Red-Light Violations and Enforcement Research

June 6, 2008
Red-Light Statistics

- According to the Insurance Institute for Highway Safety, 22% of all traffic accidents in the U.S. are caused by drivers running red lights. Every year, these accidents kill some 800 people and rack up an estimated $7 billion dollars in property damage, medical bills, lost productivity and insurance hikes. And this sort of traffic violation seems to be on the rise. In many areas, red-light violations have increased by 10% or more since the 1980s.

- In many countries red-light violations seems to be on the rise. To stop this trend, more and more traffic authorities are installing cameras for red-light enforcement.
Red-Light Enforcement History

- Although red-light camera systems have been available for more than 30 years, they have been used in the U.S. only since 1992.

- As of June 4, 2008, there are 2,739 red-light camera intersections in the U.S. and Canada and 217 speed cameras in the U.S. and Canada.

- Red-light cameras have been used in at least 33 foreign countries since the 1970s. Countries that use red light cameras include Australia, Austria, Belgium, Canada, Germany, Israel, the Netherlands, Singapore, South Africa, Switzerland, Taiwan, and the United Kingdom.
Red-Light Enforcement Locations

- Washington, DC / Baltimore, MD - 292
- Los Angeles - 249
- New York City - 201
- Dallas/Ft. Worth - 199
- Chicago - 117
- Toronto, Canada - 93
- San Francisco - 84
- Phoenix - 82
- Houston - 70
- Atlanta - 65
- Seattle / Tacoma - 62
- Vancouver - 54
- Edmonton - 52
- San Diego - 52
- Winnipeg, Manitoba - 49
- St. Louis - 48
- Calgary, Alberta - 44
- Raleigh / Cary, NC - 34
- Sacramento / Davis, CA - 34
- Longview / Kilgore, TX - 34
- Ventura / Oxnard, CA - 33
- Dayton / Middletown / Springfield, OH - 32
- Cleveland, OH - 30
- Wilmington, DE - 29
- Stockton / Modesto, CA - 28
- Lafayette, LA - 25
- Toledo, OH - 21
- Albuquerque, NM - 20
- Denver - 19
- Knoxville, TN - 18
- Columbus, OH - 18
- Providence, RI - 17
- Philadelphia - 17
- Virginia Beach, VA - 15
## Red-Light Enforcement Camera Results in Some U.S. Cities

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Accident Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garden Grove, CA</td>
<td>2005</td>
<td>47%</td>
</tr>
<tr>
<td>Costa Mesa, CA</td>
<td>2005</td>
<td>28%</td>
</tr>
<tr>
<td>Santa Ana, CA</td>
<td>2005</td>
<td>16%</td>
</tr>
<tr>
<td>San Juan, CA</td>
<td>2005</td>
<td>12%</td>
</tr>
<tr>
<td>Fullerton, CA</td>
<td>2005</td>
<td>6%</td>
</tr>
<tr>
<td>Ventura, CA</td>
<td>2001</td>
<td>80%</td>
</tr>
<tr>
<td>Savannah, GA</td>
<td>2003</td>
<td>20%</td>
</tr>
<tr>
<td>Charlotte, NC</td>
<td></td>
<td>4%</td>
</tr>
<tr>
<td>Fayetteville, NC</td>
<td></td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Year</td>
<td>Accident Reduction</td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Dayton, OH</td>
<td></td>
<td>42%</td>
</tr>
<tr>
<td>Toledo, OH</td>
<td></td>
<td>36%</td>
</tr>
<tr>
<td>Knoxville, TN</td>
<td>2006</td>
<td>13%</td>
</tr>
<tr>
<td>El Paso, TX</td>
<td>2006</td>
<td>2%</td>
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<tr>
<td>Garland, TX</td>
<td>2006</td>
<td>56%</td>
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<td>Greensboro, NC</td>
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<td>Raleigh, NC</td>
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<tr>
<td>Rocky Mount, NC</td>
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<td>31%</td>
</tr>
<tr>
<td>Columbus, OH</td>
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<td>47%</td>
</tr>
</tbody>
</table>
ACS claims to administer 80% of North America’s red-light cameras. ACS is one of the only companies in the red-light camera industry that continues to use the wet film system. Typically the wet film cameras cost the city much more in maintenance and operations due to the fact that the film must be changed every day. Most of the other red-light camera manufacturers have already switched over to digital film.
Redflex Traffic Systems, Inc.

- The company's technologies are applied in Australia, Canada, the Middle East and the U.S. Redflex Traffic Systems is a wholly owned entity of Redflex Holdings Ltd., a specialist provider of core technologies for defense, communications, traffic law enforcement and telephony access.
Nestor Systems

- Nestor Systems was the first company to develop a video-based red-light camera unit. In a media release on Nestor’s web site, David Fox, Nestor’s president and CEO, indicated the "automated enforcement systems are only as good as the evidence they collect. We believe we've raised the bar by offering the first video-based solution. Crossing Guards video sequence is like an instant replay of the violation. Other systems only offer a few still images. Video adds a broader dimension, offering more features, more capabilities and more reliable evidence." Nestor was founded in 1997.
TransCore

- TransCore has more than 80 locations throughout the U.S. and abroad. International locations include Hong Kong and Toronto as well as their affiliate, TransCore Australia, in Brisbane. TransCore has converted almost entirely to digital systems and others companies have joined the bandwagon including Mulvihill Electrical Contracting Corp., Redflex Traffic Systems and Nestor Traffic Systems of Rhode Island.
American Traffic Solutions (ATS) is a leading provider of technology and business solutions for traffic safety and electronic toll collection programs worldwide, including PlatePass®, which is an automated electronic toll payment service that enables Avis, Budget and Hertz customers to use high speed, cashless electronic toll lanes. ATS is a private corporation, which serves more than 120 municipalities and government agencies. ATS is the largest provider of photo traffic enforcement programs to America’s big cities with active programs in New York City, Philadelphia, Washington, D.C., St. Louis, San Diego and Seattle; Houston, Fort Worth, Irving and Arlington, Texas; New Orleans and Baton Rouge, Louisiana; and Phoenix, Tucson, Mesa, Glendale and Scottsdale, Arizona. ATS also serves Canada’s largest digital red-light camera and speed enforcement program in Calgary, Alberta. The company is headquartered in Scottsdale, AZ.
Manufacturers of Traffic Enforcement Cameras

- 3M
- AlphaTech
- Asia Vision
- American Traffic Solutions Inc.
- Computer Recognition Systems Inc.
- Crown Roadside
- Eastman Kodak
- Electronic Data Systems
- Gatsometer BV
- Intertraff Kria
- Laser Technology, Inc.
- Multanova (German site)
- Parking and Traffic Technologies Ltd.
- Peek Traffic Solutions
- Poltech Internation Ltd.
- Redflex Traffic Systems
- RedSpeed International Ltd.
- SAGEM SECURITE
- Sensor Dynamics
- Sensys Traffic
- Speed Check Services Ltd.
- Tenix Solutions
- Traffipax, Inc.
- Truvelo
- Hughes Electronics
- UniHz from China
- Vitronic GmbH
Red Light Enforcement Controversies

- From their inception as law enforcement instruments for red light runners, red-light cameras have been under the gun. Many believe that it is an infringement of our privacy rights; while others purport that if were in a public street, it is fair game. Some believe this is simply city politics and a money making scheme; others believe it is truly saving lives.

- There is much debate on the subject of accidents, that much more rear end collisions are caused by people who come to a abrupt stop to avoid being recorded going through the traffic light.

- Cameras have been shown to substantially reduce red light violations. Institute evaluations in Fairfax, Virginia, and Oxnard, California, showed that camera enforcement reduced red light running violations by about 40%. In addition to reducing red light running at camera-equipped sites, violation reductions in both communities carried over to signalized intersections not equipped with red light cameras, indicating community-wide changes in driver behavior. An institute evaluation of red light cameras in Philadelphia found that after red light violations were reduced by 36% following increased yellow signal timing, the addition of red light cameras further reduced red light violations by 96%.
Before cameras may be used for law enforcement, laws must authorize enforcement agencies to cite red light violators by mail. The legislation must make the vehicle owner responsible for the ticket, establishing a presumption that the registered owner is the vehicle driver at the time of the offense. This can be accomplished either by state statutes or in some states by local legislation. Red light cameras currently are authorized in about half of U.S. states. Depending on state law, violations photographed by red light cameras are commonly treated in one of two ways — as traffic violations or as the equivalent of parking tickets. If, as in New York, red light camera violations are treated like parking citations, the law can make registered vehicle owners responsible without regard to who was driving at the time of the offense.
Red-light systems rely on some sophisticated technology, but conceptually they are very simple. The system includes only three essential elements:

- One or more cameras
- One or more triggers
- A computer
How It Works - Cameras

In a typical system, cameras are positioned at the corners of an intersection, on poles a few yards high. The cameras point inward, so they can photograph cars driving through the intersection. Generally, a red-light system has cameras at all four corners of an intersection, to photograph cars going in different directions and get pictures from different angles. Some systems use film cameras, but most newer systems use digital cameras.
How It Works - Triggers

- There are a number of trigger technologies, but they all serve the same purpose: They detect when a car has moved past a particular point in the road. Red-light systems typically have two induction-loop triggers positioned under the road near the stop line (more on this later). The computer is the brains behind the operation. It is wired to the cameras, the triggers and the traffic-light circuit itself. The computer constantly monitors the traffic signal and the triggers. If a car sets off a trigger when the light is red, the computer takes two pictures to document the violation. The first picture shows the car just on the edge of the intersection and the second picture shows the car in the middle of the intersection.

- In some states, a ticket is issued to the car's owner, no matter who's actually driving. In these states, the red-light camera only needs to photograph the car from behind, since the authorities only need a clear view of the rear license plate. In other states, the actual driver is responsible for paying the ticket. In this case, the system needs a second camera in front of the car, in order to get a shot of the driver's face. The ticket is still sent to the car's owner, but the authorities have the information available if there is any disagreement down the line.
The main trigger technology used in red-light systems is the **induction loop**. An induction-loop trigger is a length of electrical wire buried just under the asphalt. Usually, the wire is laid out in a couple of rectangular loops resting on top of each other (see diagram below). This wire is hooked up to an electrical power source and a **meter**. If you've read *How Electromagnets Work*, you know that when you send electrical current through a wire, it generates a **magnetic field**. Positioning the wire in concentric loops, as in any electromagnet, amplifies this field.
How It Works - Triggers

This sort of field affects not only objects around the loop, but also the loop itself. The magnetic field induces an electrical voltage in the wire that is counter to the voltage of the circuit as a whole. This significantly alters the flow of current through the circuit.

The intensity of this induction depends on the structure and composition of the loop; changing the layout of the wires or using a different conductive material (metal) will change the loop's inductance. You can also change the inductance by introducing additional conductive materials into the loop's magnetic field. This is what happens when a car pulls up to the intersection. The huge mass of metal that makes up your car alters the magnetic field around the loop, changing its inductance.

Construction crews cut into the asphalt to install loop sensors. You can see where a loop was installed at this intersection.
The meter in the system constantly monitors the total inductance level of the circuit. When the inductance changes significantly, the computer recognizes this shift and knows that a car has passed over the loop.

This is the most common trigger mechanism, but it's not the only one in use. Some areas have had success with radar, laser or air-tube sensors.

One emerging trigger mechanism is the **video loop**. In this system, a computer analyzes a video feed from the intersection. As the computer receives each new video frame, it checks for substantial changes at specific points in the image. The computer is programmed to recognize the particular changes that indicate a car moving through the intersection. If the light is red and the computer recognizes this sort of change, it activates the still cameras. The main advantage of this system is you don't have to dig up the road to install it, and you can adjust the trigger areas at any time. Essentially, it is a virtual inductive-loop trigger.

The trigger mechanism isn't worth much if it isn't connected to a central brain. In the next section, we'll see how a red-light system's computer puts everything together to construct a case against any traffic violators.
As we saw in the previous section, a red-light-camera system is controlled by a computer. To see how these computers bring everything together, let's look at a typical intersection and a typical traffic violation.

The central control box houses the computer, the brains of the system. The computer activates the cameras based on information it receives from the traffic lights and triggers.
How It Works

For simplicity's sake, we'll only consider traffic moving in one direction through this intersection. When the light is green or yellow for incoming traffic, the computer ignores the triggers and does not activate the cameras. The system doesn't "turn on" until it receives a signal that the light is red. If you're already in the middle of the intersection when the light turns red, the system will not activate the cameras (this is not a traffic violation in most areas). Some systems wait a fraction of a second after the light turns red, to give drivers a "grace period."

In most systems, the computer will not activate the cameras if a car is just sitting over the induction loops. To trigger the cameras, you have to move over the loops at a particular speed. In most systems, there are two loop triggers for each lane of traffic. When the triggers are both activated in quick succession, the computer knows a car has moved into the intersection at high speed. If there is more of a delay, the computer knows the car is moving more slowly. If the car activates only the first trigger, the computer knows it is stopped at the edge of the intersection.

When a car activates both triggers after the light is red, the computer automatically takes a picture. This first shot shows the car just as it is entering the intersection. The computer then hesitates briefly and takes another shot. This catches the car in the middle of the intersection. The computer calculates the length of the delay based on the measured speed of the car. It's important to get two pictures of the car to show that it entered the intersection when the light was red and then proceeded through the intersection.

To fully document the violation, the computer superimposes some extra information on these two photos. It includes:

- The date
- The time
- The intersection location
- The speed of the car
- The elapsed time between when the light turned red and the car entered the intersection
How It Works

The camera is connected to the computer via long, durable wires. The camera feeds digital pictures to the computer, which stores them in its memory.
How It Works

With all of the information superimposed on the picture, along with photos of the infraction, the police have everything they need to charge the driver. In most areas, the police, or a private firm hired to maintain the system, simply look up the license plate and send the ticket in the mail. The driver (or car owner) can pay the fine through the mail and be done with it or he or she can try to contest the ticket in court. Of course, the police send the photos along with the ticket, so most drivers end up just paying the fine. Red-light cameras have been around for more than 40 years but they've only gained widespread popularity in the past decade. Police forces all over the world claim that these systems are a great addition to their communities. They serve as a deterrent against traffic violations, and they help police keep track of the worst offenders. Additionally, they are a good source of government revenue. It doesn't cost much to maintain the system once it's installed, and it works 24 hours a day, seven days a week, systematically catching violators and sending out revenue-generating traffic tickets that are really hard to contest.
How It Works – System Selection & Technology

The most widely used red light camera systems employ film-based cameras and inductive loop vehicle detection technologies. However, other red light camera technologies have become available over the past five years, most notably technologies that employ digital camera equipment where photographic data, including streamed video clips, may be immediately downloaded for processing using leased telephone line or microwave communications. Additionally, red light camera systems that use video-based and radar vehicle detection methods, as well as systems that employ overhead camera placements and floodlighting equipment as an alternative to the curb-based placements, are used by many State and local agencies.

A red light camera system consists of the following on-the-street components:

- Camera Units
- Intersection Lighting
- Camera Housing and Supporting Structure
- Vehicle Detection
- Communications
- Warning Signs
How It Works – Camera Unit

There are three general types of cameras units used to automatically record red light violations. The types of camera units used in red light camera systems include:

- 35mm Conventional Film Units
- Digital Still Picture Units
- Digital Video Units
How It Works – Intersection Lighting

Additional intersection lighting is required in conjunction with the operation of the camera units. The additional lighting will need to be installed in accordance with the equipment manufacturer's specifications, as well as with State or local ordinances that govern the amount of lighting that is permitted in the driver's field of view.

For camera units that record violations with one or two photographs or digital images, flash units synchronized with the camera shutter provide additional lighting at the intersection at time of exposure so vehicle license plate and drivers, if local or State law allow, can be more clearly photographed. Typically, one flash unit is installed as an integral part of the camera housing. Additional flash units may be installed at intersections where there are more than two lanes being monitored or to maximize the amount of backlighting in the vehicle interior as it traverses the intersection.

For camera units that record a video clip for each violation, continuous additional lighting will be considered. This may be provided by curb or overhead mounted lighting equipment, as specified by the equipment manufacturer.
How It Works – Camera Housing & Supporting Structure

The types of camera housing and supporting structures will depend on the type of red light camera system being installed.

Curb-mounted red light camera systems, the most common type currently being employed by State and local agencies, need a camera housing enclosure that is mounted on a pole. The camera unit housing should be weather and damage resistant, and contain a locking mechanism to protect the system from vandalism. Additional poles may be employed for auxiliary flash lighting units. For digital camera systems, a separate enclosure for the data storage and communications equipment is also required at the intersection.

The poles for curb-mounted red light camera systems should be tall enough to provide the necessary angle of view to clearly record violations at the intersection. There are at least two types of poles currently in use. The first, a hinged pole, lowers the camera housing on a hinge located in the center of the pole. A second type, a solid pole, utilizes a motorized “elevator” to raise and lower the camera housing.

Overhead-mounted red light camera systems normally require curb-mounted poles with cantilever arms extending over the traffic lanes. Camera and flash units are mounted on the cantilever arms as required for system operation. Red light camera systems of this type provide an increased field of view that is especially advantageous for red light camera systems on wider arterial streets as well as enhanced lighting for enhanced photographic data quality.

Some jurisdictions have found that they can afford only a limited number of red light camera systems. By installing red light camera housings at problem intersections, and periodically moving the actual cameras from housing to housing, gives motorists the impression that cameras are omnipresent and reduces red light violations throughout the community.
Vehicle detectors are used to trigger the camera to record a vehicle running a red light. Different vehicle detection technologies are available for this purpose.

Most red light camera systems employ pairs of inductive loops installed near the intersection at a location suitable for showing that a violation has occurred. It is critical for the system design and operation that the inductive loops be installed in the appropriate locations, consistent with the agency's definition of a violation. Red light camera systems may also employ piezo elements, video-based equipment, or radar devices for vehicle detection and tracking, as an alternative to, or in conjunction with, inductive loop detectors.

The placement of the vehicle detectors is critical to the integrity of the red light camera system and the citations developed from the photographic data.

For red light camera systems that document violations with two photographs, the first photograph should be taken to show the motor vehicle that will be running the red light, at a location immediately before it enters the intersection against a red traffic signal indication. The vehicle detection equipment should be configured to detect the presence of the vehicle at the desired location and to initiate the first photograph being taken with the vehicle at that location. If the vehicle is detected after it has already entered the intersection, it cannot be determined with certainty from the photographs that the vehicle entered the intersection illegally and consequently, a citation should not be issued. The second photograph is taken after the vehicle has entered the intersection, at a time interval after the first photograph calculated to provide the best view of the vehicle and its license plate, and where required, the driver's face.

For red light camera systems that document violations with video clips that show the vehicle running the red light continuously starting at a location before the vehicle enters the intersection against the red traffic signal indication, vehicle detection should be configured so that the video clip recording is initiated at an appropriate location.

The placement of inductive loop detectors immediately in advance of the intersection stop line for vehicle detection may require that existing stop line loop detectors used for the traffic signal operations need to be abandoned, relocated, or replaced with another type of vehicle detection system, such as video-based detection. Generally, a solution that accommodates vehicle detection requirements for both traffic signal operations and the red light camera system can be developed although there may be some additional costs for vehicle detection associated with the installation of the red light camera system equipment under these circumstances.
How It Works - Communications

For digital camera units, a communications link with adequate bandwidth should be provided from the intersection to a location where the violations data is processed. The required communications may be implemented using State and local agency fiber optics, leased high-capacity telephone lines, or microwave technologies.

No communications outside of the intersection are required for 35mm conventional film camera units. Communications links are normally required to support certain functions related to citation data processing, including access to vehicle registration and driver’s license databases, data transfers to and from traffic court data processing systems, and on-line inquiries or payments from persons receiving citations.
There Are Other Alternatives
## Payment Options – Contractor Owned and Operated

<table>
<thead>
<tr>
<th>Payment Option</th>
<th>Equipment</th>
<th>Equipment Installation</th>
<th>Equipment Maintenance</th>
<th>Citation Data Processing</th>
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<td>Initial Fixed Price Payment</td>
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<td>Initial Fixed Price Payment and Fixed Monthly Payments</td>
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<td>Fixed Monthly Payments</td>
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<td>Per Citation Payments</td>
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<tr>
<td>Time Worked and Materials Used</td>
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## Payment Options – Agency Owned and Operated

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<tr>
<td>Time Worked and Materials Used</td>
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Go – No Go Decision

IntranS Should GO:

- Our Current knowledge and Technology in place now can support this venture.
- The Growth potential will be big with more and more cities around the world going to this technology on a daily basis.
- Lucrative Income could be big with Fixed price and Pay Per Citation contract.
- Some of our current competitors are already selling Red Light Enforcement Technology.