

**THE FIRST SMART TRAFFIC SIGNAL EXPERIMENT IN THE WORLD IS A GREAT SUCCESS: A NEW ITS SYSTEM BASED ON "CONNECTED" VEHICLES COULD PAVE THE WAY TO DISRUPTIVE CHANGES IN TRAFFIC SIGNAL TECHNOLOGY: TEST DRIVERS SURPRISED BY ALWAYS RECEIVING THE GREEN LIGHT**



On Tuesday the 30 of July 2019 the first experiment of a traffic signal regulated by "connected" vehicles was carried on at University OF CALABRIA (UNICAL) with the help of common commercial smart phones by a team of researchers working for Unical and the innovative Start Up SOMOS. A complete new system has been developed and experimented that can use a simple mobile application to broadcast vehicle location and speed to the infrastructure management. This innovation can

therefore allow for a real-time change of signal phase and timing: the system works combining GPS fix with cellular data networks. Traffic lights can finally be controlled (without expensive infrastructures) according to a vehicle's position and speed, in a cheaper and different way than the majority of current systems, which detect traffic volumes only at fixed points.

**A disruptive innovation**

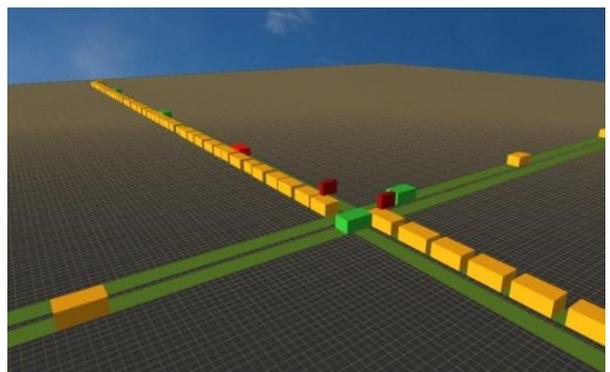
Most of the current traffic signal systems are based on low technology fixed-time control units, where the signal timing is preset with cycle duration between 35 and 120 seconds and the fixed phases are regulated according to outdated traffic counts. Richer city administrations implement expensive real-time traffic signals that use a dynamic control technology based on data coming from sensors embedded in the road. Unfortunately these sensors (which can detect and send to the controlling unit traffic flow data at intersections) enable real-time control at an incredibly high monetary cost. The experiment, that was carried out at UNICAL has demonstrated that real-time traffic signal control can be performed with common smart phones and standard existing cellular networks. The research team at UNICAL and SOMOS has been working for years at developing and evaluating this system using a

**50bn of Euro is the annual cost of congestion in just the European Union**

**How does it work? A simple mobile phone application can help to better control signal phase and timing**

Drivers can download a mobile application on their mobile phone. The application will run smoothly in background connecting to the traffic management server and sending every second position and speed. The central server gathers vehicle position and speed of every subscriber. When a vehicle that has subscribed to the system is approaching a traffic signal the central server will communicate in real time with the electronic controller commanding the traffic lights. The signals will then be regulated on the basis of the known speeds and positions

dedicated simulation laboratory. Simulations have evidenced a cooperative-competitive paradigm: when subscribers to the system are few they will get a considerable advantage on





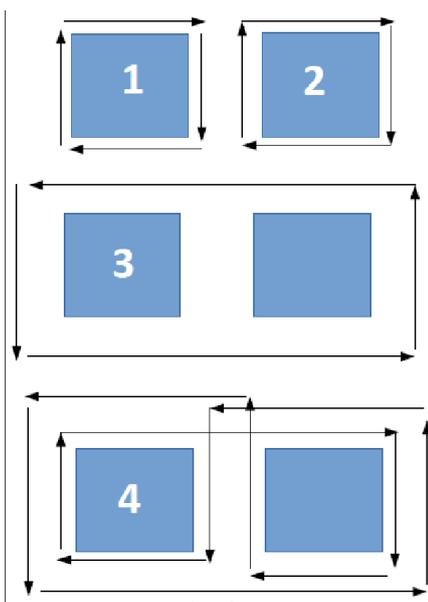
vehicles which are not "connected". In this case there are huge benefits for those who have actually signed up first to the system, as they will have priority over cross-traffic at traffic signals and almost always get the green right away.

This advantage would fade away when at least 30% of drivers subscribe to this system. Simulations revealed, in fact, that this next-generation technology

can have a major positive impact on city's overall traffic regulation when just 30% of vehicles subscribe to the scheme. In fact, the algorithms showed in simulation that when the customer base is over 30%, every driver will benefit from the scheme regardless of whether they are subscriber or not. In an area where traffic signals are poorly regulated, waiting times at intersections could be reduced up to 50% for everyone. The system does not have a required minimum percentage of subscribers. The system would fall back on standard pre-established fixed-time cycles when there are no subscribers driving around an intersection. In practical terms the system can work with very few vehicles, even though, with more subscribers, it would adjust traffic lights according to real overall traffic demand providing benefits to all drivers and the community.

### The experiment and the implications

A dedicated experimental site was set up in a parking lot area of University of Calabria. The intersection of this first experiment was a three legs intersection with single lane approaches so that the three traffic lights control all maneuvers of an approach at the same time for a single shared lane. Drivers were instructed to repeat the same path. To avoid the formation of cluster of vehicles moving along the same path it was possible to identify different paths which were assigned to drivers.



Drivers participating in the experiment were told to repeat again and again the same path.

In the first part of the experiment the traffic signal was set on a fixed signal cycle where queues were unavoidable and

drivers were annoyed by the formation of queues to the point that one driver (in spite of all recommendations given in advance) once marched through the intersection with the red light on.

In the second part of the experiment the system was given control of the traffic signal and the success was incredible and beyond any expectation. Drivers were surprised to practically always receive the green light. They were amazed that they could drive practically

without stopping at the intersection. A post-analysis of trajectories showed that on average each driver was able to double the space traveled in the same time. Traffic flows at intersection were increased by more

than 100%, travel times reduced more than 70% and average speeds increased more than 200% for every driver.

Scientifically the experiment demonstrated the technical feasibility of such a prototype system and confirmed the expected results obtained by simulation techniques. Results of the experiment suggest that with very low cost and with just the right knowledge it would be possible to better regulate existing traffic signals taking advantage of the already developed wireless phone internet data infrastructures.

The experiment showed that a better use of FCD (Floating Car Data) is possible and real-time control of traffic signals can be performed with existing technologies in an economically sustainable way according to an easy to get rich data set of speeds and positions of single vehicles. The infrastructure costs of using FCD for traffic signal regulation are in fact extremely low compared to traditional adaptive traffic signal system infrastructures.

As reported above, the results based on simulation have shown that when over 30% of vehicles are "connected" the benefit are for the whole traffic, while, when less than 30% of vehicles are connected, then the "traditional" vehicles not participating in the system would receive little delays with respect to the time savings of connected vehicles. In other words no matter what is the penetration rate of the system simulations showed that with the implementation of FCD adaptive traffic signals (FCDATS) the whole traffic flows overall better with reduced travel times and reduced pollution emissions and fuel consumption. The

first experiment conducted at UNICAL has showed a way to demonstrate that these simulation results can be reproduced for real vehicles on the road. The proposed experimental prototype system and the proposed experimental setting answer to this kind of doubts demonstrating the feasibility and convenience of such systems and paving the way for the introduction of real FCDATS in our future smart cities.

***When only a few drivers***

***choose this system***

***they will benefit and practically  
always get the green while the  
overall traffic will in any case  
slightly flow better with  
reduced delays***

***When 30 % of drivers***

***choose this system***

***the benefits are  
shared among all  
road users***