



# **Intelligent Solutions to the Traffic Signal Control Problem**

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# Facts

- More than half of the world population lives in cities
- 180,000 people moves to cities every day
- By 2050, 70% of the global population will be urban population
- There are 600 million passenger cars in the world and it increases roughly 50 million per year
- An average of 40% of the population spends at least 1 hour on the road every day

# Traditional solutions?

More traffic signal or optimized pre-timed control



Not enough? Freeways

An aerial photograph of a multi-lane highway, likely a toll road, showing severe traffic congestion. The road is filled with cars, and the lanes are packed closely together. The highway curves through a landscape with green hills and some buildings in the background. The text is overlaid in yellow on the image.

**"Adding highway lanes to deal with traffic congestion is like loosening your belt to cure obesity"**

**Lewis Mumford**

# Traditional solutions?

More traffic signal or optimal  
pre-timed control



Not enough? Freeways

# Alternative solutions

- Improve public transportation systems
- Implement transportation policies and restrictions
- Autonomous car
- Traffic-responsive control of traffic signals



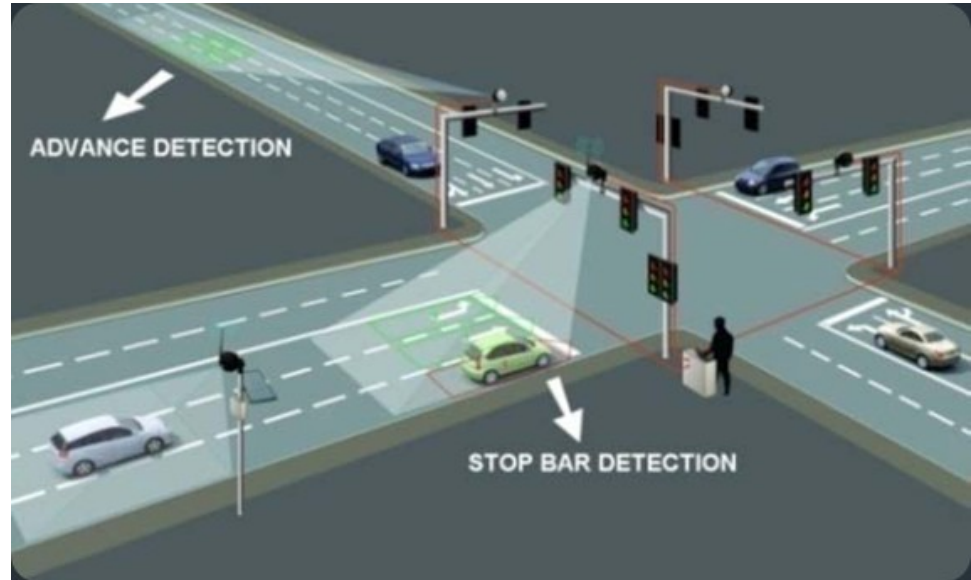
# Dynamic Traffic Signal Control

Dynamic signals are programmed to adjust their timing and phasing to meet changing traffic conditions



# Control approaches

Actuated



**Macro Control**

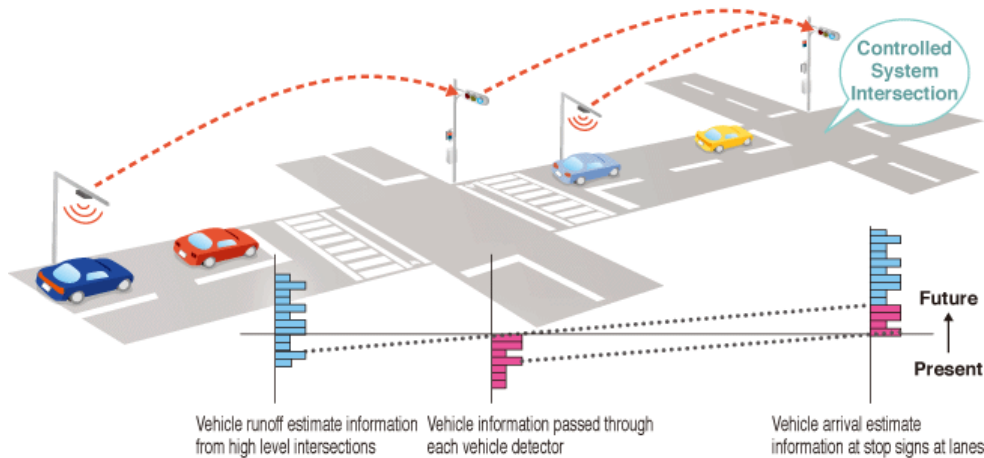
Total Road Network Strategy

**Micro Control (demand prediction control)**

Optimization of Each Intersection

**Information Transmission**

Detector information / Vehicle runoff estimate  
/ Signal control



**The outline for the traffic signal control system MODERATO-S**



# Implementation

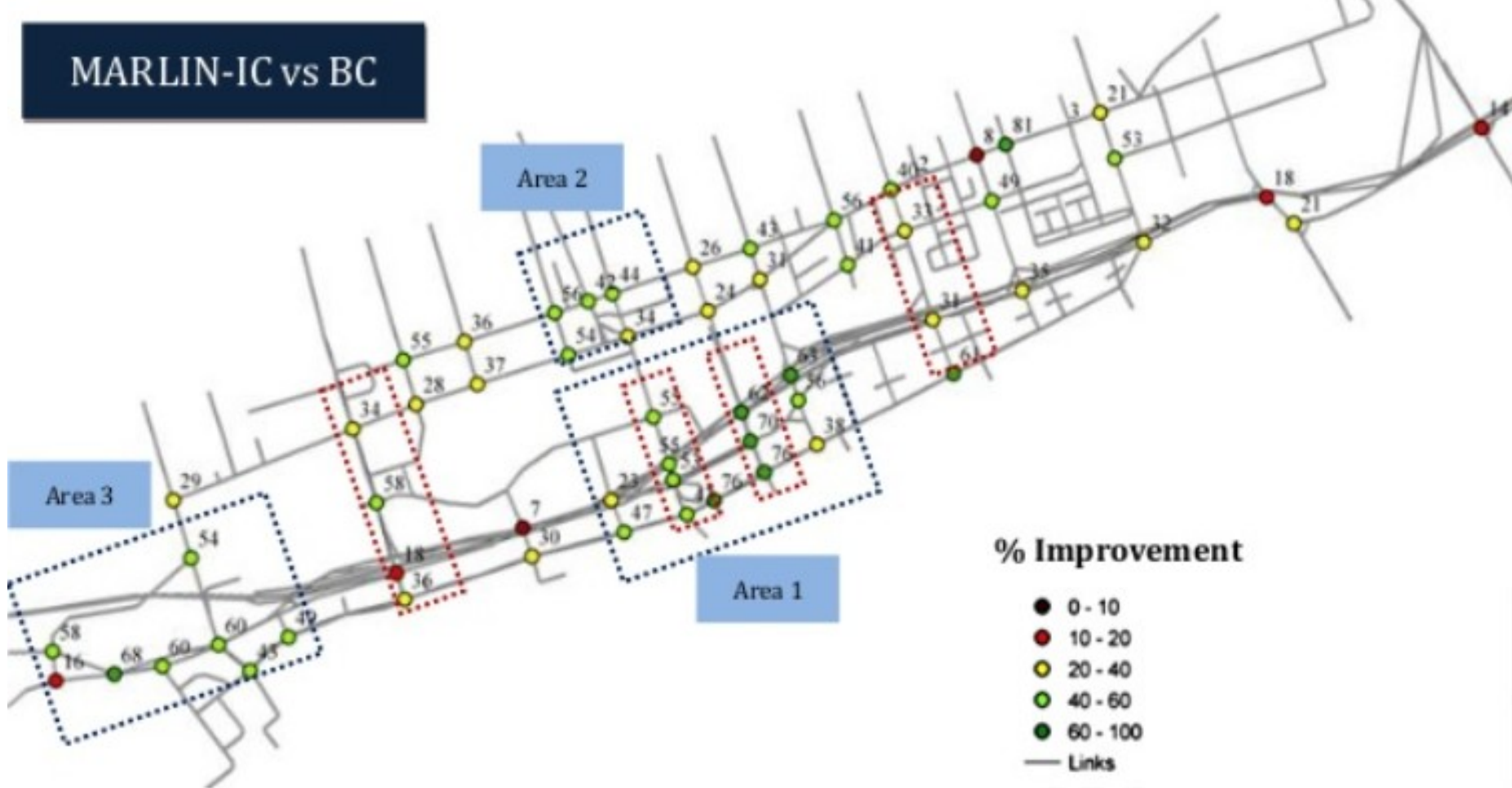
- Generate a traffic model of the city
- Use a simulator with current traffic conditions
- Implement Intelligent control of the signals in the simulator
- Let the algorithm learn or adapt to the traffic conditions
- Implement the system in the real world
- Maintenance, monitoring and constant updates



# How much can it be improved?

B. Abdulhaty and S. El-Tantawy from UT

MARLIN-IC vs BC

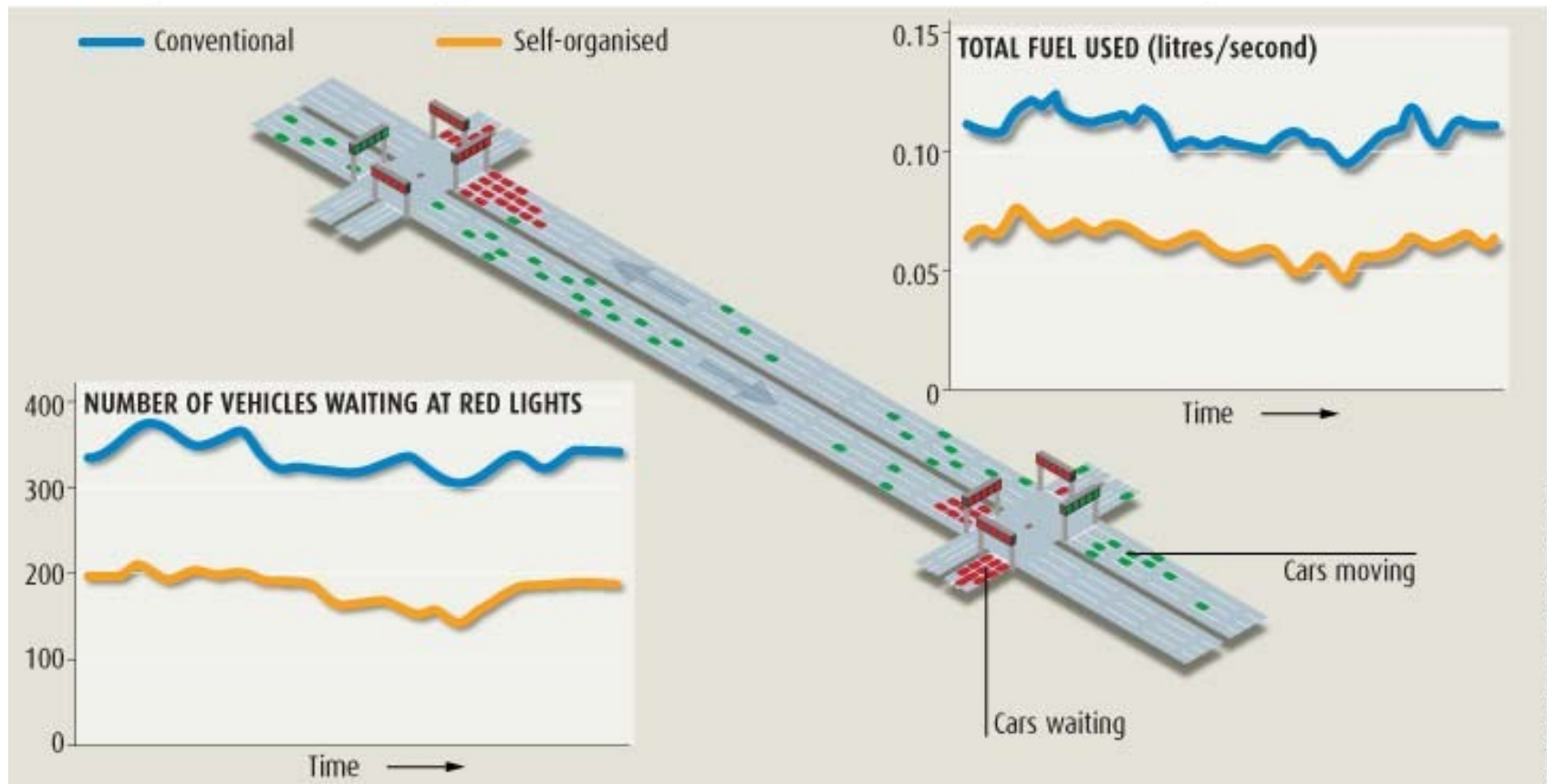


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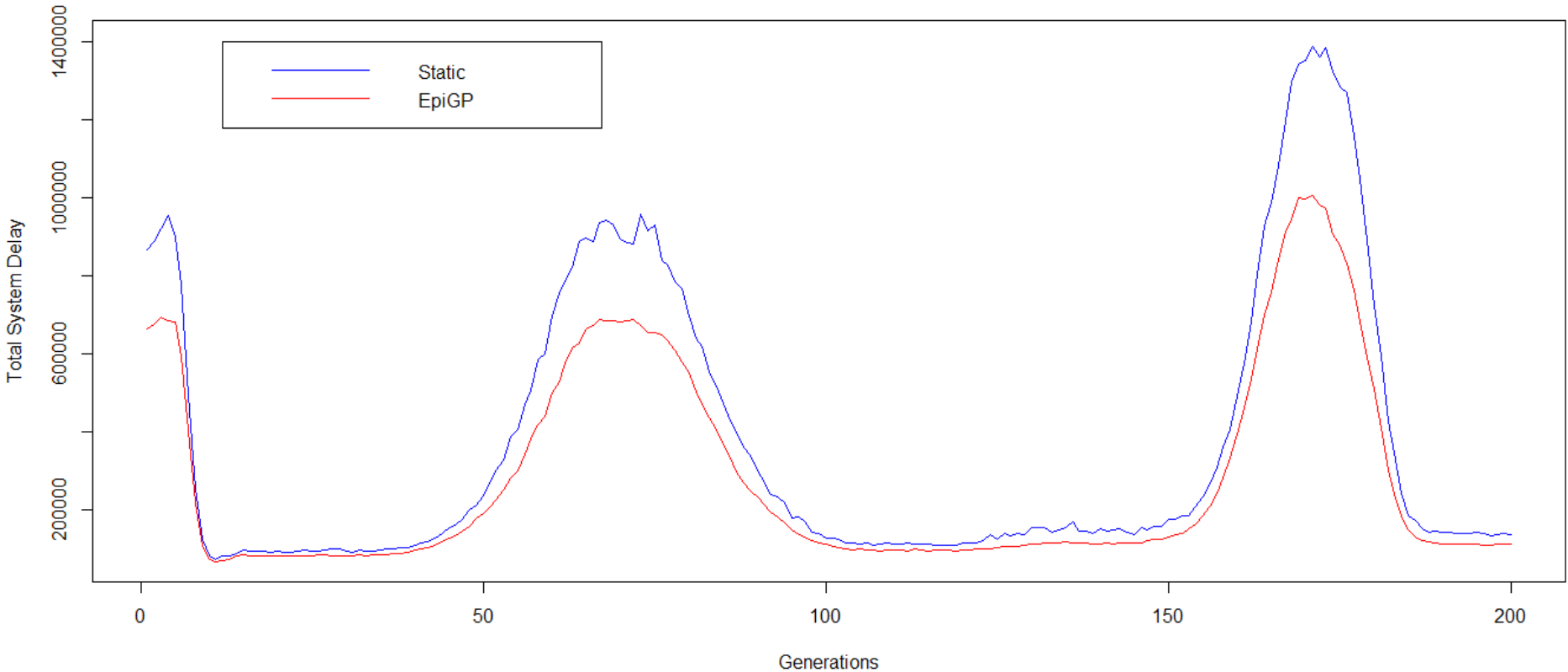
D. Helbing and S. Lämmner, Technical University of Dresden, Germany

## SMART TRAFFIC LIGHTS

Simulations show that self-organised traffic lights able to adapt to continually changing conditions lead to less congestion and lower fuel consumption than conventional lights. These results are for 1000 cars on a road network with 10 busy intersections



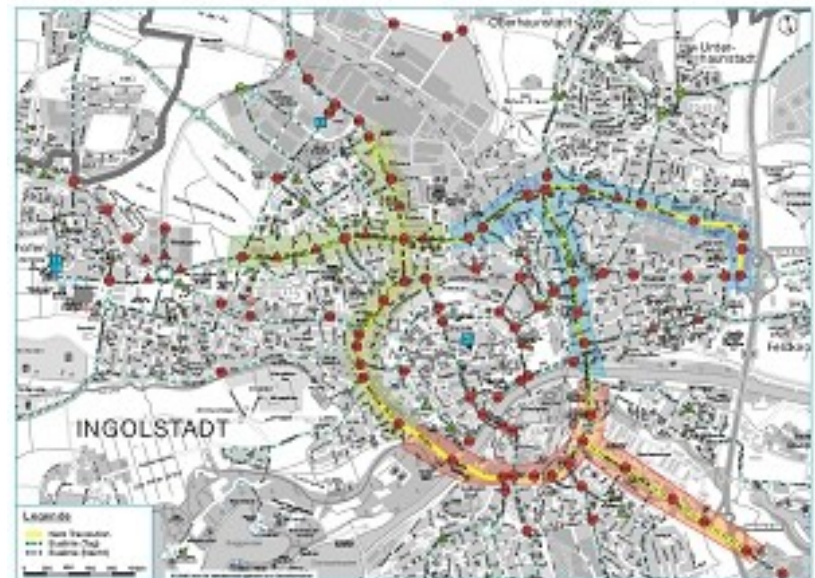
# How much can it be improved?



Waiting time difference:  
231,698 seconds > 64 hours

# Real Scenario

- Ingolstadt, Bavaria, Germany
- TRAVOLUTION = TRaffic and eVOLUTION
- Started on June 2008
- **21%** reduction in average daily delays
- **700.000** liters of fuel are saved each year
- **1.600 tons** of CO<sub>2</sub> pollution less in the air



# Readings

TRAVOLUTION project description

<http://www.travolution-ingolstadt.de/index.php?id=69&L=1>

MARLIN – smart traffic lights becomes a campaign issue <http://techronto.com/civics/marlin-smart-traffic-lights-becomes-a-campaign-issue>

Why complex systems do better without us

[http://www.sciencearchive.org.au/nova/newscientist/094ns\\_003.htm](http://www.sciencearchive.org.au/nova/newscientist/094ns_003.htm)

# References

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- Traffic Signal Optimization in “La Almozara” District in Saragossa Under Congestion Conditions, Using Genetic Algorithms, Traffic Microsimulation and Cluster Computing. J Sánchez- Medina, M. Galán-Moreno, E. Rubio-Royo. IEEE Transactions on Intelligent Transportation Systems. 2009.
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- Parallel Control and Management for Intelligent Transportation Systems: concepts, Architectures and Applications. F Yue. IEEE Transactions on Intelligent Transportation Systems. 2010