An Alternative for Emergency Preemption of Traffic Lights

This system resolves potential conflicts among emergency vehicles.

NASA's Jet Propulsion Laboratory, Pasadena, California

An electronic communication-and-control system has been developed as a prototype of advanced means of automatically modifying the switching of traffic lights to give priority to emergency vehicles. This system could be used alternatively or in addition to other emergency traffic-light-preemption systems, including a variety of systems now in use as well as two proposed systems described in "Systems Would Preempt Traffic Lights for Emergency Vehicles" (NPO-30573), *NASA Tech Briefs*, Vol. 28, No. 10 (October 2004), page 36. Unlike those prior systems that depend on detection of sounds and/or lights emitted by emergency vehicles, this system is not subject to severe range limitations. This system can be retrofitted into any pre-existing traffic-light-control system, without need to modify that system other than to make a minimal number of wire connections between the two systems.

This system comprises several subsystems, including a transponder and interface circuitry on each emergency vehicle, a monitoring and control unit at each intersection equipped with traffic lights, and a wide-area two-way radio communication network that connects the emergency vehicles and intersection units. Computers in the various intersections and vehicle units run special-purpose software that implements the traffic-light-preemption scheme. The operations of the intersection and vehicle units are synchronized by use of Global Positioning System (GPS) timing signals. The transponder in each vehicle estimates its own position and velocity by use of GPS signals, deductive ("dead") reckoning, data from the onboard diagnostic (OBD) computer of the vehicle, and/or triangulation of beacon signals.

When the operator of an emergency vehicle turns on its flashing lights and sirens in response to a request for an emergency response, the transponder unit goes into action, reading the OBD data to determine speed and acceleration, and reading and gathering further navigational data as described above. The position, velocity, and acceleration data are combined with vehicle-identification data in a prescribed format, and the resulting set of data is transmitted to the intersections within communication range of the transponder.

In each intersection unit that receives such a data signal, a processor estimates the time of arrival of the vehicle, compares it with the estimated times of arrival of other emergency vehicles approaching the intersection, and determines which vehicle will arrive first. The intersection unit notifies the transponders of all emergency vehicles of a potential conflict and states, as part of the notice, which vehicle has the right of way. At the same time, the processor collects information on the current operation of the traffic lights at the intersection and calculates when pedestrians should be alerted not to cross and when preemption of the traffic lights should start. When preemption starts, the traffic lights are augmented by textual displays of a message that emergency vehicles are approaching and graphical displays indicating the direction(s) of approach. Once the emergency vehicles have passed through the intersection, normal operation of the traffic lights is resumed.

This work was done by Conrad Foster and Aaron Bachelder of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Vehicle Transponder for Preemption of Traffic Lights

This unit provides timely information on statuses of vehicles and intersections.

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The purpose of this article is to describe, in more detail, the transponder installed in each vehicle that participates in the emergency traffic-light-preemption system described in the immediately preceding article. The transponder (see figure) is a fully autonomous data-collection, data-processing, information-display, and communication subsystem that performs robustly in preemption of traffic lights and monitoring of the statuses of street intersections.

This transponder monitors the condition of the emergency vehicle in which it is installed and determines when the vehicle has been placed in an emergency-response condition with its siren and/or warning lights activated. Upon detection of such a condition, the transponder collects real-time velocity and acceleration data from the onboard diagnostic (OBD) computer of the vehicle. For this purpose, the transponder contains an OBD interface circuit, including a microprocessor that determines the manufacturer and model of the vehicle and then sends the appropriate commands to the OBD computer requesting the speed and acceleration data. At the same time, data from an onboard navigation