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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Refer to NPO-30604, volume and number of this NASA Tech Briefs *issue, and the page number.*

Vehicle Transponder for Preemption of Traffic Lights

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

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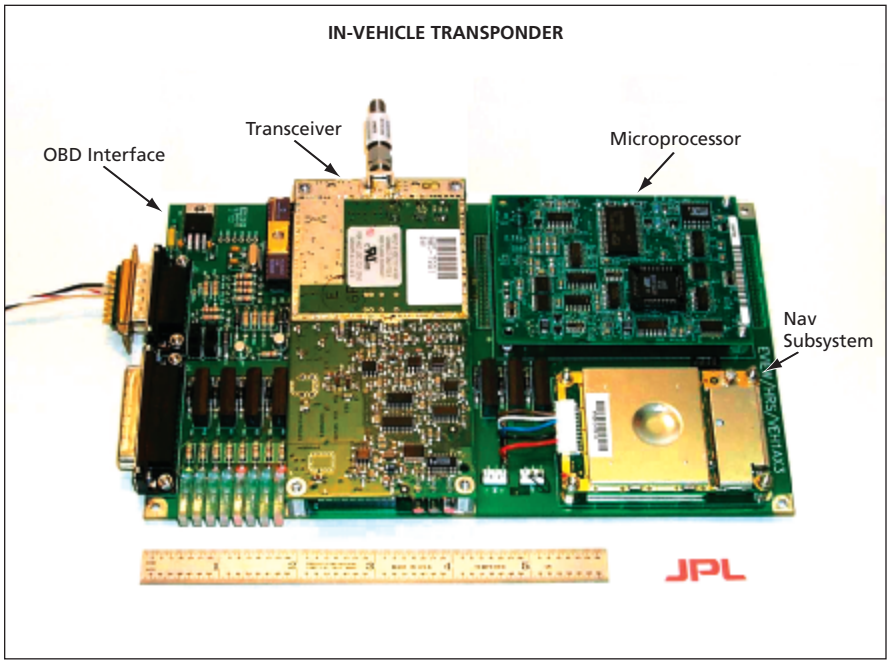
The purpose of this article is to describe, in more detail, the transponder installed in each vehicle that participates in the emergency traffic-light-preemption system described in the immediately preceding article. The transponder (see figure) is a fully autonomous data-collection, data-processing, 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



An **Emergency-Vehicle Transponder** contains electronic circuits designed by NASA's Jet Propulsion Laboratory. The transponder is packaged such that it can be easily mounted in the vehicle in less than one hour.

system are collected to determine the location and the heading of the vehicle. Then acceleration, speed, position, and heading data are processed and combined with a vehicle-identification number and the resulting set of data is transmitted to monitoring and control units located at all intersections within communication range.

When the unit at an intersection determines that this vehicle is approaching and has priority to preempt the intersection, it transmits a signal declaring the priority and the preemption to all participating vehicles (including this one) in the vicinity. If the unit at the intersection has determined that other participating vehicles are also approaching the intersection, then this unit also transmits, to the vehicle that has priority, a message that the other vehicles are approaching the same intersection. The texts of these messages, plus graphical symbols that show the directions and numbers of the approaching vehicles, are presented on the display panel of a computer that is part of the transponder.

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Automated Announcements of Approaching Emergency Vehicles

Pedestrians would be given advance warning.

NASA's Jet Propulsion Laboratory, Pasadena, California

Street intersections that are equipped with traffic lights would also be equipped with means for generating audible announcements of approaching emergency vehicles, according to a proposal. The means to generate the announcements would be implemented in the intersection-based subsystems of emergency traffic-light-preemption systems like those described in the two immediately preceding articles and in "Systems Would Preempt Traffic Lights for Emergency Vehicles" (NPO-30573), *NASA Tech Briefs*, Vol. 28, No. 10 (October 2004), page 36.

Preempting traffic lights is not, by itself, sufficient to warn pedestrians at affected intersections that emergency vehicles are approaching. Automated visual displays that warn of approaching emergency vehicles can be helpful as a supplement to preemption of traffic lights, but experience teaches that for a variety of reasons, pedestrians often do not see such displays. Moreover, in noisy and crowded urban settings, the lights and sirens on emergency vehicles are often not noticed until a few seconds before the vehicles arrive.

According to the proposal, the traffic-light preemption subsystem at each intersection would generate an audible announcement — for example, "emergency vehicle approaching, please clear intersection" — whenever a preemption was triggered. The subsystem would estimate the time of arrival of an approaching emergency vehicle by use of vehicle identity, position, and time data from one or more sources that could include units connected to traffic loops and/or transponders connected to diagnostic and navigation systems in participating emergency vehicles. The intersection-based subsystem would then start the announcement far enough in advance to enable pedestrians to leave the roadway before any emergency vehicles arrive.

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