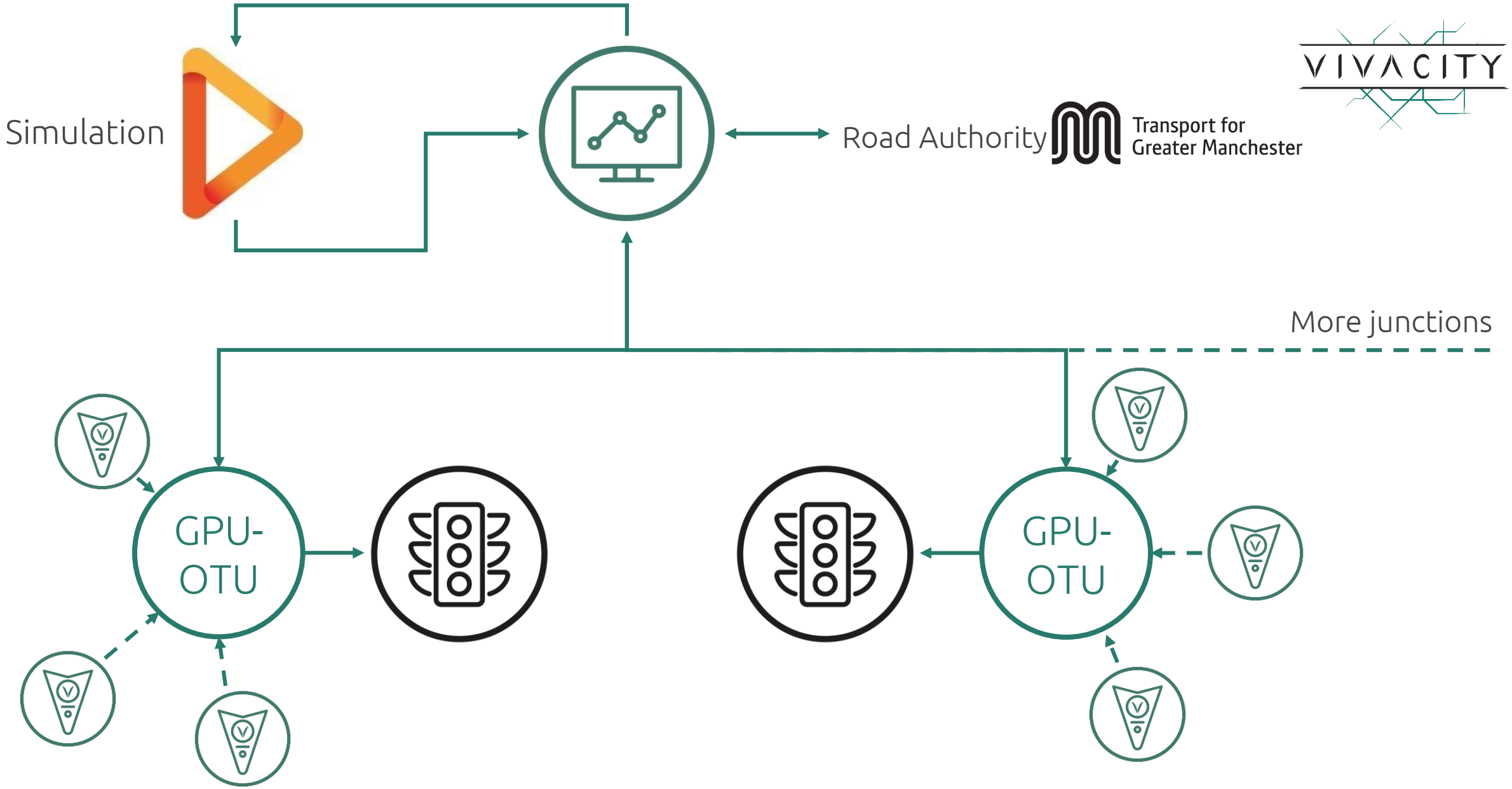
Traffic Signals Optimization

Signal Optimisation: Current Tech

- Outdated algorithms assuming limited compute available
- Based on very simple data
- Doesn’t include pedestrians and cyclists well
- Manual calibration
- Inflexible optimisation priorities

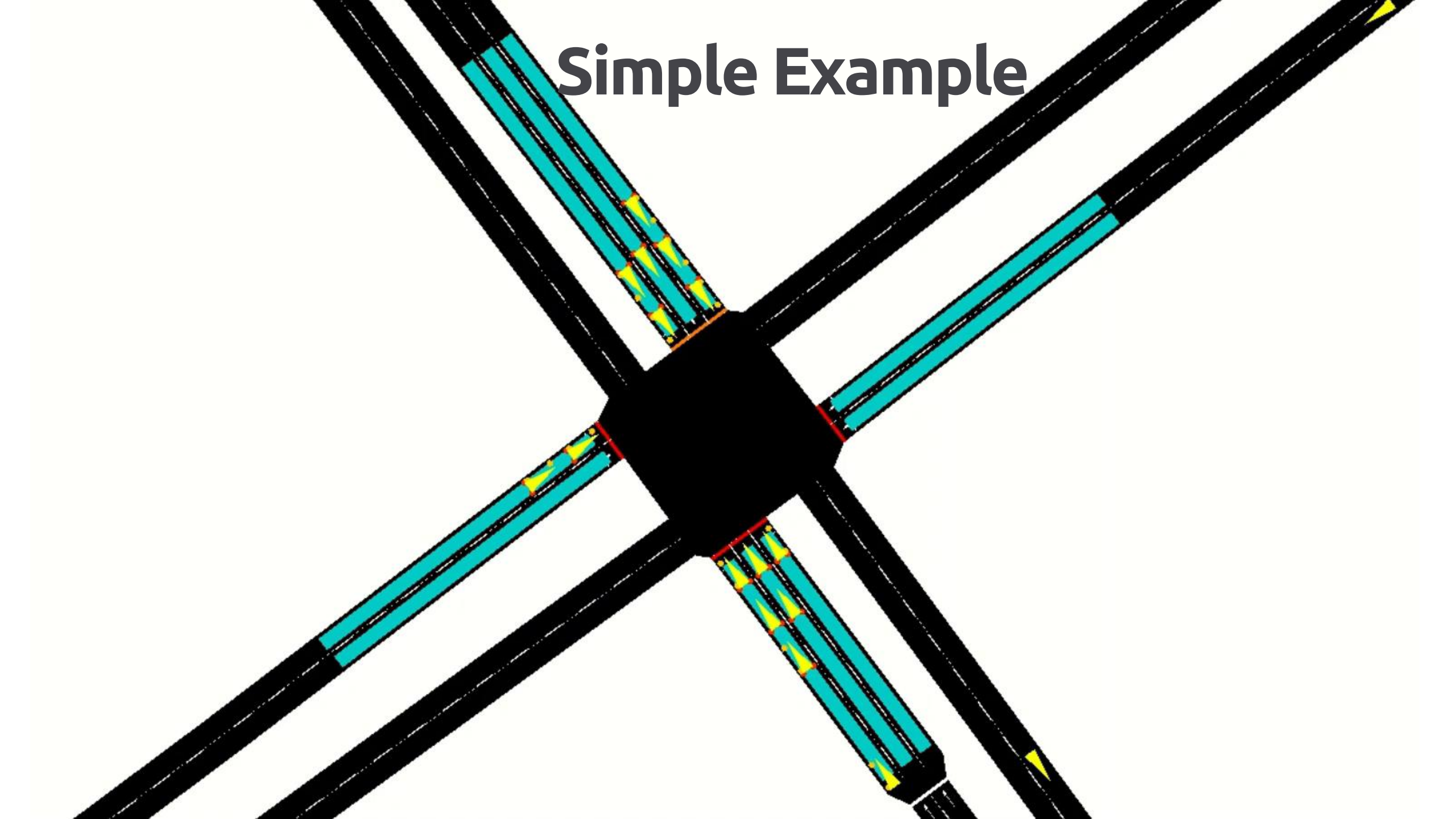
Signal Optimisation: Vivacity

- GPU-accelerated signal control
- -> Enabling reinforcement learning
- Automated, ongoing calibration
- Flexible optimisation priorities
- -> Less delay, more balanced system
- Ready to interface with Connected and Autonomous Vehicles

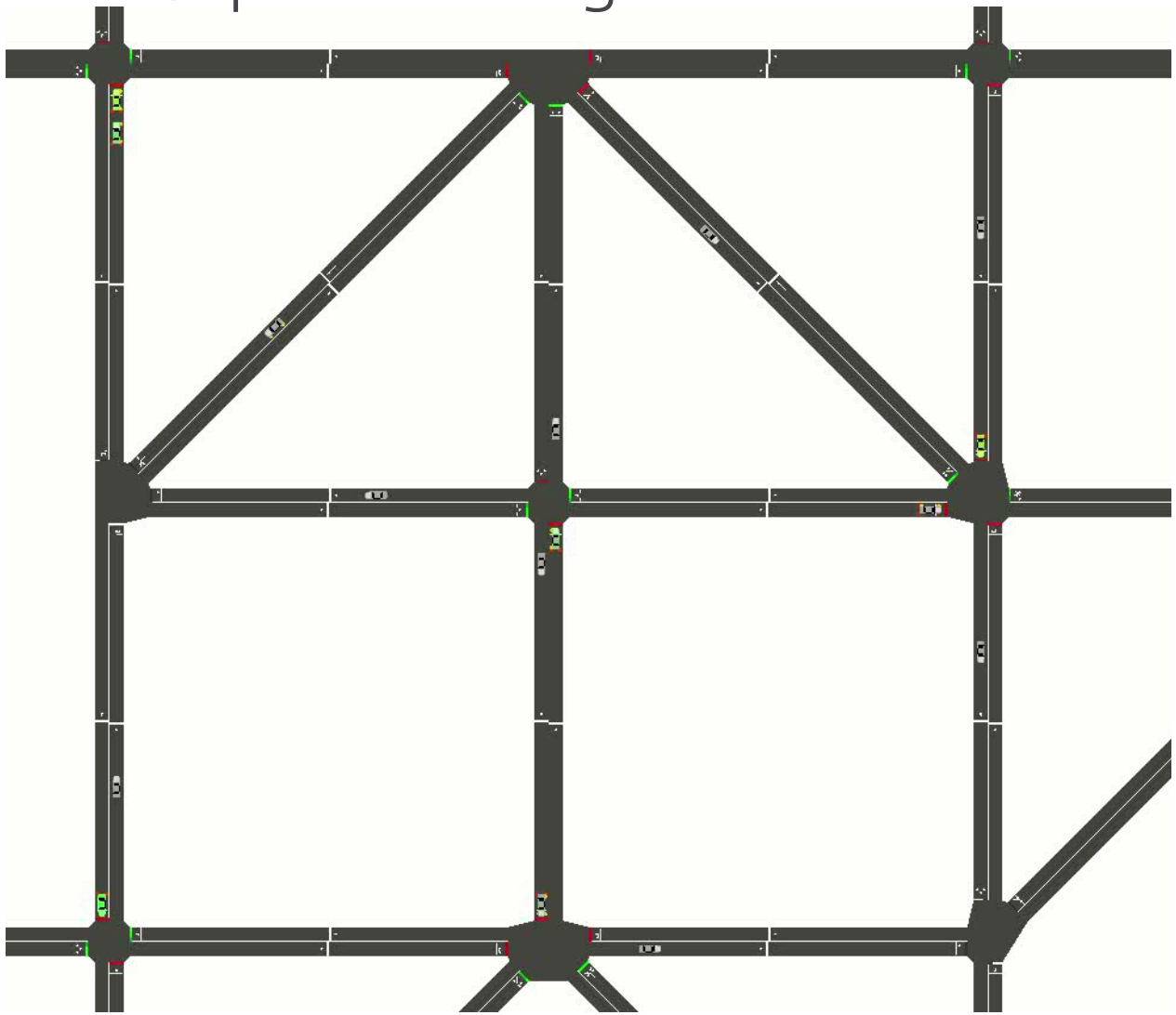


- Gather data
- Calibrate simulation
- Train ML control system
- Deploy
- Demonstrate & configure
- Connect to signals

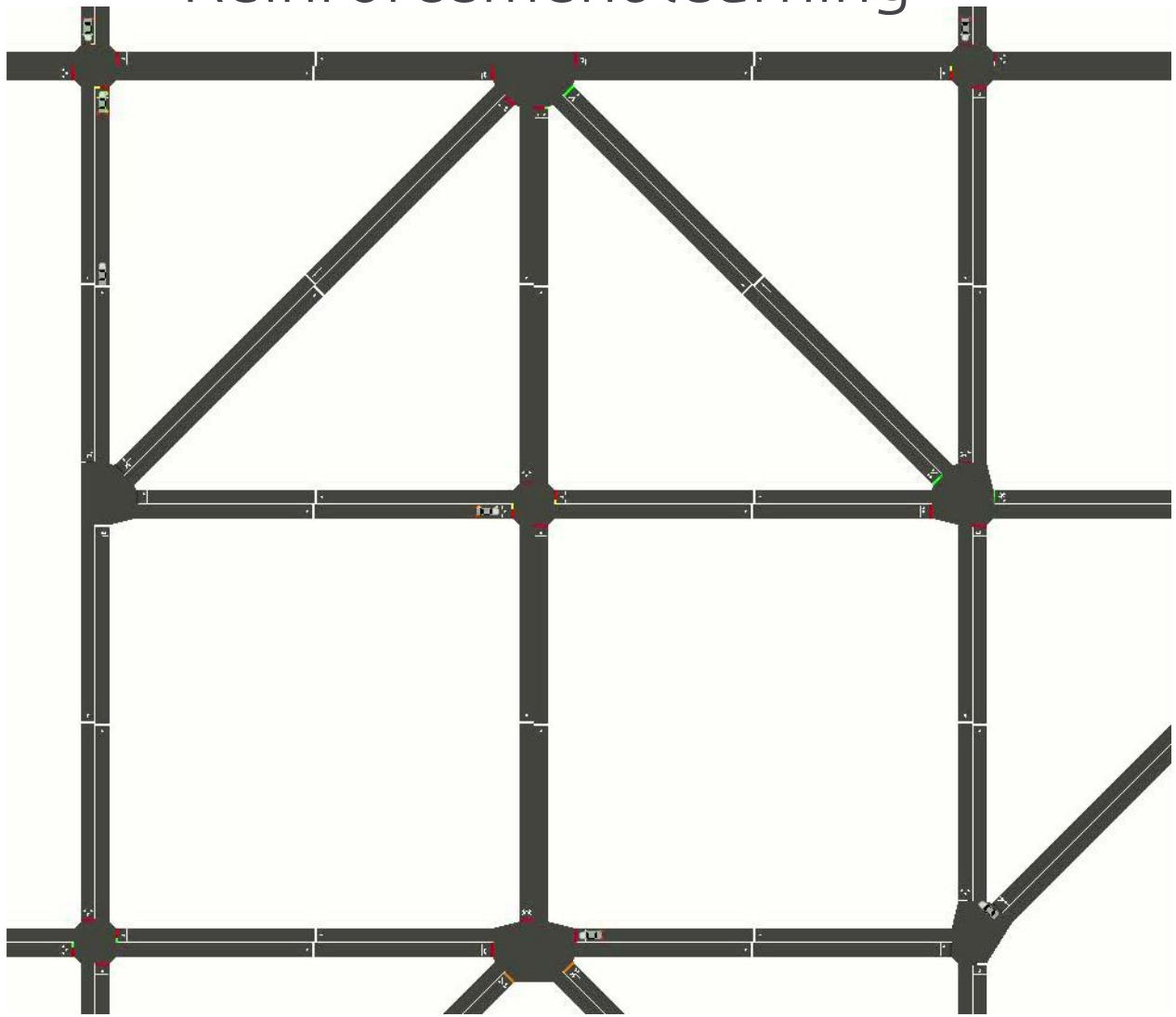
Simple Example



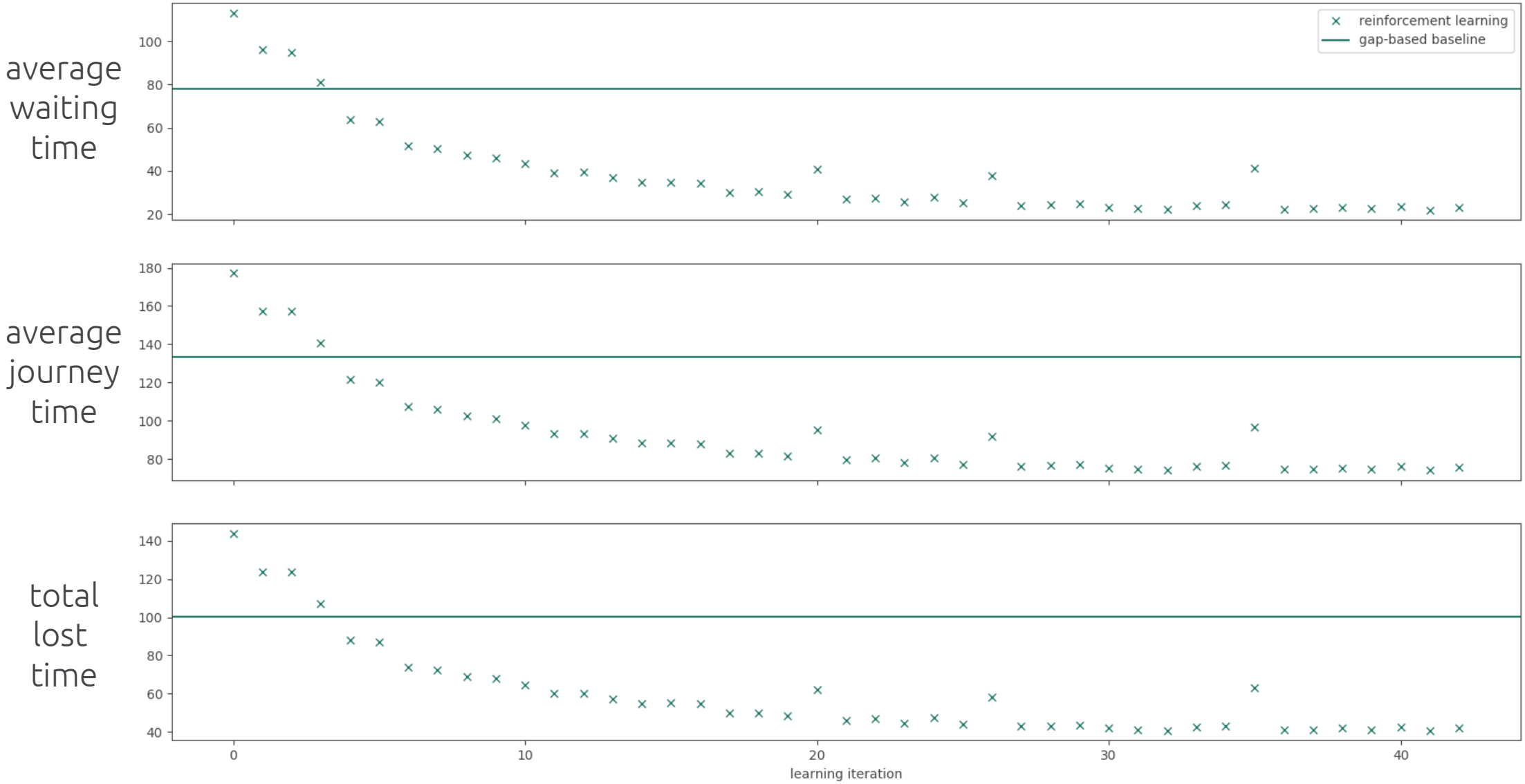
Gap-based stage extension



Reinforcement learning



Comparison to Gap-Based Optimisation



Going Forwards

Data Collection

GPU enabled AI traffic signal control

Integrated urban mobility optimisation

Analytics and Insights

Real-time data sharing with CAVs

Get in touch

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Shaun Howell: shaun@vivacitylabs.com

Please provide feedback via the GTC mobile app