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The Death of the Traffic Light?

Researchers at MIT, ETHZ, and CNR have developed slot-based intersections that are more efficient than traffic lights, eliminating queues and delays.

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Cambridge, MA, 15 March 2016

Images and videos available upon request

An international group of researchers at the Massachusetts Institute of Technology (MIT), the Swiss Institute of Technology (ETHZ), and the Italian National Research Council (CNR) have developed slot-based intersections that could replace traditional traffic lights, significantly reducing delays, make traffic patterns more efficient, and lower fuel consumption. Results of the study will be published in the journal, PLoS ONE on March 16, 2016. (Full article details: "Revisiting Street Intersections using Slot-Based Systems," by Remi Tachet, Paolo Santi, Stanislav Sobolevsky, Luis Reyes-Castro, Emilio Frazzoli, Dirk Helbing, and Carlo Ratti).

The idea is based on a scenario whereby sensor-laden, self-driving vehicles would pass through traffic intersections by communicating with and remaining at a safe distance from other vehicles, rather than grinding to a halt at traffic lights. By removing the wait time caused by traffic lights, slot-based intersections would speed up traffic flow.

"Traffic intersections are particularly complex spaces, because you have two flows of traffic competing for the same piece of real estate," says Professor Carlo Ratti, Director of the MIT Senseable City Lab, which initiated the study. "But a slot-based system moves the focus from the traffic flow level to the vehicle level. Ultimately, it's a much more efficient system, because vehicles will get to an intersection exactly when there is a slot available to them."

Slot-based intersections are similar to slot-based management systems used for air-traffic control. Upon approaching an intersection, a vehicle automatically contacts a traffic management system to request access. Each self-driving vehicle is then assigned an individualized time or "slot" to enter the intersection. Stop and go is largely avoided, which has the effect of reducing pollutants and greenhouse gases caused by acceleration and deceleration cycles. Furthermore, slot-based intersections are flexible and can easily accommodate pedestrian and bicycle crossing with vehicular traffic.

Results show that intersections providing real-time slot allocation might double the number of vehicles that an intersection with traffic lights can manage. This could have a major impact on the road network of a given city. "Travel and waiting times would be considerably reduced and fuel consumption would go down," said Professor Dirk Helbing of the ETHZ. "This would make a contribution to the reduction of emissions and

climate change. Overall, people would benefit, the environment would benefit, and cities would become more livable."

“Transitioning from traffic light to slot-based system could dramatically improve intersection performance, with traffic volume queues vanishing and travel delays cut to almost zero,” said Paolo Santi, a Research Scientist at the MIT Senseable City Lab and a member of the Italian National Research Council.

“It is important that we start looking into the impact of self-driving vehicles at the city level as soon as possible,” added Ratti. “The lifetime of today’s road infrastructure is many decades and it will certainly be impacted by the mobility disruptions brought in by new technologies.”

The research team was led by Paolo Santi and included Remi Tachet, Stanislav Sobolevsky and Carlo Ratti at the MIT Senseable City Lab, Emilio Frazzoli and Luis Reyes-Castro at the MIT Laboratory for Information and Decision Systems, and Dirk Helbing at the Swiss Institute of Technology. Research activities have been supported by ENEL Foundation and the Singapore-MIT Alliance for Research and Technology (SMART).

ADDITIONAL MATERIAL. A video showing a side-by-side comparison of slot-based and traffic light intersections can be downloaded at http://senseable.mit.edu/light-traffic. The article: "Revisiting Street Intersections using Slot-Based Systems”, PloS ONE, 2016, by Remi Tachet, Paolo Santi, Stan Sobolevsky, Luis Reyes-Castro, Emilio Frazzoli, Dirk Helbing, Carlo Ratti can be accessed on the journal PLoS ONE website.

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ABOUT THE MIT Senseable City Lab.
Started in 2005, the Senseable City Lab at the Massachusetts Institute of Technology a multidisciplinary research group that studies the interface between cities, people, and technologies. It investigates how the ubiquity of digital devices and the various telecommunication networks that augment our cities are impacting urban living. With an overall goal of anticipating future trends, the Lab bring together researchers from many academic disciplines to work on groundbreaking ideas and innovative real-world demonstrations. This research is undertaken in partnership with cities, the private sector and other universities; through this collaborative approach we strive to reveal how a new, rapidly expanding network of digital devices is serving to modify the traditional principles of understanding, describing and inhabiting cities. The Lab's work has been exhibited in leading venues including the Venice Biennale, the Design Museum Barcelona, the Canadian Centre for Architecture and the Museum of Modern Art (MoMA) in New York. Among many awards are TIME Magazine's Best Invention of the Year in 2007 (Digital water Pavilion) and 2014 (Copenhagen Wheel).