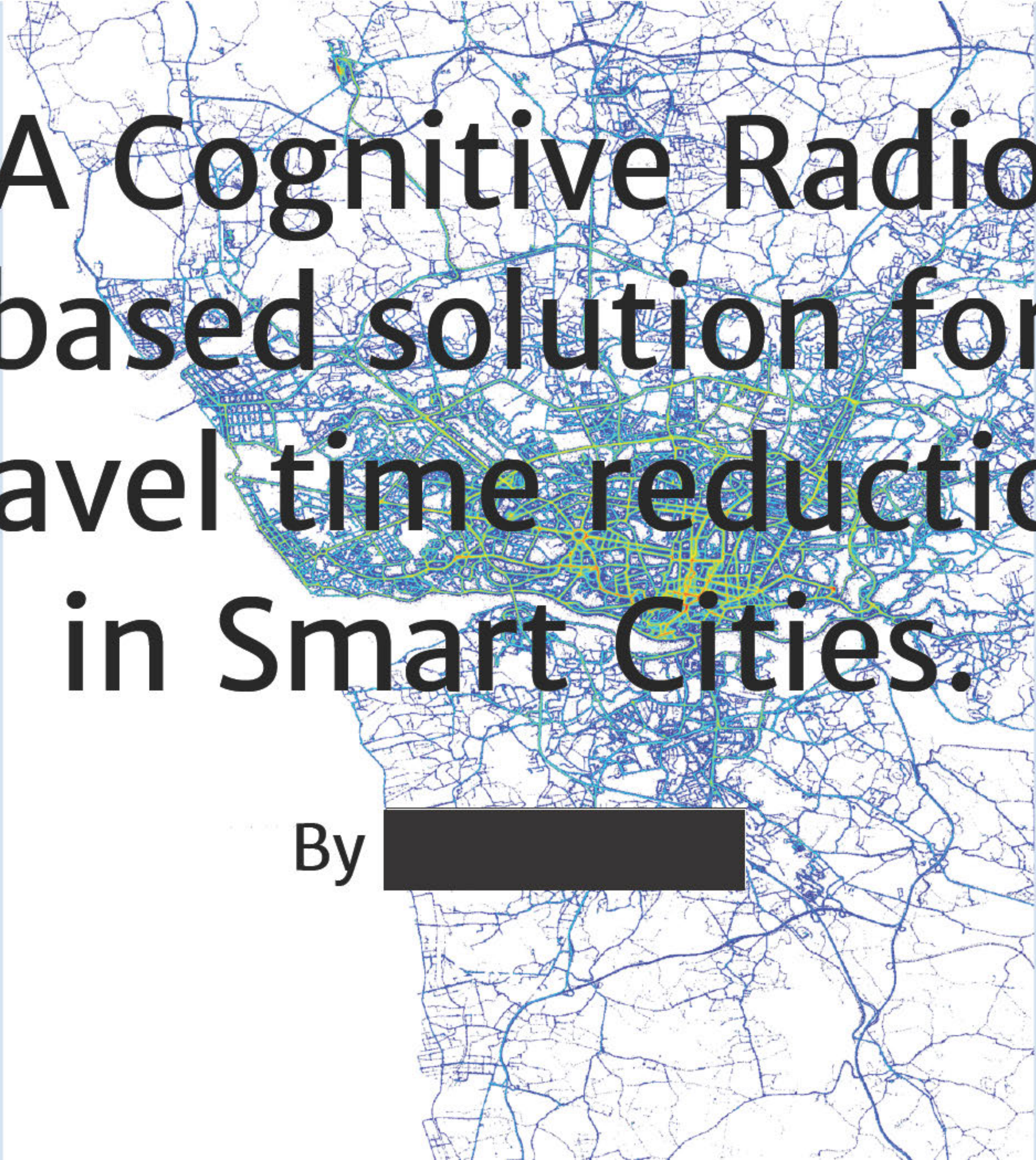

A Cognitive Radio based solution for travel time reduction in Smart Cities.

By [redacted]

What is my research?

A Cognitive Radio based solution for Travel Time reduction in Smart Cities

My task was to implement a Cognitive radio inspired traffic algorithm, in order to try and mitigate traffic congestion.

Why?

- A study conducted by INRIX a leading traffic investigation service.
- Between 2013 and 2030 the expected economic loss due to traffic congestion in UK alone is expected to be a staggering £307 billion [1].
- Further reporting that this roughly equates to an increased congestion per-household cost from £1,426 in 2013 to £2,057 in 2030 [1].

Why?

- To save money
- Increase safety
- Boost the economy
- Reduce the stress of road users
- Reduce air pollution

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Existing solutions?

After performing background research on the effects of traffic congestion. I then proceeded to research cutting edge traffic mitigation techniques.

TMS systems [17]

Smart TMS systems [25]

Smart vehicles V2I/V2V [26]

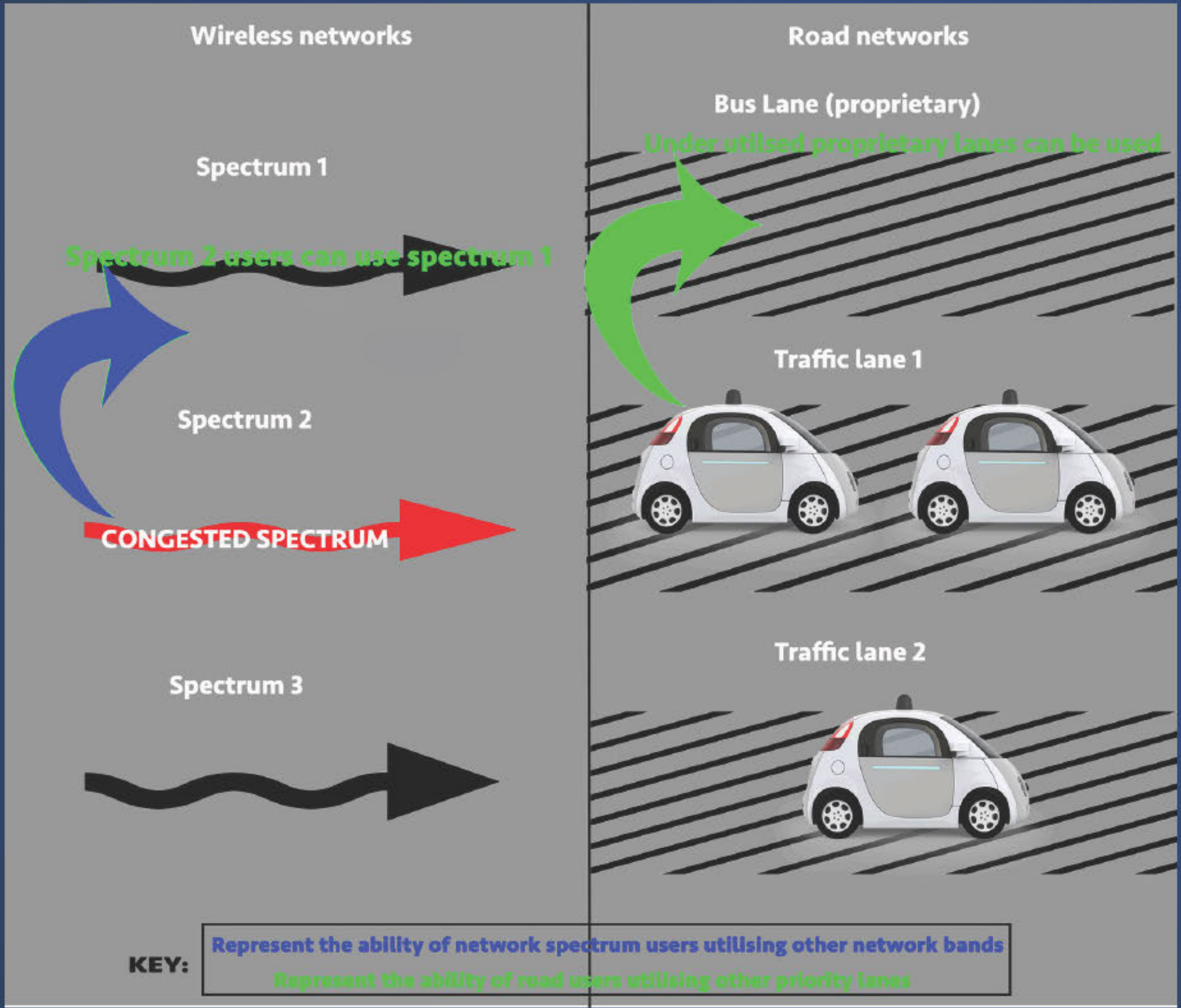
My Solution?

To Mimic Cognitive Radio on a road traffic network.

What is Cognitive Radio?

Cognitive Radio Inspired TraffIc Congestion algorithm (CRITIC)

My Solution?



- Knowledge of its operational and geographical environment, established policies, and its internal state.
- Autonomously adjust its operational parameters and protocols according to its obtained knowledge to achieve predefined objectives
- Learn from the obtained results.

Implementation

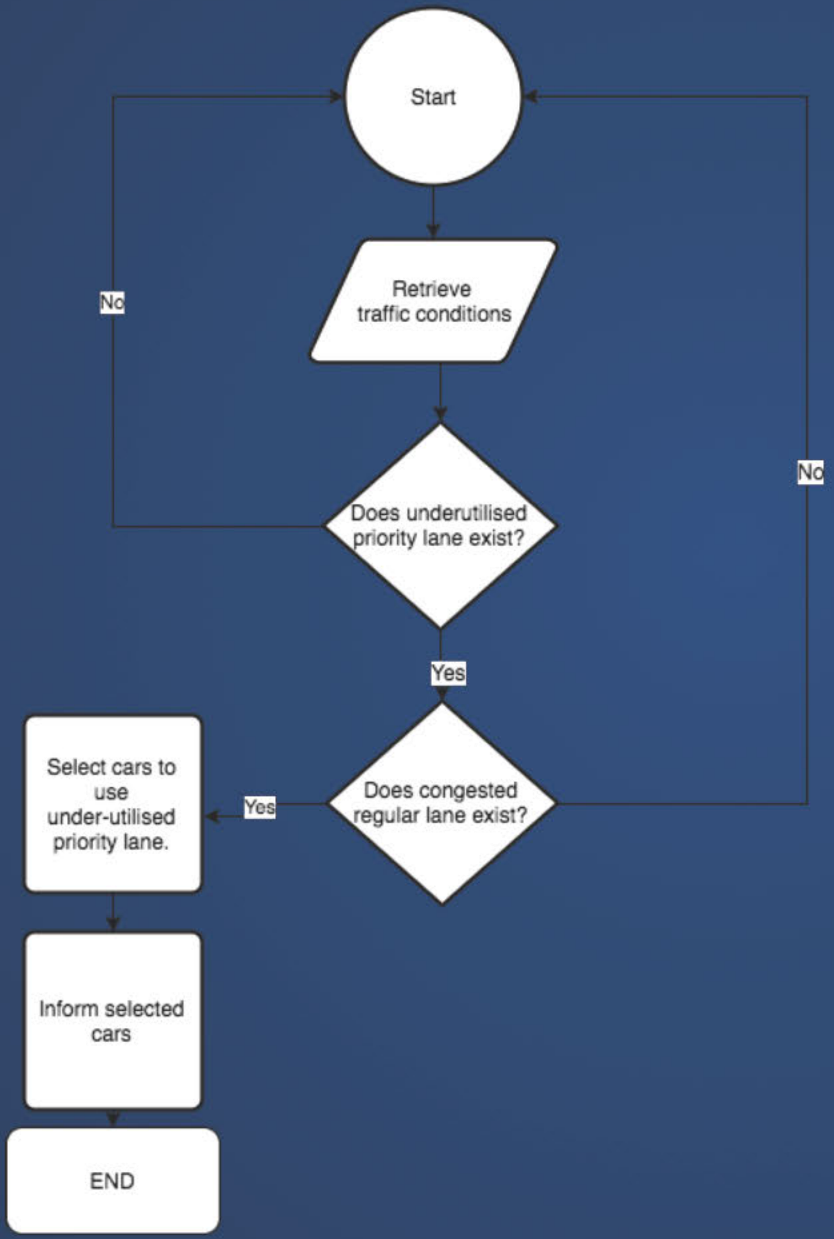
Python was chosen to implement the logic required for the algorithm.

Python works very well with the simulation software.

Implemented priority vehicle detection system.

Implemented priority lane management system.

Implementation



A flow chart of the TMS logic

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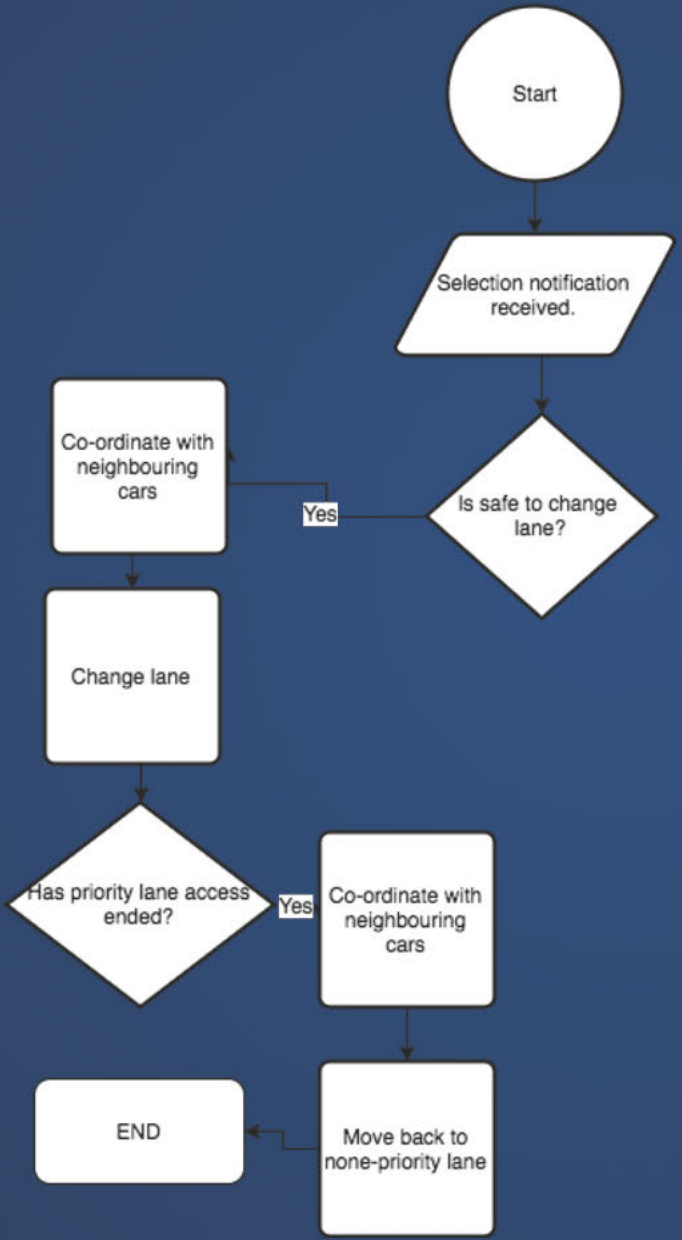
Implementation



A flow chart showing the vehicle action logic

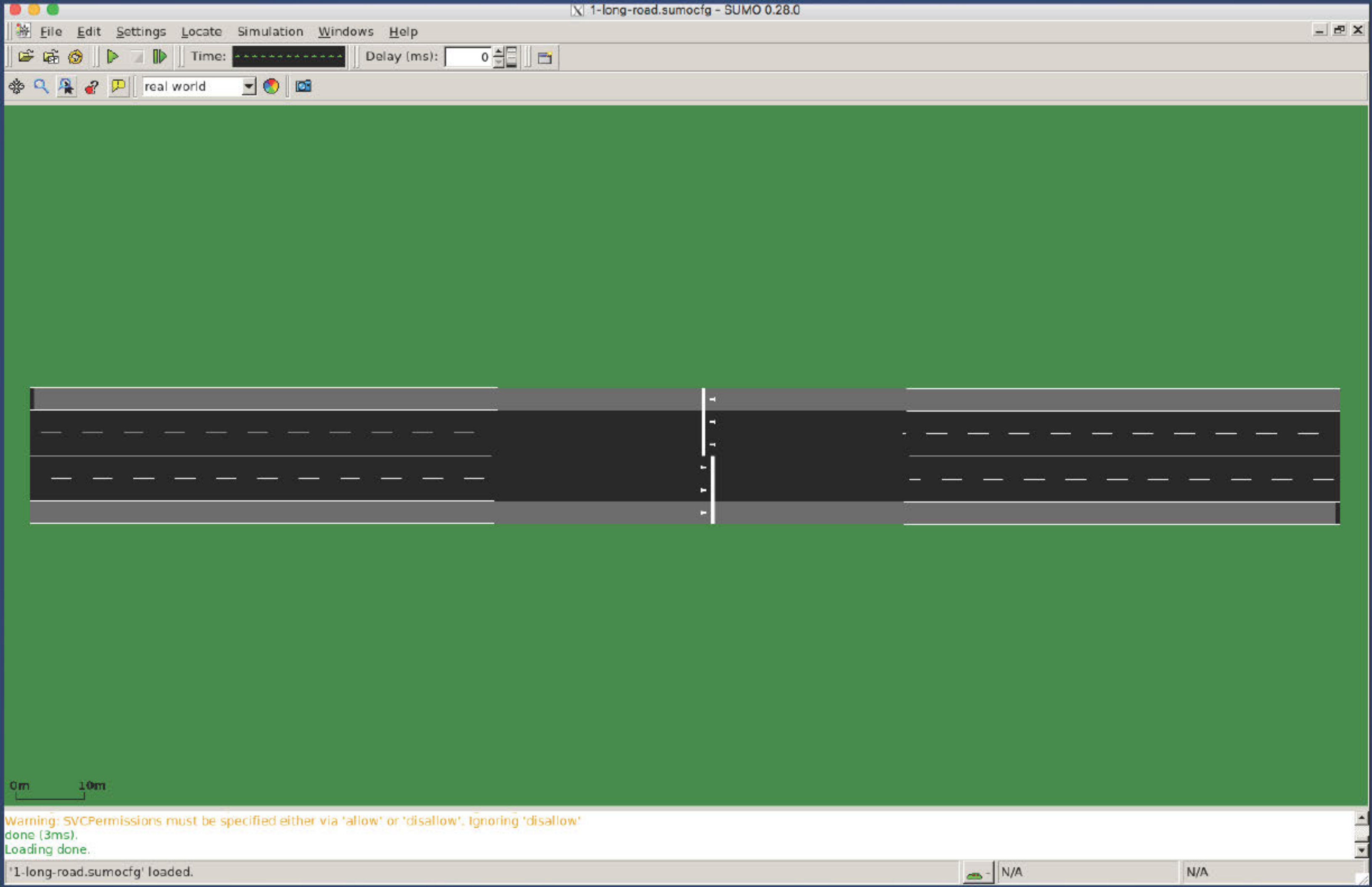
Simulation Environment

I utilised SUMO, which is an open source traffic simulator.

SUMO provides an array of tools, which allow us to generate and simulate an array of different road network topologies.

Along side SUMO I also utilised TraCi, which is a Python API for interfacing and modifying SUMO simulations during run time.

Simulation Environment



Simulation Environment

I produced 3 simulations to test my Algorithm:

Custom Prototype

10x10 GRID network

Abstract Network

Results

Results

Statistics

Three unique iterations with different seed values.

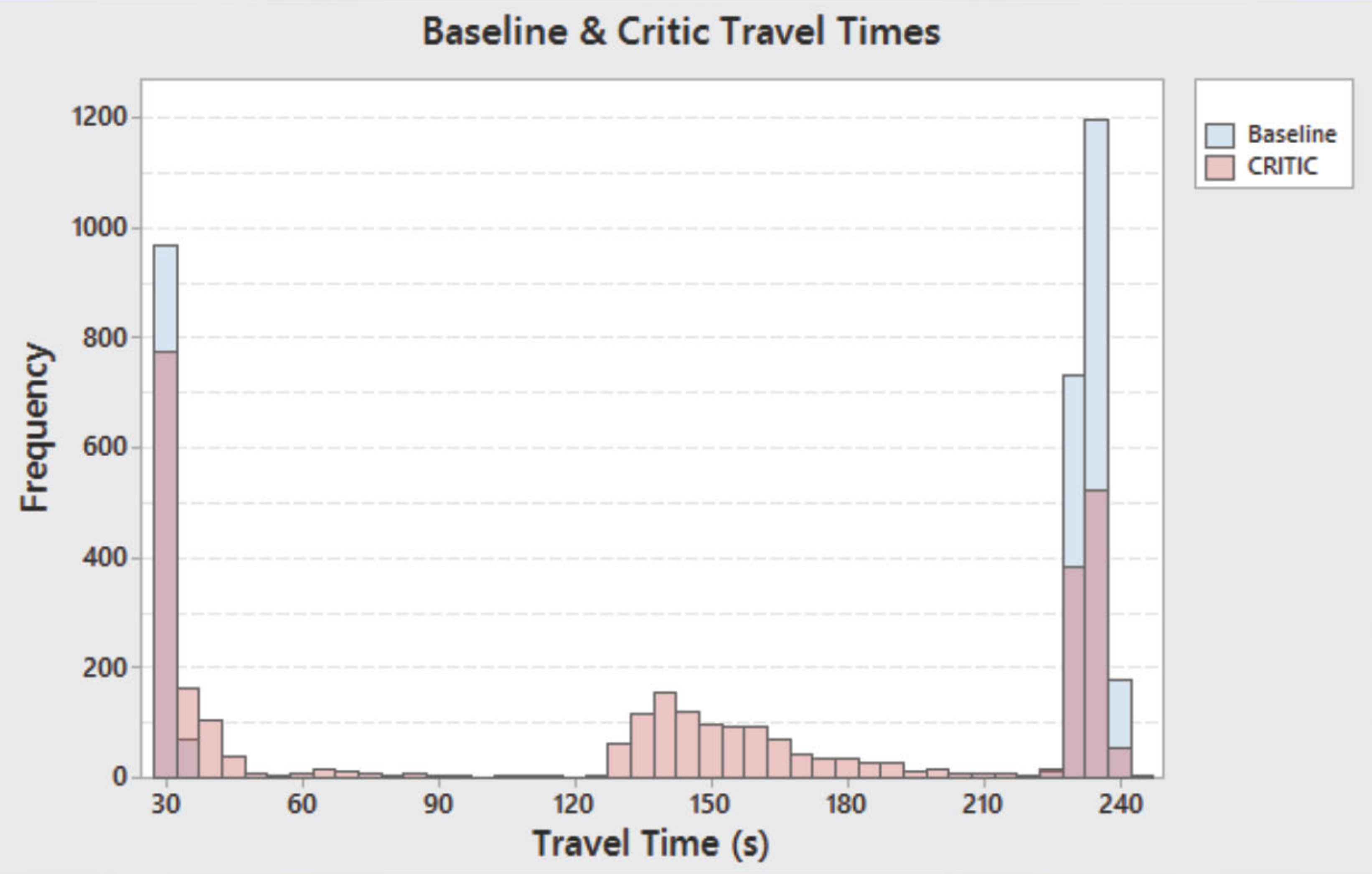
To assess the performance of the simulation I utilised 2 different metrics:

- Average Travel Time (ATT)
  - All travel times / total num vehicles
- Travel Time Index (TTI)
  - For example, a TTI of 1.3 indicates a 20-minute free-flow trip required 26 minutes.

Statistics

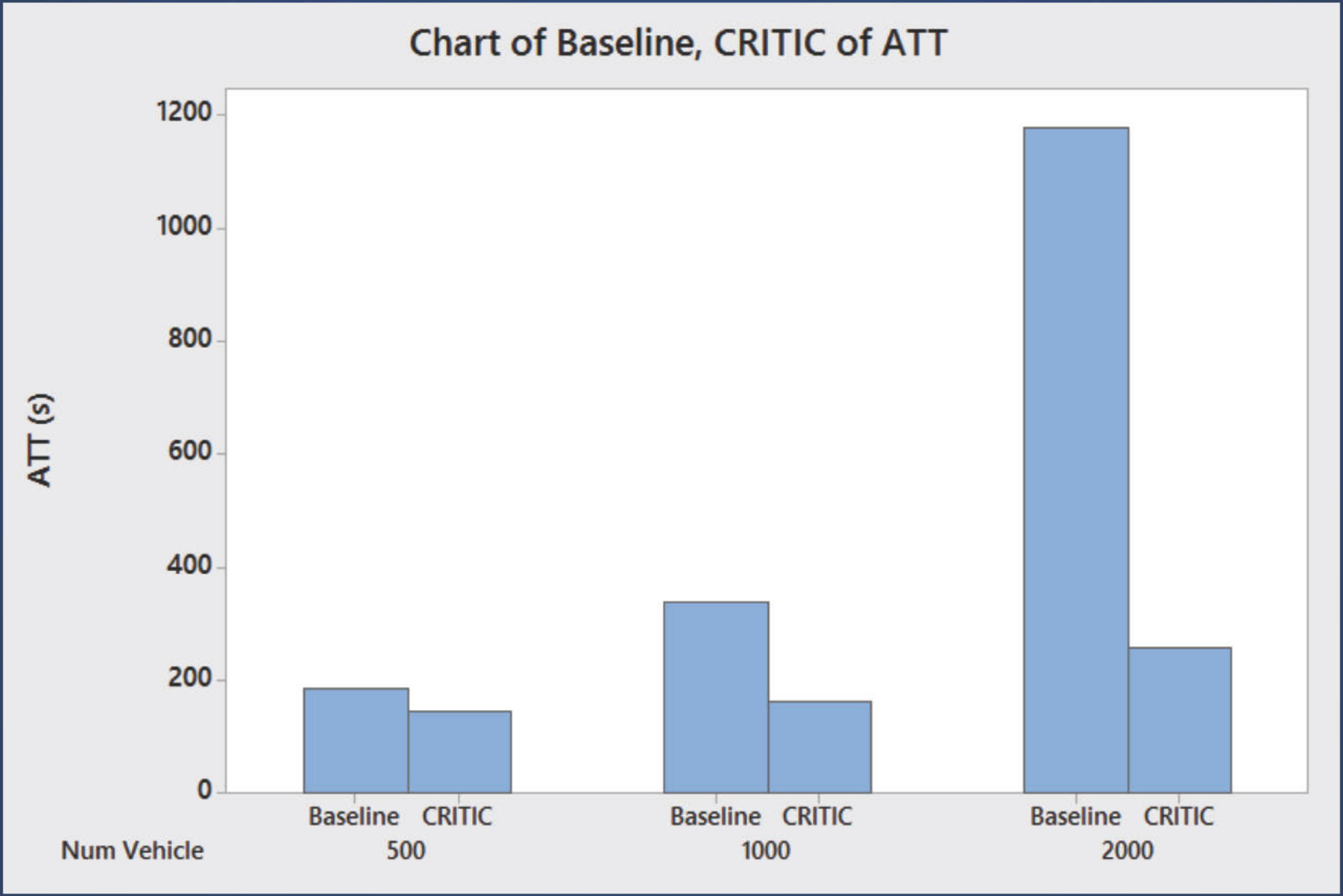
CRITIC vs Baseline: Achieved Travel Times in Bespoke network (5000 vehicles)

%ATT: -19.24 %TTI: -19.56



Statistics

CRITIC vs Baseline: The achieved ATTs in the Abstract Network



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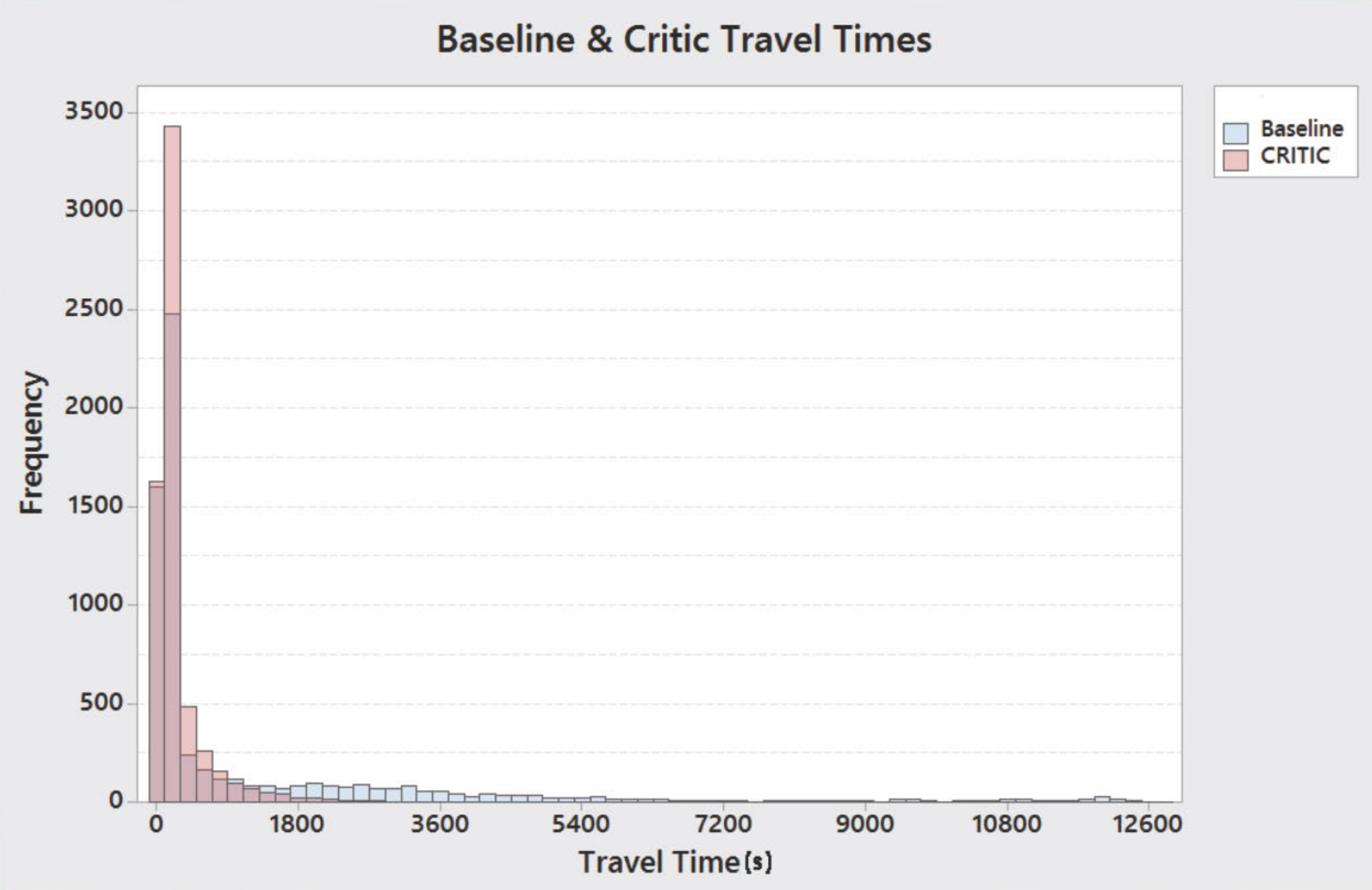
Statistics

CRITIC vs Baseline: The achieved Travel Times in the Abstract network (2000)

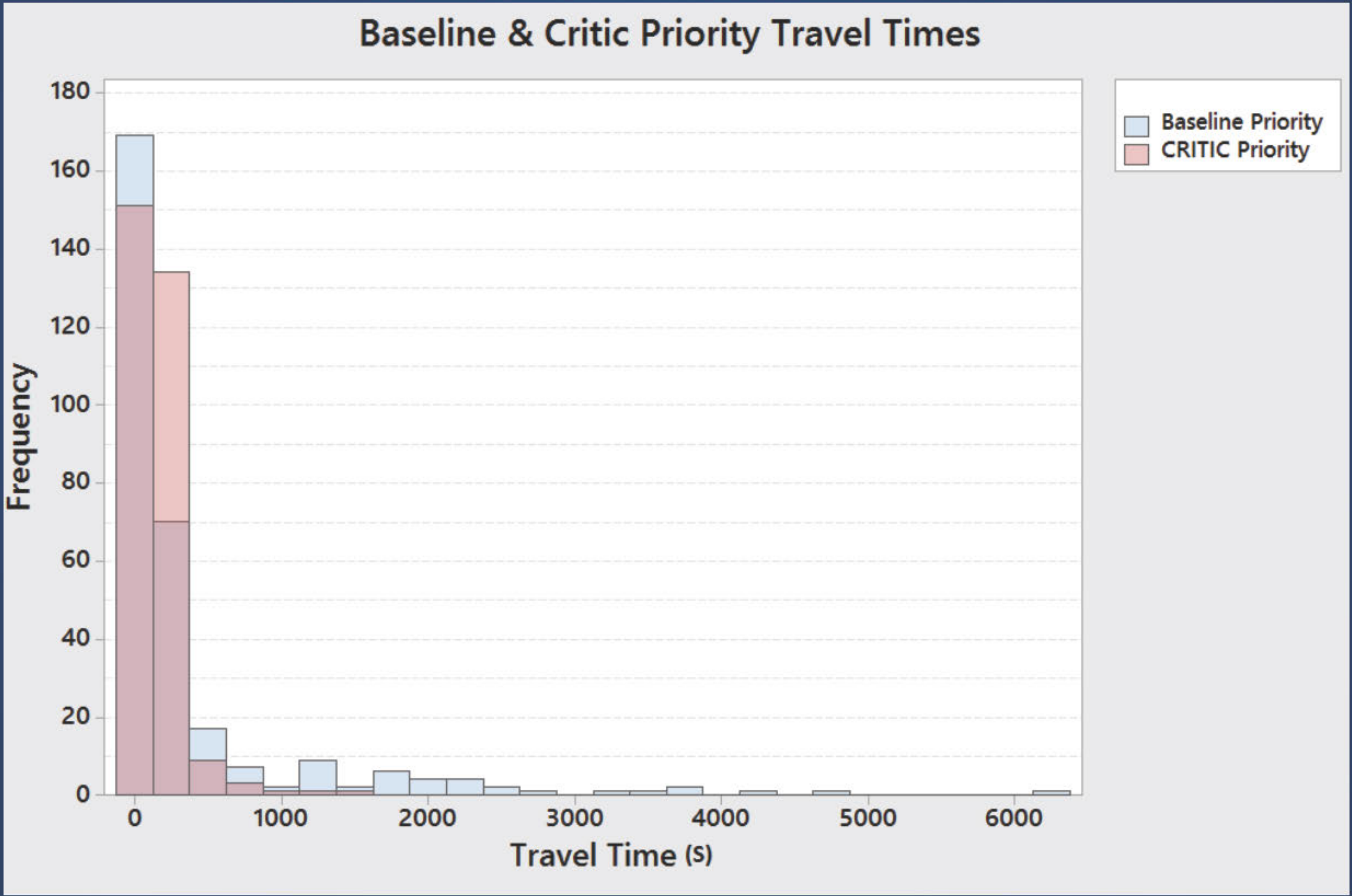
%ATT: -78.04%   %TTI: -75.99%



Statistics

CRITIC vs Baseline: The Achieved Travel Times by priority vehicles in Abstract network (2000)

% ATT: -59.71%   %TTI: -64.60%



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Conclusion

The CRITIC algorithm shows promising results at reducing congestion on a road network.

Further real world research is required.

The algorithm is something that will be extremely trivial to implement with the advent of smart cars.

This work will be submitted to the IEEE ISC2 conference 2017

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[26] Fuchs, S., Rass, S., Lamprecht, B. and Kyamakya, K. (no date) 'Context-Awareness and Collaborative Driving for Intelligent Vehicles and Smart Roads', Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.471.3854&rep=rep1&type=pdf