U.S. Department of Transportation
Federal Highway Administration

Next-Generation Traffic Incident Management: (NextGen TIM Tech) for Saving Lives

Emergency Vehicle Preemption (EVP)

Photo Credit: Enforcement Engineering, Inc.

Emergency vehicle operation is a dangerous part of the job for public safety agencies, such as police, fire, and emergency medical services. Signalized intersections are particularly dangerous, and they require responders to slow or stop and proceed cautiously when facing a red signal. Emergency vehicle preemption (EVP) changes the traffic signal indication to green for an approaching emergency response vehicle, while promptly displaying a red signal to drivers who may cross the emergency vehicle's path. This interruption of the normal traffic signal operation enhances safety and reduces response time for an approaching emergency response vehicle.

The concept of EVP has existed for several decades and is generally implemented in one of two ways: vehicle based and system based. Vehicle-based systems rely on transmitter equipment mounted in the responder vehicle that communicates with receiver equipment at each signalized intersection. Upon receiving a visual, audible, or wireless signal that an emergency vehicle in response mode is approaching, the individual signal controller at the intersection preempts the timing plan and gives preference to the appropriate intersection approach (see *figure 1*).

Although the vehicle-based approach is still widely used, system-based approaches are quickly becoming a focus of attention. By taking advantage of newer, modern technologies, system-based traffic signal preemption is more reliable, more cost effective, and less cumbersome to manage. Automated vehicle location (AVL) technology, computer-aided dispatch (CAD), and centralized traffic signal system control using advanced traffic management systems (ATMS) allow agencies to implement signal preemption without dedicated hardware installed in the field (see *figure 2*).

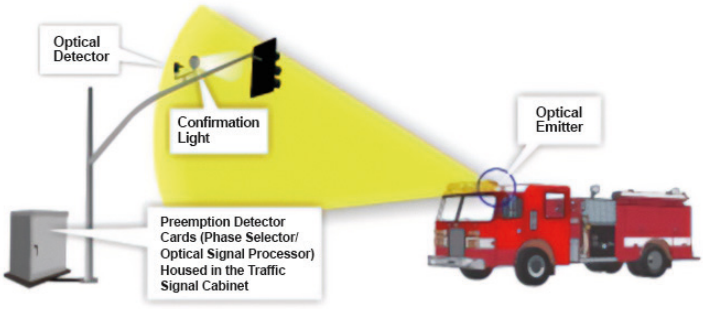

Figure 1. Illustration. Maricopa Association of Governments vehicle-based emergency vehicle preemption solutions. (Photo Credit: Maricopa Association of Governments.)

Through CAD integration, the ATMS may know when dispatchers assign response vehicles to high-priority emergency calls and provide preferred response routes. The AVL pinpoints the real-time location of responding vehicles, and preemption requests are transmitted to traffic signals using a central traffic control system with communication to the traffic signal.

System-based EVP allows the response vehicle to select any route to the emergency scene. Rather than define the route and trigger EVP at equipped signalized intersections along the way, the system-based approach may easily be scaled for an entire network. The Global Positioning System-based technology uses geofences around the signalized intersection to detect the approaching emergency vehicle and send a request to change or keep the signal phase green. The real-time speed and distance of the responding vehicle are factored into triggering the signal and the duration of the preemption.

Although both vehicle and system approaches are proven, the latter has advantages when it comes to cost, reliability, scalability, and ease of management. Managing EVP across jurisdictions is possible with both systems with planning and coordination.

Figure 2. Photo. Image of first responder vehicle. (Photo Credits: Enforcement Engineering, Inc. and Getty Images.)

IMPLEMENTATION AND BENEFITS

Coordinated planning, policies, and involvement from agencies responsible for traffic signal and public safety are key to a successful EVP program. Beyond the equipment or systems required to establish the EVP, agency policy and user training are necessary. Performance management and reporting are also relevant parts of implementation to monitor activations, quantify benefits, and justify the program.

St. Paul, MN, experienced a 71 percent reduction in emergency vehicle crashes after deploying EVP.[1]

The Virginia Tech Transportation Institute determined that the average duration of a preemption was 25 seconds and that effects on side streets were usually cleared within one cycle.[2]

Response times decreased by 14 to 23 percent, or a total of 70 seconds, on average, in a Denver, CO, EVP evaluation at six intersections.[3]

The Plano, TX, Fire Department experienced 7 crashes at signalized intersections from 1981 to 1983, and just 4 intersection crashes in the more than 20 years following implementation of EVP.[4]

Average delay per intersection before EVP was 7 seconds, and 1 second after implementation.[5]

The system-based arrangement installed in San Jose, CA, was approximately $8 million less than the hardware-based alternative for fewer intersections (see *figure 3*).[6]

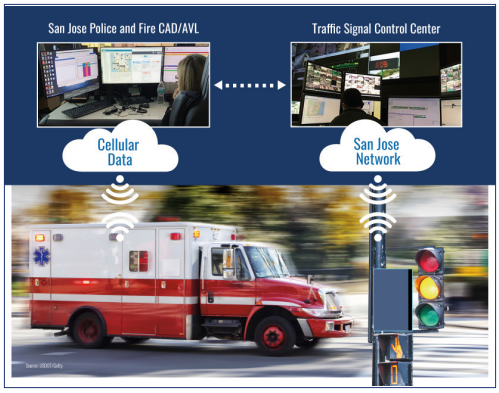

Figure 3. Illustration. System-based arrangement of emergency vehicle preemption. (Photo Credits: Enforcement Engineering, Inc. and Getty Images.)

CONCLUSION

Although the concept of EVP is not new, advances in traffic signal and vehicle location technologies have paved the way for innovation. Cost-effective implementation coupled with fewer operational challenges and reduced maintenance costs make EVP worthy of a new look.

RESOURCES

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[5] Nguyen, H. 2023. Central EVP. Presented at the 2023 Intelligent Transportation System (ITS) Northern California Luncheon.

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