



Red Light Protection

Protecting the intersection from possibly fatal accidents

Red Light Runner Protection

The Use of Dynamic All Red Extension (DARE)
RLP (Red Light Protect) in Omni

Scottsdale
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Enlighten

Encourage

Red Light Protection using DARE

Dynamic **All-Red Extension** is the ability to extend the all-red clearance interval or add an all-red clearance when a red-light runner is predicted.

Endow

01. Statistics

This is to impress upon everyone the significance and severity of Red Light Running in the US

02. Mitigation for Red Light Running

What are current ways to reduced Red Light Running and protect against it? What are the costs? Where's the Funding?

03. Studies

Discuss one study done in San Bernardino

04. How it works

How SWARCO's Omni Controller software uses DARE.

05. Conclusion

Review why DARE is important and answer questions.

Red Light Running Defined

Uniform Vehicle Code (UVC)



Simply stated, red-light running is entering, and proceeding through, a signalized intersection after the signal has turned red. According to the Uniform Vehicle Code (UVC) (3), a motorist "...facing a steady circular red signal shall stop at a clearly marked stop line, but if none, before entering the crosswalk on the near side of the intersection, or if none, then before entering the intersection and shall remain standing until an indication to proceed is shown ..." (section §11-202).

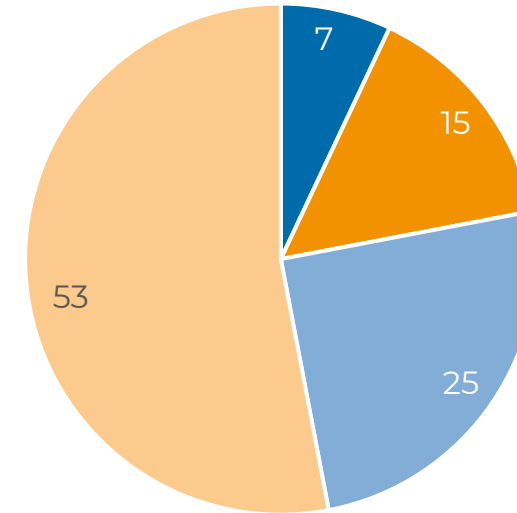
The Problem

The Red-Light Running Problem

The Problem

- Intersection violation rates are known to be higher than **18 violations / hour** on average
- There was a **15% increase** in the number of fatal red-light running crashes during the **last 4 years**
- For any red-light running crash there is a potential **47% injury rate**, which is higher than other crash types.
- Direct economic impact of red-light running crashes is estimated at **\$14 Billion** annually

Type



- A-type: Fatal or Incapacitating
- B-type: Non-Incapacitating
- C-type: Possible injury
- Property Damage Only: No injury

Why use Red-Light Protection (DARE)

- Problem Statement*
1. In 2023, **1086 people were killed** in crashes involving red light running
 1. More than half were pedestrians, bicyclists or people in other vehicles.
 2. It is estimated that about **260,000 crashes** occur annually.
 1. Someone runs a red light every **20 minutes** somewhere in any urban environment.
 3. Red Light Runners are likely to be male, younger, and have previous crashes or substance related convictions.
 4. Three times as many accidents occur within **200 feet** of an intersection than any other distance

* sources: 1)IIHS, 2)Science Direct, 3)USDOT



Someone's life is
ruined because
someone is not
coming home
tonight!

Statistics on Red Light Running

7/3/2026

•Additional Facts

- **1 in 3** know somebody that has been killed or seriously injured in a Red-Light running accident.
 - 1/3 admitted to running a red light in the previous 30 days
- A study in Virginia showed that a Red-Light Violation happened about once every 20 minutes at most urban intersections.

• Human Factors Affecting Red Light Running

- No specific category to point to; all ages, classes, gender.
- 48% are due to being in a hurry (deliberate)
- Chemical influence; alcohol, marijuana, others.
- Distraction; phones, texting, reading GPS, radio, etc.
- Inattention; simply zoning while driving
- Lack of visibility of the signal; tailgating
- **Most will have multiple traffic violations**

• Average Costs associated with Red Light Accidents*

• Death	\$1,750,000 US
• Disabling	\$101,000 US
• Evident	\$29,200 US
• Possible	\$23,900 US
• No Observable Injury	\$12,800 US
• Property Damage Only	\$4,700 US

*Does not include long term medical costs, societal costs, burdens on employers, potential losses.

•Societal Costs

- Loss of Productivity (personal lifetime)
- Legal Costs
- Pain and Suffering of loved ones and families
- Quality of Life
- Employer costs
 - Medical
 - Leave of Absence
 - Productivity

Statistics For Red Light Running*

States w/ highest % of fatalities

•Washington D.C.: 5.62%

•Nevada: 5.41%

•Arizona: 4.48%

•Delaware: 4.33%

•California: 3.89%

States w/ lowest % of fatalities

•North Dakota: 0.47%

•Montana: 0.52%

•Wyoming: 0.57%

•Vermont: 0.59%

•Arkansas: 0.62%

Additional Statistics

•**California:** Leads the nation in the total number of red-light running crashes.

•**Arizona:** Has the highest per capita rate of red-light running fatalities.

•**Pennsylvania:** In 2023, red-light running accounted for nearly 4% of all crashes and 3% of all fatalities in the state.

•**Kentucky:** In 2023, 3,914 crashes resulted from red-light running, with 46 fatalities and 2,194 injuries.

Side Note:

In 2023, 4.6 million drivers were caught running a red light.

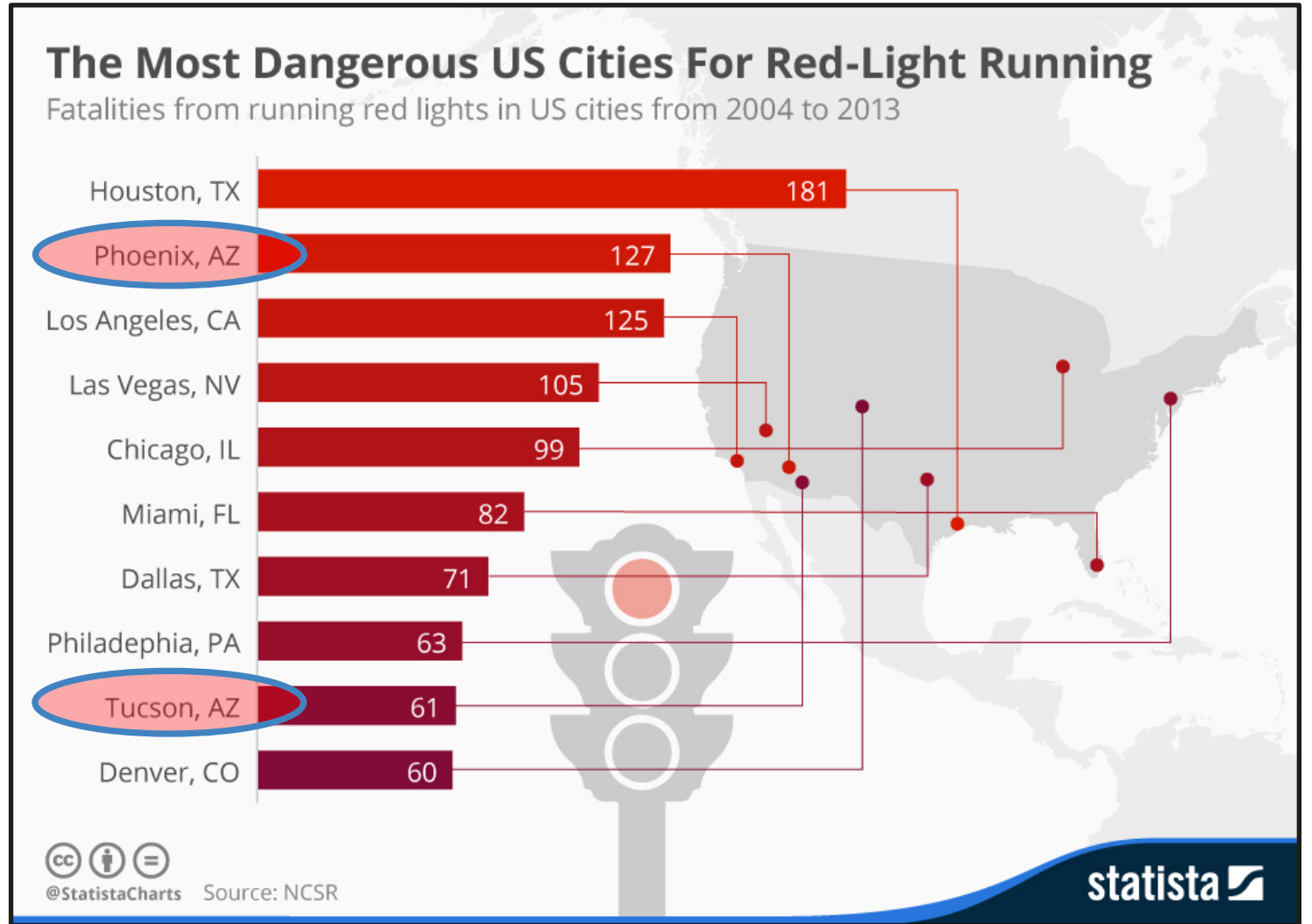
AAA Cam <https://newsroomaaa.com/2019/08/red-light-running-deaths-hit-10-year-high/#:~:text=28%25%20of%20crash%20deaths%20that,who%20ran%20the%20red%20light>
 Verra Mobility: <https://www.ttuhub.net/2017/10/red-light-cameras-and-driver-safety-in-west-texas/>.

Most Dangerous Cities in the US

Where do you live?

Red Light Runners are active everywhere

The Top 10 cities in the US are listed here for fatalities.



Do the math for National Statistics - *Hypothetically*

Assumptions

- **Average Red Light Running events** per hour is 25 Red Light Runners at Urban intersections.
 - Accounts for lower night- time averages
- **Average Red Light Running events** per hour is 2 Red Light Runners at Rural intersections.
 - Accounts for lower night-time averages.
- **INRIX / ITE** estimated 327,860 signalized intersections in the US in a 2018 study
- **FHWA** notes that 327,860 is ~10% of the 3,000,000 total intersections, includes any intersection of two roads.
- **Urban Dominance** in one example state there are 5,313 urban signalized intersections and only 116 rural signals.
- **Fatality rates** are higher at Rural intersections (1.5 times) attributed to higher speeds
- **Road Mileage:** About 71% of US road centerline miles are rural, but only 30-31% of annual Vehicle Miles Traveled (VMT) occur there.
- **Fatalities:** In 2023, 73% of intersection crash fatalities were in urban areas, versus 26% in rural areas.
- **Crash Types:** Pedestrian/bicyclist deaths and general intersection fatalities are higher in urban areas; large truck occupant deaths are more common in rural areas.

Number of intersections	327,860
Percentage of Urban signalized intersections	97.8%
Percentage of Rural signalized intersections	2.2%
Number of Urban RLR / hour (25) for 24 hours	600
Number of Rural RLR / hour (2) for 24 hours	48
Total number of urban RLR estimated annually	192,421,053
Total number of rural RLR estimated annually	343,596
Total RLR events estimated annually in US	192,764,648

320,702

7,158

192,421,053

343,596

Volunteer Community-led Effort

Lexington, KY



"We are shocked, but not surprised, at the number of red-light runners our volunteers counted. This is a public safety issue that affects all residents – whether they are a pedestrian or a driver."

- 3 intersections surveyed saw an average of **over 100 red- light runners per hour** during our count period.
- 5 intersections surveyed saw an average of **50 to 99 red- light runners per hour** during our count period.
- 16 intersections surveyed saw an average of **49 or fewer red-light runners per hour** during our count period.

WHAT ARE THE
CURRENT
MITIGATION
ALTERNATIVES
FOR REDUCING
RED LIGHT
RUNNING
ACCIDENTS?

Four Types of Risk Mitigation



Technical Solutions

Red Light Cameras

1. Effective
2. Reduces Accident rates
3. Reduces Fatalities
4. Expensive
5. May increased Rear-ender accidents

Costs / Effectiveness
High / limited

All Red Clearance

1. Initially can be effective
2. Initially accident rates go down.
3. Promotes or teaches bad driving behavior
4. Overall accident rates return to previous rates.
5. Inexpensive

Costs / Effectiveness
Low / Low

Dilemma Zone Detection

1. Effective in getting people through the dilemma zone
2. Reduces some red light running by postponing the onset of the yellow and red clearance.
3. Does not protect against red light runners
4. Bad behavior can still be induced.
5. Inexpensive

Costs / Effectiveness
Low / Low

DARE – Red-Light Protect

1. Effective in reducing Accident rates
2. Effective at reducing injuries and deaths
3. Does not teach bad driving behavior
4. Does not increase Rear-enders
5. Easily implemented with any technology
6. Can be used at any intersection with detection.
7. Low Cost of entry

Costs / Effectiveness
Varies / High

Other mitigation plans for Red Light Running

The 3 E's: Education, Enforcement, Engineering

In 1970, the National Highway Traffic Safety Administration (NHTSA) was created to take responsibility for traffic safety Education and Enforcement, as distinct from the Engineering responsibilities of the Federal Highway Administration (FHWA). The 3 E's

Example:



Let's be Safer Together, Carlsbad!

The City of Carlsbad uses the three Es of traffic safety -- education, engineering and enforcement -- to help ensure everyone uses local streets safely. Thanks to your support, it's working! Please continue to look out for one another, follow our safety tips and share your commitment publicly so others will do the same.



**KNOW E-BIKE
RULES**



**REDUCE
SPEEDING**



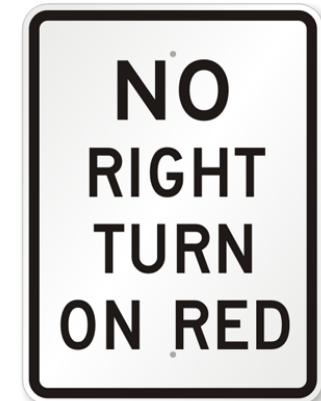
**SAFE STREET
DESIGN**



**SAFER STREETS
TOGETHER**

Reduce Conflicts

Reintroduce a No Right Turn on Red policy in locations with high conflicting crash rates.



Not considered running a red light but can be included in red light crash data.

Mitigation and Focus for Pedestrians

Leading Ped Interval



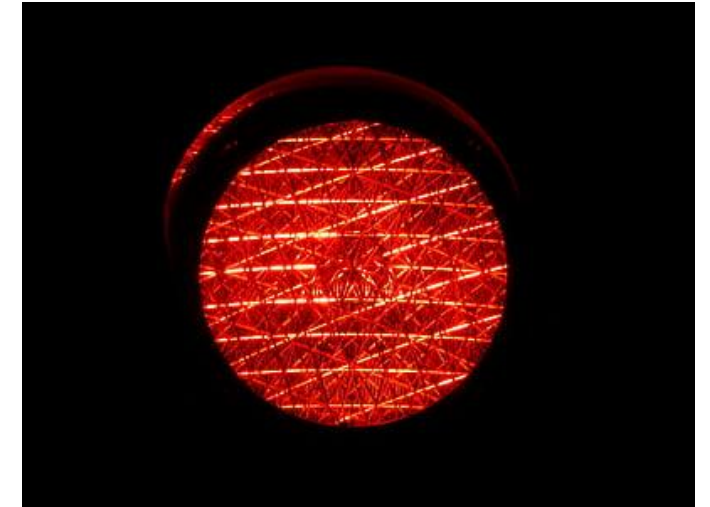
Provides a head start for Pedestrians ahead of the associated Vehicle Movement

Flashing Right / Left Arrows



Warns Drivers of potential pedestrian conflicts

DARE



Provides an additional all red interval when pedestrians are present.

Red-Light Running and Pedestrian / VRU Safety

More E's: Encouragement, Evaluation

SS4A E's: Equity, Ethics, Empathy

In the 80's and 90's with rising prices of fuel there were other "E"s added to the 3 E concept.

Encouragement¹ – the League of American Bicyclists promoted bicycle and pedestrian activity, thus making focus on the safety of these VRUs more significant.

Evaluation¹ – This is a revolving process of feedback including research, planning, development, operations and evaluation.

SS4A has added additional **E's** for Vision Zero

Equity / Ethics / Empathy¹ – With Vision Zero and other safety focused programs, focus has been towards pedestrian, and other VRU safety especially for low income, tribal communities, and other siloed communities which don't have the same opportunities as more affluent communities.

¹ History of the 3 E's - <https://tooledesign.com/the-history-of-the-3-es/>

Red-Light Protection (DARE)

Dynamic All Red Extensions is a proven technology that works. It's not just a band-aid.

Several Alternatives to look at...



Engineering Red Light Protection for Vehicles, Pedestrians and VRUs

Vehicles with no Pedestrians

- Red Clearances are provided with normal times or removed
- RLR will add additional time as necessary for Red Light Runners.

Pedestrians

- Passive activations would force an extended all red.
- Active detection could vary based on if the pedestrian is in the crosswalk or clear of the cross walk

Other VRUs

- Passive activations would force an extended All Red.
- Active detection could vary All Red time based on if the VRU is detected in the roadway or crosswalk.

Red Light Protect

*Detector Technology Agnostic**



Wavetronix Matrix®



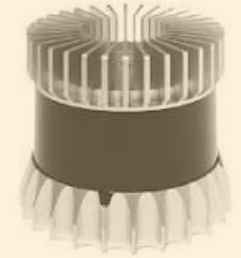
Iteris Vector®



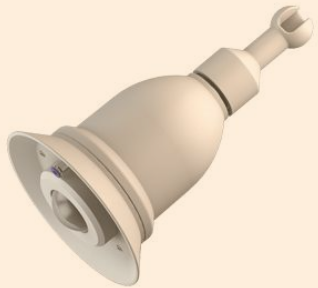
Teledyne FLIR Traffic Radar®



NoTraffic IoT Sensor®



Ouster Lidar



Cubic Gridsmart FE3®



Smartmicro®



EDI Oracle®



Reno A&E Model C®



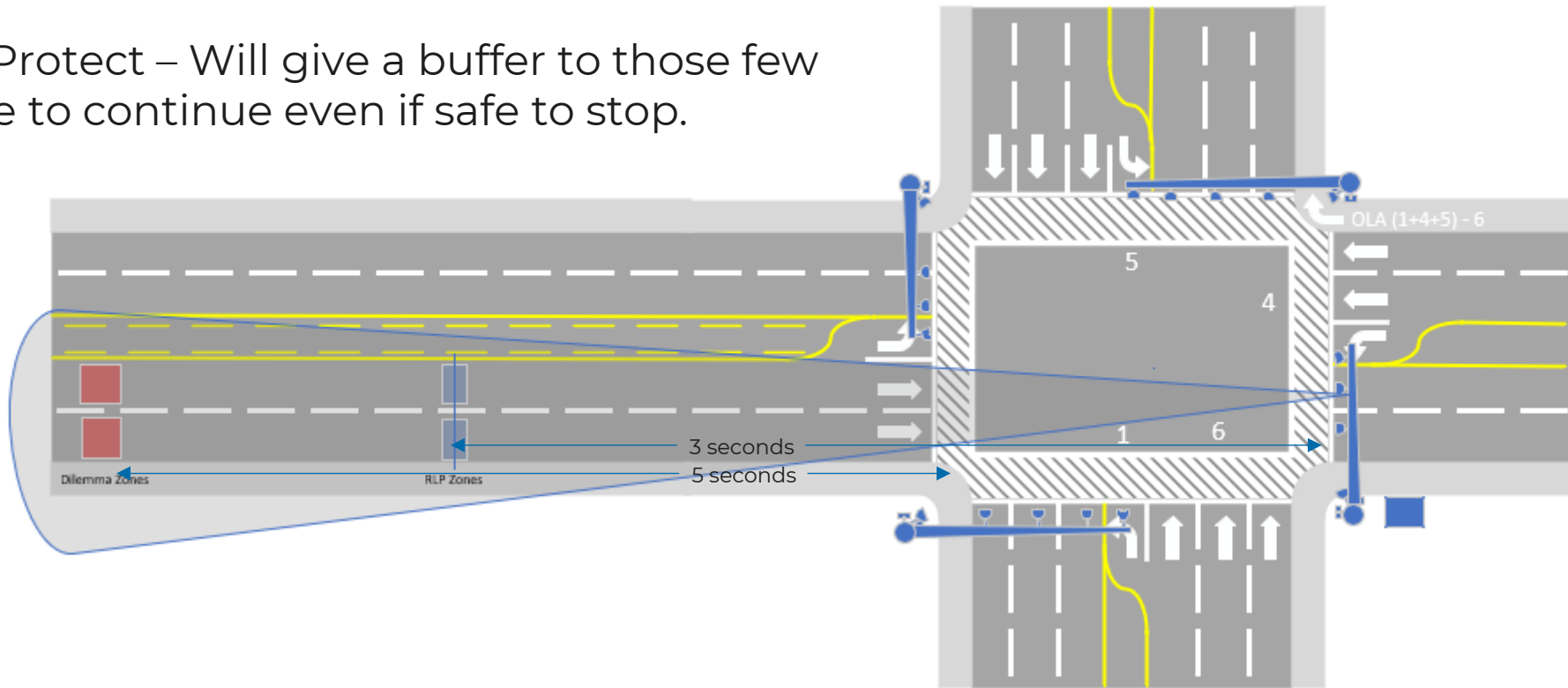
Miovision Smartview 360®

- * The detector must be able to detect a potential red-light runner or give an accurate ETA, there may be others...
- * Pedestrian detection is important too...

Combining DARE and Dilemma Zone together

Dilemma Zone – Provides a small window to add green time to a vehicle in a “dilemma” to continue or stop.

Red Light Protect – Will give a buffer to those few who decide to continue even if safe to stop.



Grants through Vision Zero and SSFA

Vision Zero

- Vision Zero is a strategy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all. First implemented in Sweden in the 1990s, Vision Zero has proved successful across Europe — and now it's gaining momentum in major American cities.
- There are six principles that form the basis of the Safe System approach:
 - deaths and serious injuries are unacceptable,
 - humans make mistakes,
 - humans are vulnerable,
 - responsibility is shared,
 - safety is proactive,
 - redundancy is crucial.

<https://visionzeronetwork.org/about/what-is-vision-zero/>

Chasing the money!
Using Vision Zero and SS4A safety initiatives as a focus for funding



Department of Transportation



Grants Available until 2026

Infrastructure Investment
and Jobs Act (IIJA)
Being Restructured

Raise Grant Formally TIGER

Rebuilding American Infrastructure With
Sustainability and Equity Grant

SS4A

Safe Streets for All
Grant Program
\$5B
\$1B annually

BUILD Grant

Better Utilizing
Investments to
Leverage
Development
\$5M / project min.



SMART

Strengthening Mobility
& Revolutionizing
Transportations Grant
\$500M
\$100M annually

IIJA Funding as of 2026

- **Authorization Gap:** Following the expiration of the IIJA at the end of FY 2026, a projected revenue gap of **\$199 billion** exists for a five-year reauthorization starting in FY 2027.
- **Non-Expiring Funds:** Approximately **\$120 billion** of the original IIJA allocation does not have a set expiration date, allowing for long-term project execution.
- **Spending Status:** As of early 2026, roughly **half of IIJA funds** remain unspent, with many large-scale projects slated for construction in 2027 and 2028.

Funding Breakdown by Program



[https://www.dlt.com/infrastructure-investment-and-jobs-act-iija#:~:text=Infrastructure%20Investment%20and%20Jobs%20Act%20Overview&text=Approximately%20\\$120B%20of%20funding,to%20compete%20for%20federal%20grants.](https://www.dlt.com/infrastructure-investment-and-jobs-act-iija#:~:text=Infrastructure%20Investment%20and%20Jobs%20Act%20Overview&text=Approximately%20$120B%20of%20funding,to%20compete%20for%20federal%20grants.)

Grants That Were Available in 2026

- **Funding Opportunities**

- **Federal - Safe Streets and Roads for All (SS4A):** The SS4A program, part of the \$5 billion IIJA, continues through 2026, with the final Notice of Funding Opportunity expected around March 30, 2026, targeting regional, local, and tribal safety projects.
- **Local - Seattle:** A proposed 8-year transportation levy includes nearly \$300 million for Vision Zero, safe routes to school, and bike safety projects.

- **Grant Application Deadlines & Timelines:**

- Road to Zero Grant (NSC): Applications were due by January 16, 2026.
- SS4A Notice of Funding Opportunity (NOFO): Expected around March 30, 2026.
- BC Vision Zero Grant Program: Adjudication for the 2026 period runs from December 2025 – March 2026, with projects evaluated in September 2026.
- It is recommended to check the USDOT SS4A website for the most up-to-date information on 2026 application windows.
- RAISE Grants – Now BUILD grants: https://www.transportation.gov/sites/dot.gov/files/2025-12/FY_2026_BUILD_NOFO_Final.pdf expired February 24, 2026

Various Controller Operations for DARE

SWARCO McCain Omni

Red Light Protect (RLP)

1. Provides a per-pattern Headway or activations per cycle, if desired
2. Provides programming for a red extension up to 25.5 seconds
3. Provides a per phase activation limit up to 2 events per phase if desired.
4. Any of the 128 detector inputs can be used for the trigger from the detection technology.
5. All detector parameters can be used if desired.
6. Omni looks at the input for the whole clearance interval (yellow + red).
7. Time is added as needed to provide the programmed red protection period.
8. Second activation will add additional time to the red protect time.
9. Four (4) sets

•Econolite ASC3 / Cobalt

•Red Max

1. Allows up to 25.5 seconds
2. Holds all red if detection is present during red clearance.
3. Holds red max until detection is removed or max time is reached.
4. Red maximum has no effect when there is no red extension detector present.

•Siemens (Yunex) SEPAC

•Red Protect

1. Recognizes red light runner calls only during the red clearance.
2. Can use delay and extension with the detector input.
3. Amount of time the detector will hold the controller in an all-red condition and is 0 – 999 seconds
4. Can be programmed essentially with a headway time. No input will be serviced if time programmed has not expired.
5. SEPAC can limit the number of times a red protect call is placed. (Unknown if this is by cycle or by phase)

Intelight / Q-Free MaxTime

+RedClr

1. Add Red Clearance time to the duration of the Phase Red Clearance interval.
2. Not clear how this is activated

Trafficware / Cubic Scout

BikeClr

1. If the bike clear time has not counted down by the time red clearance has terminated, then the phase will hold in red until the remaining bike clearance time has expired
2. Red Extension provides an alarm when Red Clearance is being extended.
3. Not clear how this is activated

San Bernardino (first field trial)

•Setup

- Installed the DB from their 2033 to Omni
- The most time was spent with the conversion of DBs
- Loaded the DB on a 2070 LX with a 2070-1C
- Setup the 2070 for a 332 cabinet
- Turned on BIUs 10 and 11 and MMU to send on the TS2 configuration
- Setup detectors that would be used in this manner:
 - Detector 32 for phase 2, Detector 34 for phase 4
- Went into I/O mapping and enabled detector channels 32 and 34 or detector 32 and 34.
- Programmed the RLP parameters for 2 seconds.
- Kept number of activations to unlimited.

•Implementation

- Iteris setup their Vector for trip lines at 112 feet from the stop bar. That is 2 seconds at 35 MPH.
 - We chose a lower speed to optimize the test
- Once they were set, we connected their system to the 2070 LX and tested inputs to make sure they were getting them into the controller.
- Once that was verified, we swapped their 2070 with our 2070 LX and ran the intersection with our controller.
- Controller was in coordination, but we put it Manual to see more Red-Light runners.
- We also reduced the speed to 0 and increased the RLP to 5 seconds so city could see applications of the RLP.
- It worked as expected and San Bernardino was satisfied with the results.

San Bernardino Early Results

•Reduced accident rates

- Early results show that the accident rates were significantly reduced over the previous year where Red Light Protection was not used
- Injuries were significantly reduced because of the reduced Red Light running events.
- No data to confirm that the injuries were less severe.

•Reduced Deaths

- Before the Red-Light Running protection there were approximately 13 deaths in a two-year period.
- Two years with Red Light protection – Zero deaths.

This data has not been published yet and is still preliminary.

NC DOT DARE Project

•Overview of project

- Implemented at 9 intersections since 2011
- Results suggested there was minimal driver habituation to the system.
- Operated successfully for over a 3-year period and remains in operation.
- Dynamic Reds were not associated with noticeable increases in delays.
- The project only extended the Red Clearance
- The target group were those that entered the intersection in all red and at least one second into the all red.

•Project Data

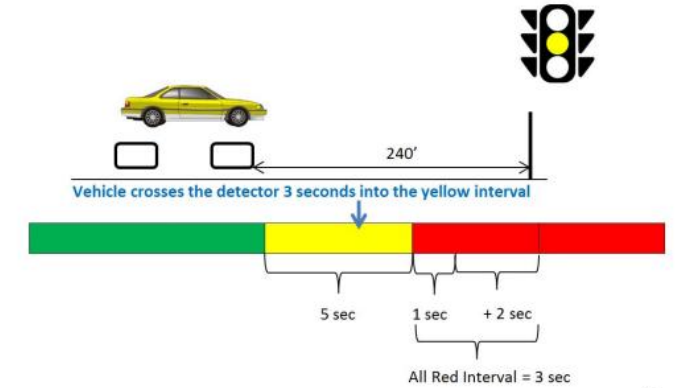
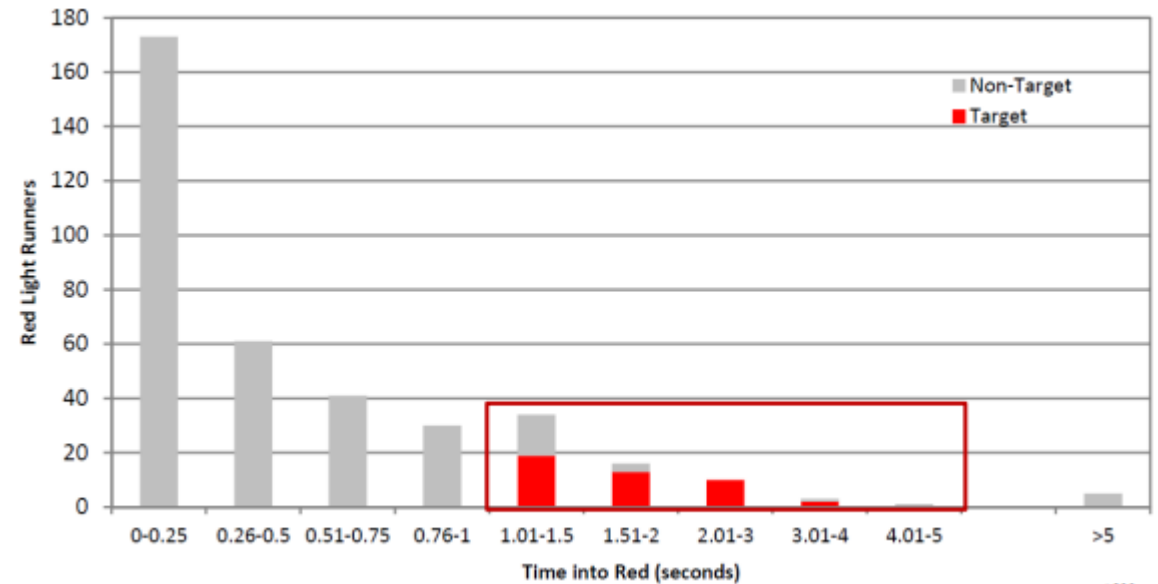


FIGURE 2 Example Scenario



<https://connect.ncdot.gov/resources/safety/Safety%20Evaluation%20Completed%20Projects/Dynamic%20All%20Red%20Research%20Paper%202016.pdf>

CMF – Crash Modification Clearinghouse

•Study ID: 660 Published Nov 2021

•Presented at TRB 2022

•NC DOT Study

- Limited to Frontal impact Crashes (Angle, Left Turn, Right Turn, and Head On)
- CMF using aggregate EB* (Empirical Bayes) Methodology is .93 (7% reduction in target RLR crashes for all 16 sites.
- CMF using EB methodology for seven Multilane sites was .65 (35 % reduction in target RLR crashes), statistically significant at 95% confidence.
- Benefit to cost ratio of the treatment was calculated at 143:1.
 - Low cost of installation vs. high costs of RLR crashes.

*EB combines observed crash counts with predicted frequencies from safety performance functions (SPFs) to estimate expected safety changes.

Simpson, C. L. (2022). Dynamic All-Red Extension: An Innovative Safety Countermeasure to Treat Red Light Running Crashes. Transportation Research Record: Journal of the Transportation Research Board, 2677(2), 753-762.



TRID

the TRIS and ITRD database

Dynamic All-Red Extension: An Innovative Safety Countermeasure to Treat Red Light Running Crashes

Enforcement Mitigation

- How can enforcement be implemented

- Tattletale Lights

- Provides feedback to Law Enforcement when the Red Interval is on.
- Faces upstream of the intersection.
- Usually Blue, but can be White, Red, or Amber

- Deterrent for those who may want to run a red light knowing that there may be added time.

- Ties into the Red Signal output. Mounted on top of or behind the signal head.

- SWARCO McCain Enforcer



- Tattletale light Examples



DARE is effective

TAKEAWAY...

DARE measures can be implemented at relatively low costs and shows significant promise in reducing accidents and possibly the severity of accidents due to Red Light Runners.

01. Red Light Running Statistics

- Red Light Running Accidents are on the increase
- Red Light Running Accidents are very costly even at just property damage
- Red Light Running can be reduced

02. Mitigation

- Several ways of reducing Red Light Running Accidents are available
- Mitigation of Red Light Running needs to be implemented
- Costs Vary but the ability to provide a Dynamic All Red Extension is cost effective
- Additional mitigation for pedestrian and VRUs should also be considered
- DARE does not show that drivers learn bad behavior

03. Trials

- Initial trials and test cases show promise in reducing numbers of incidents.



- Red light running is deadly and costly

- Different solutions are available



The Better Way. Every Day.

Let's start
the journey
together.