Vantage Vector®

Dilemma / Decision Zone Protection and Red-Light Runner Protection:

Why and How

Nader Ayoub, P.E.
Allison Palumbo, P.E.

iteris®

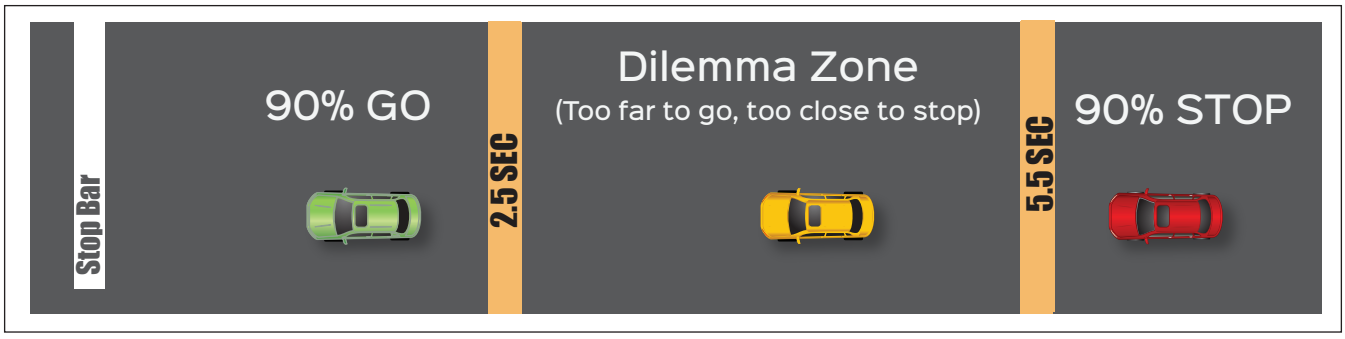
Table of Contents

The Dilemma / Decision Zone

iteris®

What is a Decision-Making Dilemma Zone?

Location on an approach where, based on speed, it is unknown if a vehicle will make the decision to stop or go if the signal turns yellow.



From NCHRP Report 812 – Signal Timing Manual, 2nd Edition

> The decision zone has historically been defined using a variety of measures, including distance to the stop bar (*4*, *5*), travel time to the stop bar (*6*), and stopping sight distance (*7*). Based on trends from these previous studies, the limits of the decision zone tend to be between 5.5 and 2.5 seconds of travel time from the stop bar. Exhibit 4-7 provides quick reference distances representing the beginning and end of the decision zone (if 5.5 seconds from the stop bar is considered the beginning and 2.5 seconds from the stop bar is considered the end). In order to design with the decision zone in mind, one detector (or more in some complex designs) should be placed upstream of the stop bar, starting at the beginning of the decision zone. Detection at the beginning of the decision zone can then be programmed to prevent a phase from terminating before a vehicle clears the decision zone (using the passage timer, which is discussed further in Chapter 6).

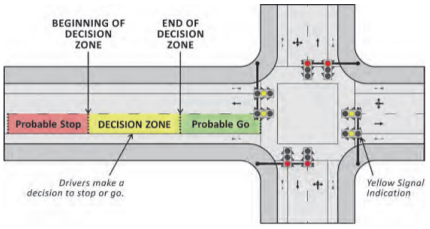


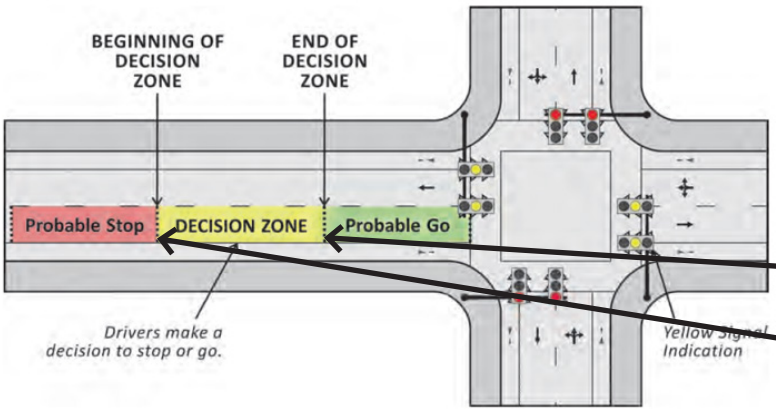
Exhibit 4-7 Limits of Decision Zone

Approach Vehicular Speed (Miles Per Hour)	Beginning of Decision Zone (5.5 Seconds from Stop Bar)	End of Decision Zone (2.5 Seconds from Stop Bar)
35	285 feet	125 feet
40	325 feet	145 feet
45	365 feet	165 feet
50	405 feet	180 feet
55	445 feet	200 feet

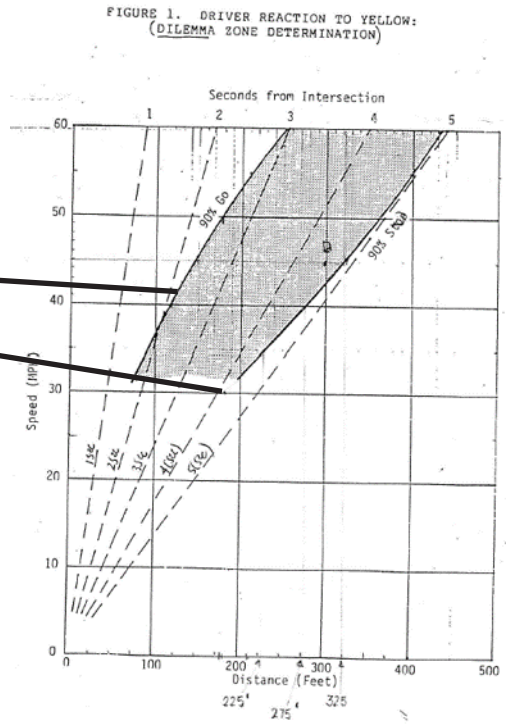
Where do the Decision Zone Distances Come From?

Research conducted in the 1970's defined the first dilemma zone boundaries for vehicles traveling at different speeds. The latest values are recorded in NCHRP Report 812, Signal Timing Manual, 2nd Edition.

From NCHRP Report 812



Original Decision Zone Research

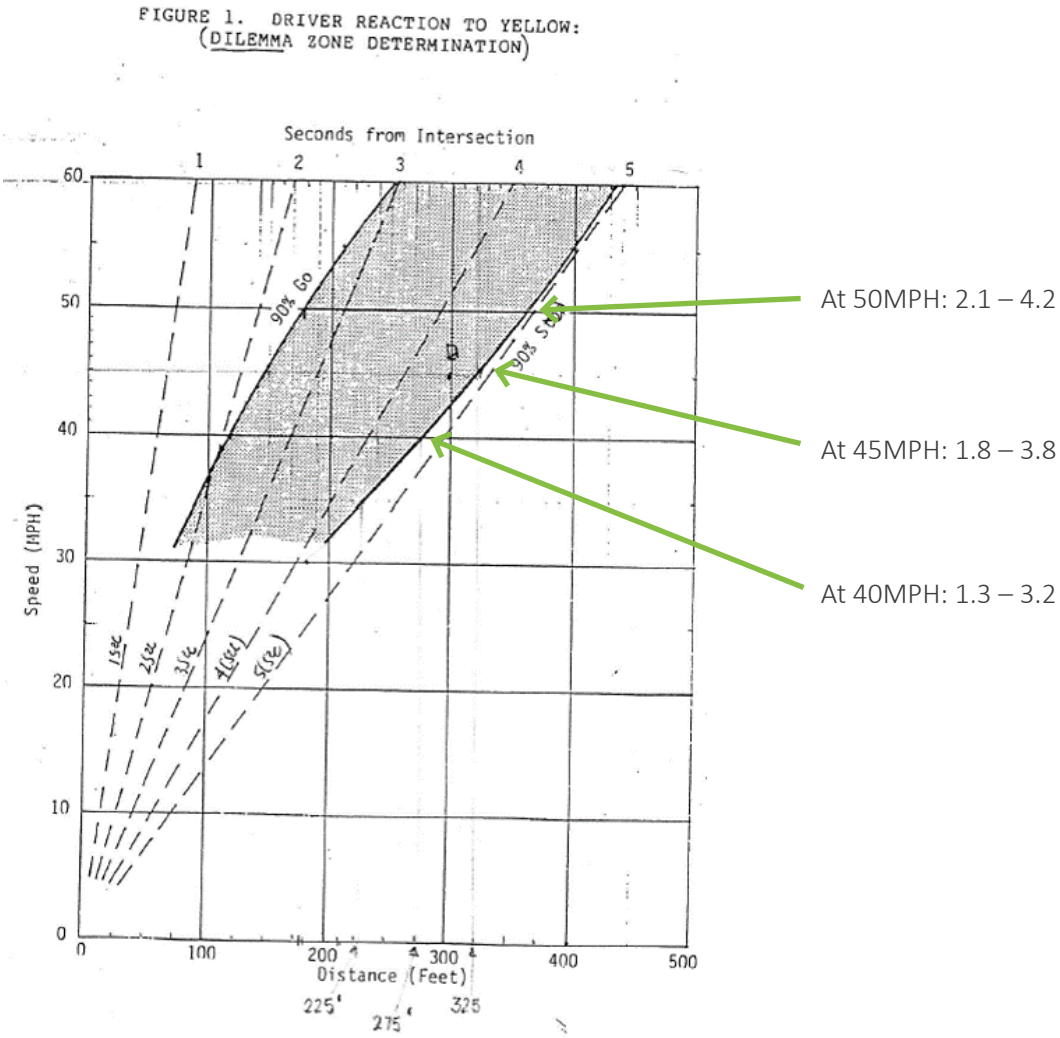


4. Parsonson, P. S., R. W. Roseveare, and J. R. Thomas, Jr. Small-Area Detection at Intersection Approaches. *Traffic Engineering*, Vol. 44, No. 5, 1974, pp. 8–17.
5. Zegeer, C. V., and R. C. Deen. Green Extension Systems at High-Speed Intersections. *ITE Journal*, Vol. 48, No. 11, 1978, pp. 19–24.
6. Chang, M. S., C. J. Messer, and A. J. Santiago. Timing Traffic Signal Change Intervals Based on Driver Behavior. In *Transportation Research Record 1027*, TRB, National Research Council, Washington, D.C., 1985, pp. 20–30.

Does Everyone Use the Same Decision Zone Boundaries?

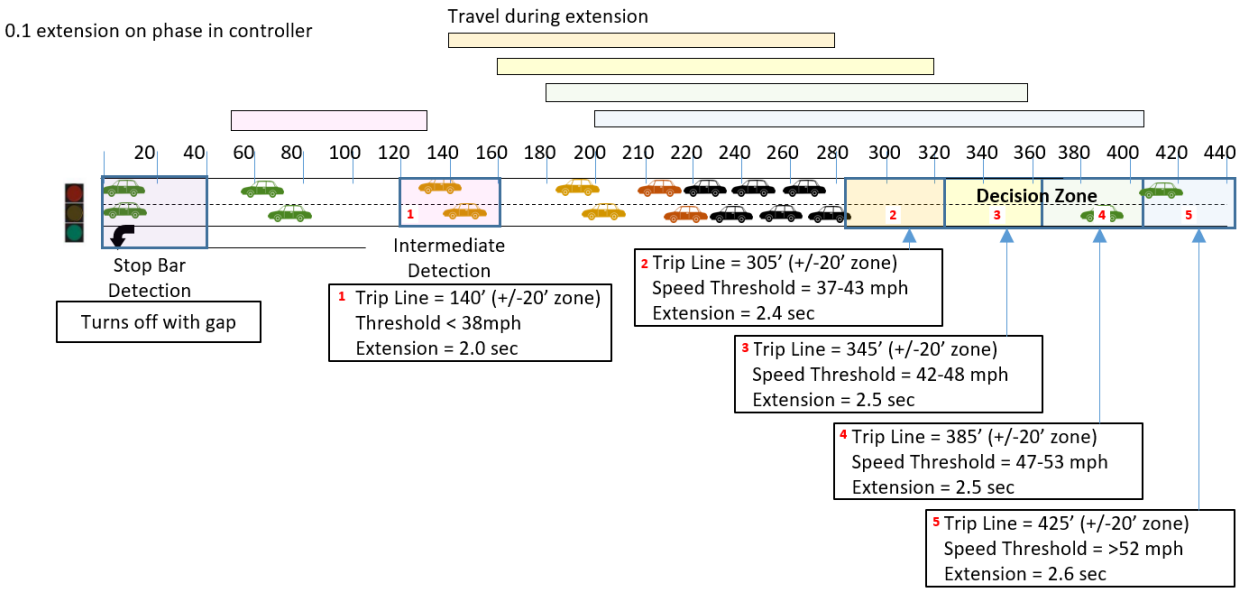
No, different agencies have developed different standards over the years. If your agency has its own standards, use those. Otherwise, this document's values are based on common practice as defined in the Signal Timing Manual.

Example of an agency with its own standards:



What is Iteris' Recommended Setup for Decision Zone Detection?

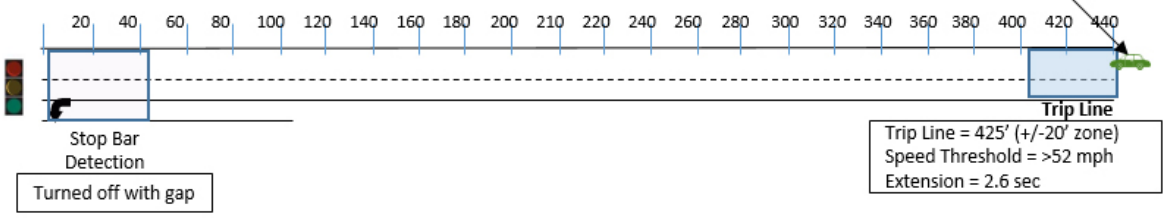
Iteris Decision Zone Layout



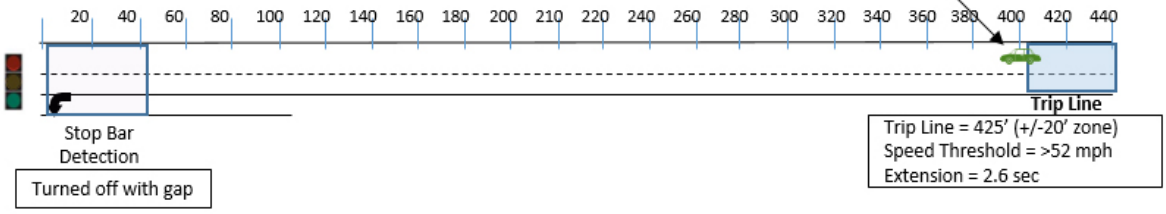
All trip lines / zones should be on a separate output channel
(if needed, decision zones can be on the same output channel)

How does Decision Zone Detection Work?

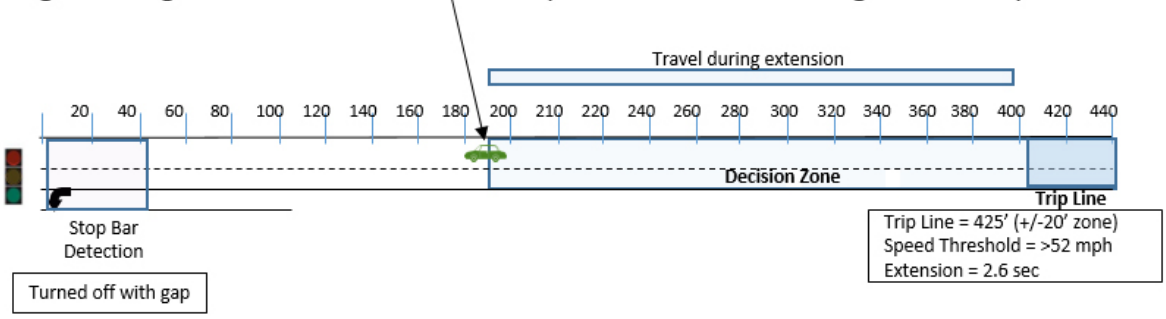
1. Vehicle going at the right speed crosses a speed-sensitive radar trip line – sends detection to controller.



2. Radar continues to detect while vehicle is in the trip line width – sending detection to controller.

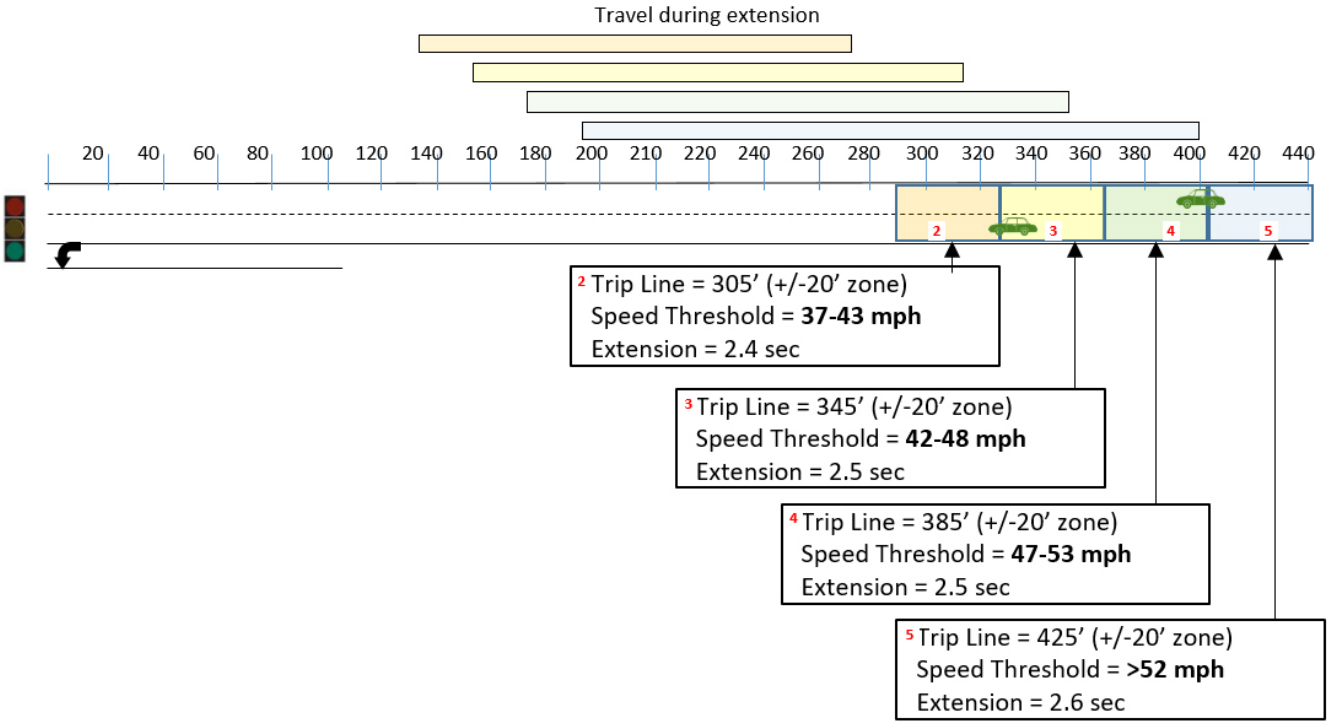


3. Extension timer set for trip line provides enough extension for a vehicle at that speed to get through the Decision Zone. At that point it is safe for the signal to turn yellow.



Why Do I Need Multiple Decision Zone Trip Lines?

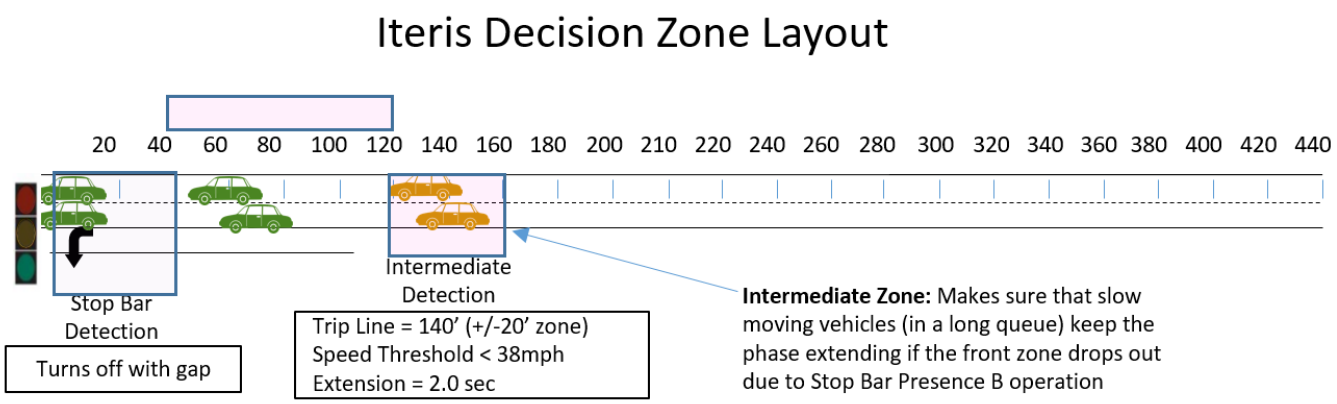
Decision Zone distance is based on the speed of the vehicle, and not all vehicles are traveling at the same speed on an approach. Multiple trip lines with different speed thresholds can be used to protect vehicles traveling at varying speeds.



What is the Intermediate Zone and Why Do I Need It?

The intermediate zone is a speed-sensitive zone that sends a call to the controller when any slow-moving vehicles are detected.

This zone holds a call on the phase while a queue is present and turns off when the queue has cleared it. Without it, there is potential that the phase will prematurely gap out before vehicles are traveling at speeds high enough to engage the decision zone trip lines if the stop bar presence detection has seen a gap.



Iteris Vantage Vector

Vantage Vector Setup for Up to 55 MPH Posted Speed

Decision Zone distance is based on the speed of the vehicle, and not all vehicles are traveling at the same speed on an approach. Multiple trip lines with different speed thresholds can be used to protect vehicles traveling at varying speeds.

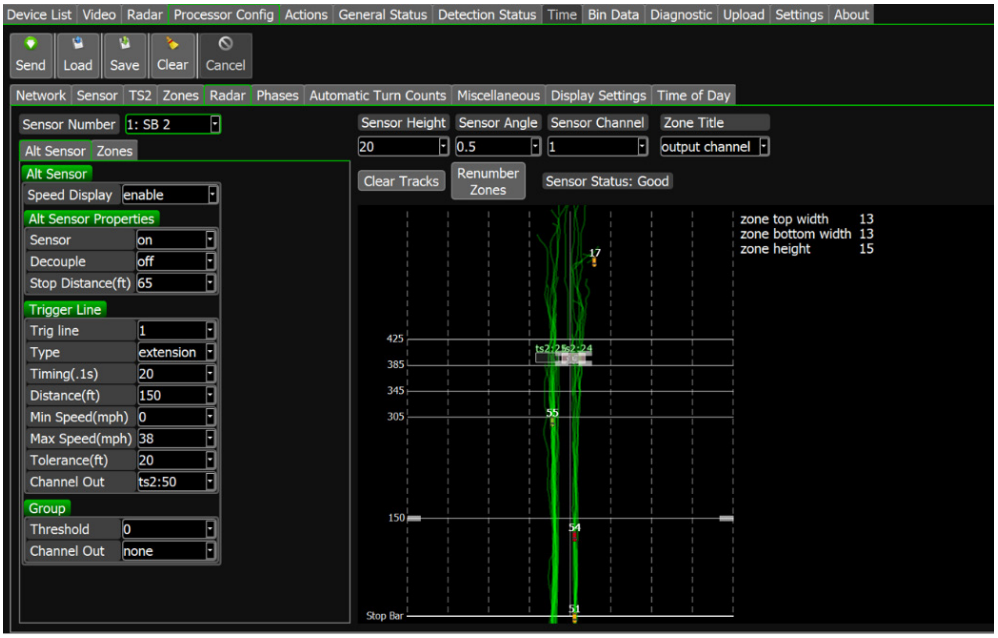
Trip Line	Speed (MPH)	Trip line Distance	Trip line Width	Speed Threshold	Extension	Controller Settings
Vector Dilemma Radar Zone Settings						
5	55	425	+/-20	>52	2.6	Call + Ext
4	50	385	+/-20	47-53	2.5	Call + Ext
3	45	345	+/-20	42-48	2.5	Call + Ext
2	40	305	+/-20	37-43	2.4	Call + Ext
Vector Intermediate Radar Zone Settings						
1	All	140	+/-20	<38	2.0	Call + Ext
Vector Stop Bar Presence Video Detection Settings						
Video	N/A	Stop Bar	40’ Zone	N/A		Drop after gap

These setup parameters are available as a default program that can be uploaded to the processor from your laptop. The only programming needed is the distance to stop bar.

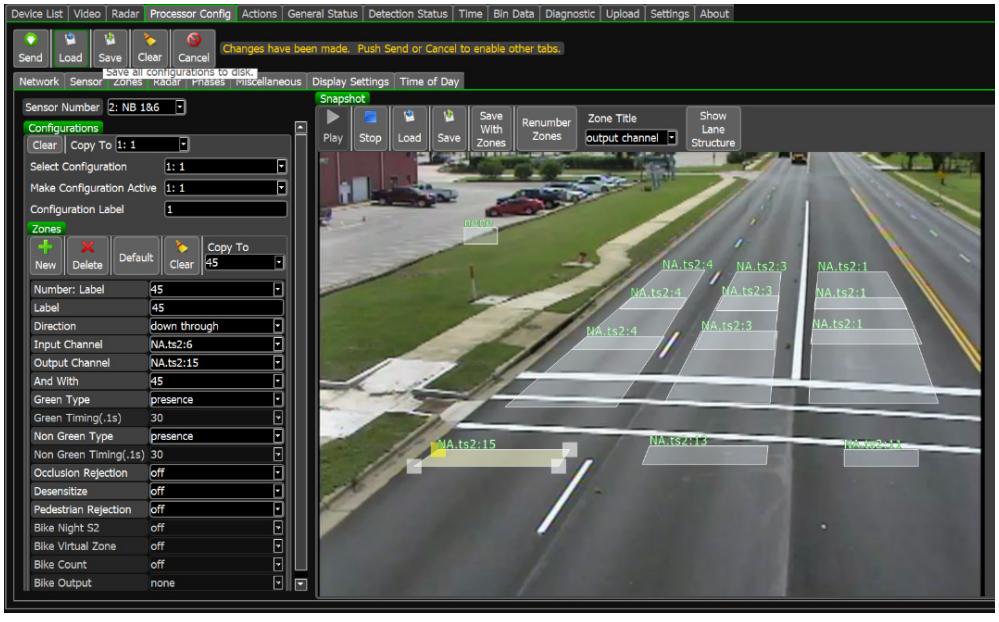
This table is available for download on the Resource Center.

Iteris Vector Decision Zone Setup for 55mph approach

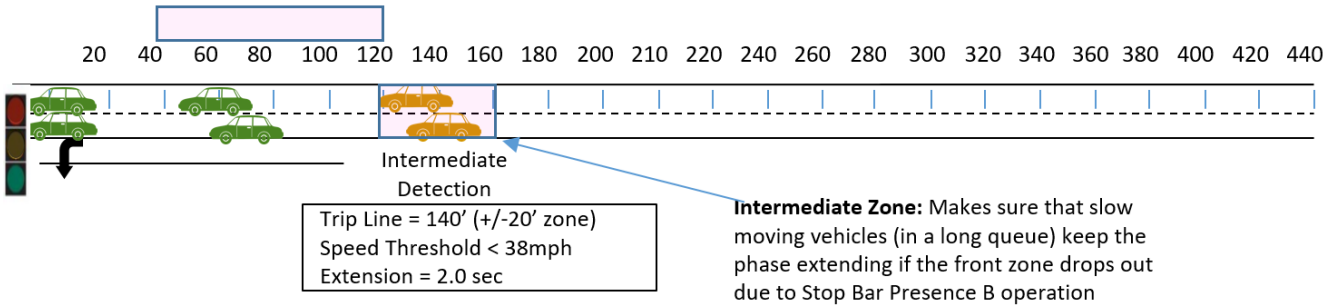
Radar Trip Lines will be set up for the four Decision Zones and the Intermediate Zone



Video Detection will be used for Stop Bar Presence



Trip Line #1
Intermediate Detection Zone Settings

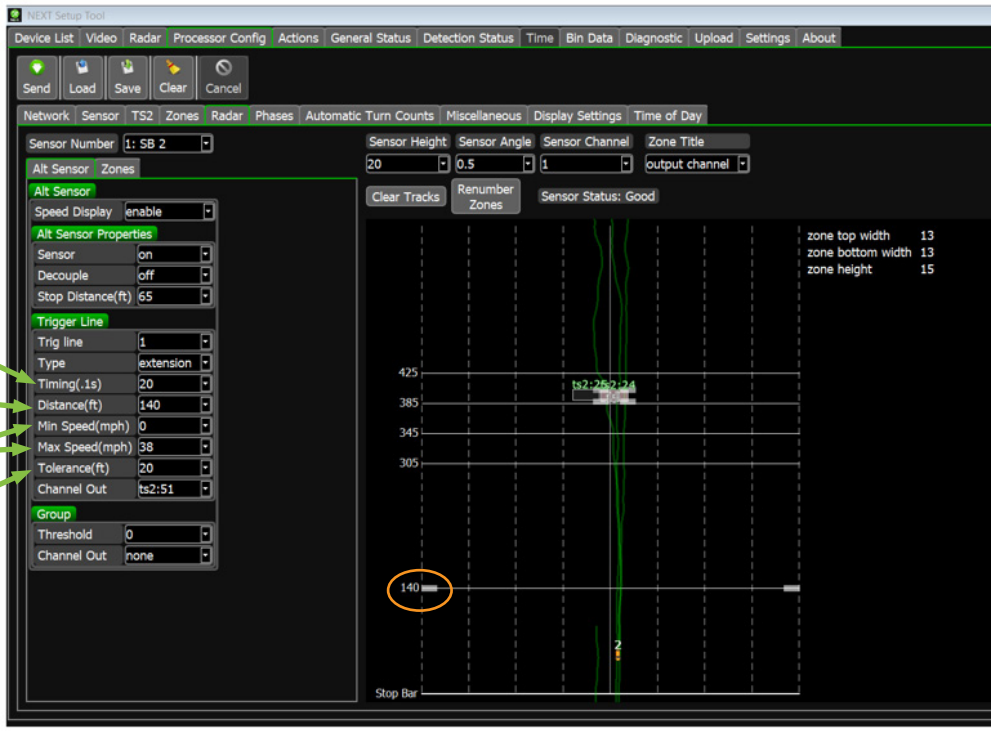


Extension Timing = 2.0 sec

Trip Line Distance = 140'

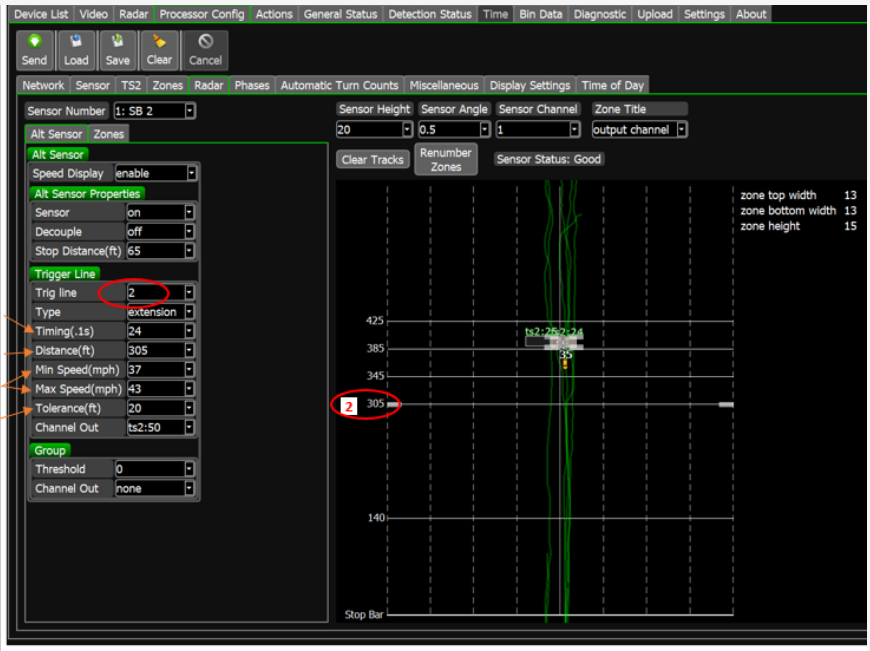
Speed Threshold = 0-38 mph

+/-20' zone



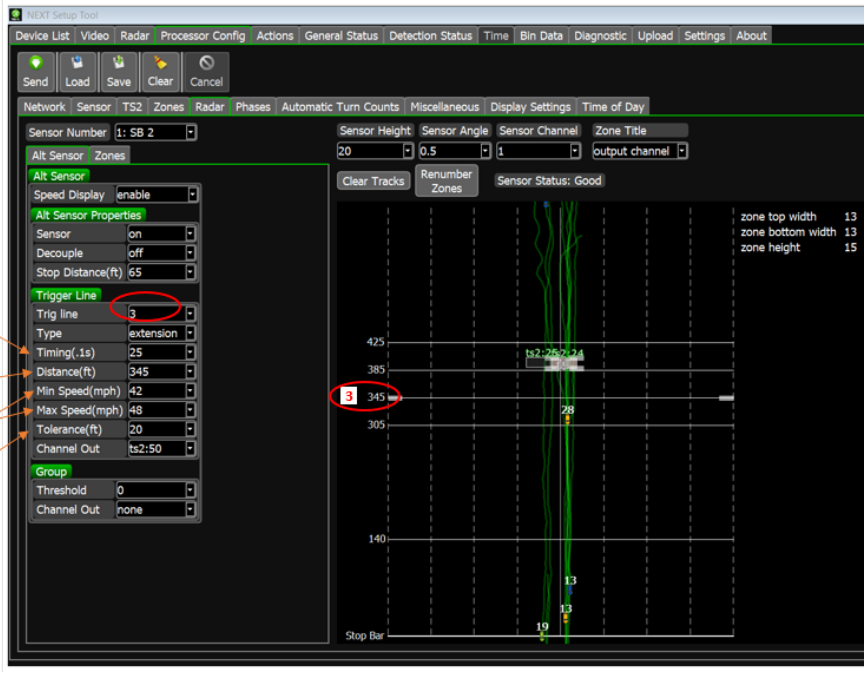
Trip Line #2 - 40 mph zone

Extension Timing = 2.4 sec
Trip Line Distance = 305’
Speed Threshold = 37-43 mph
+/-20’ zone



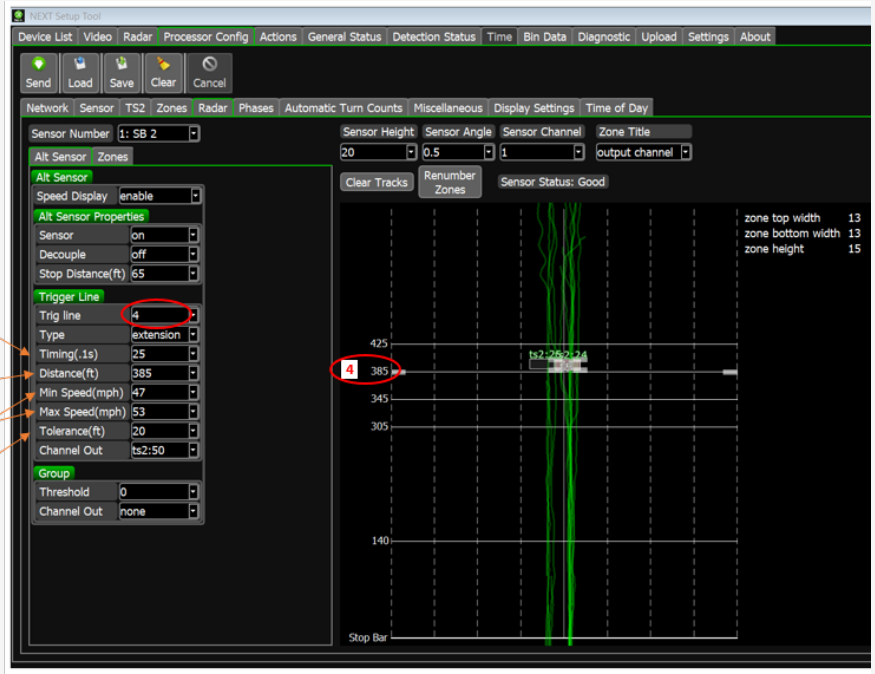
Trip Line #3 - 45 mph zone

Extension Timing = 2.5 sec
Trip Line Distance = 345’
Speed Threshold = 42-48 mph
+/-20’ zone



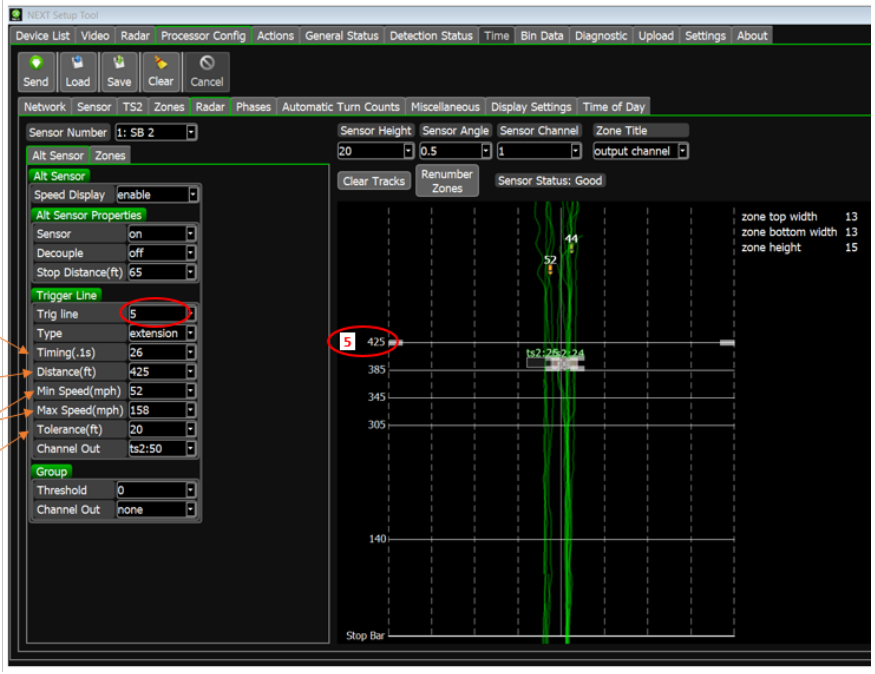
Trip Line #4 – 50 mph zone

Extension Timing = 2.5 sec
Trip Line Distance = 385’
Speed Threshold = 47-53 mph
+/-20’ zone

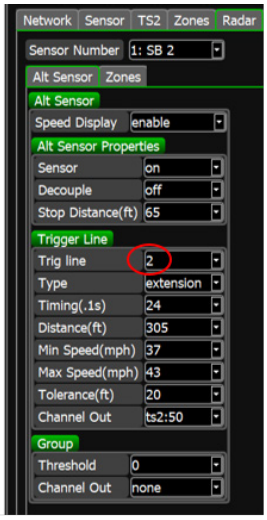


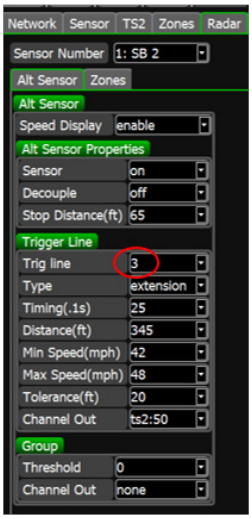
Trip Line #5 – 55 mph zone

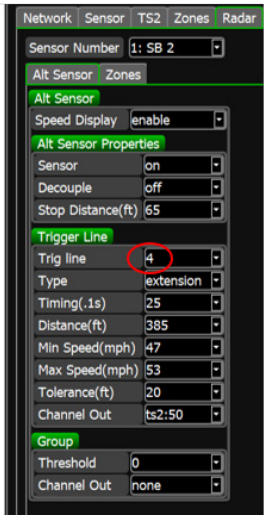
Extension Timing = 2.5 sec
Trip Line Distance = 425’
Speed Threshold = 52+ mph
+/-20’ zone

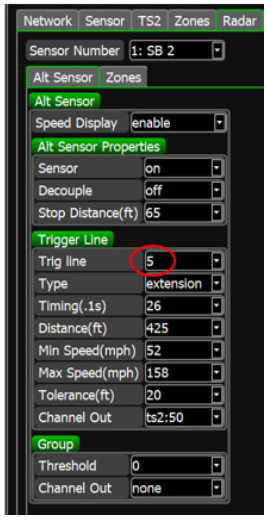


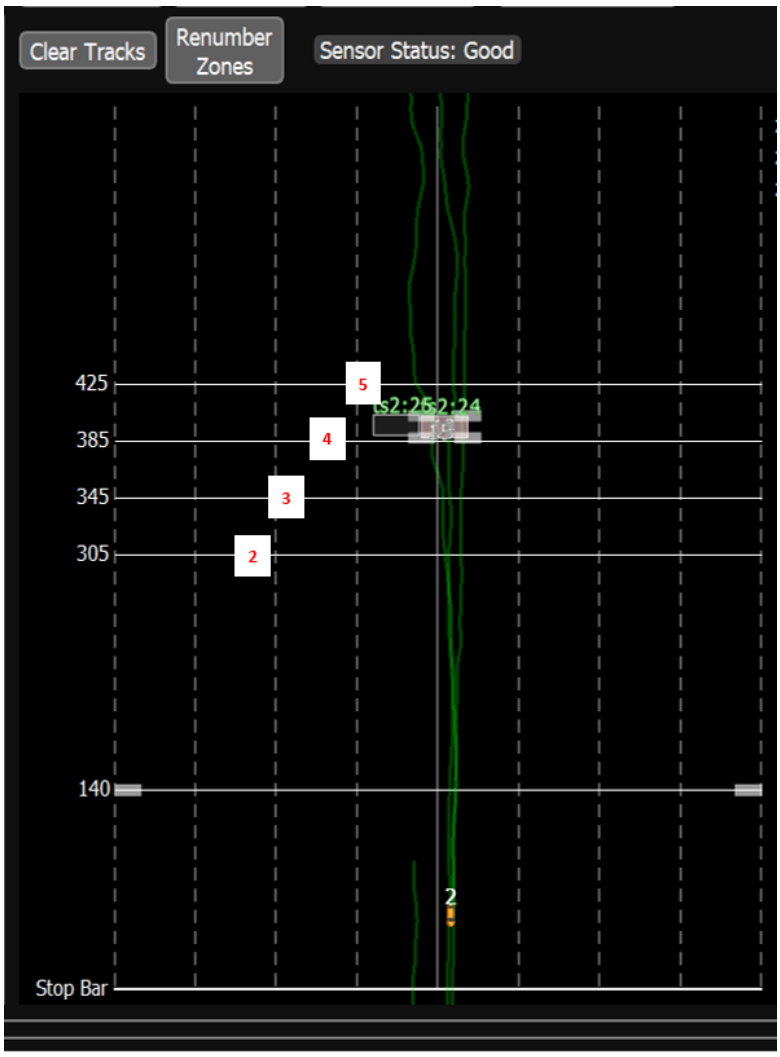
Summary of Decision Zone Trip Line Settings





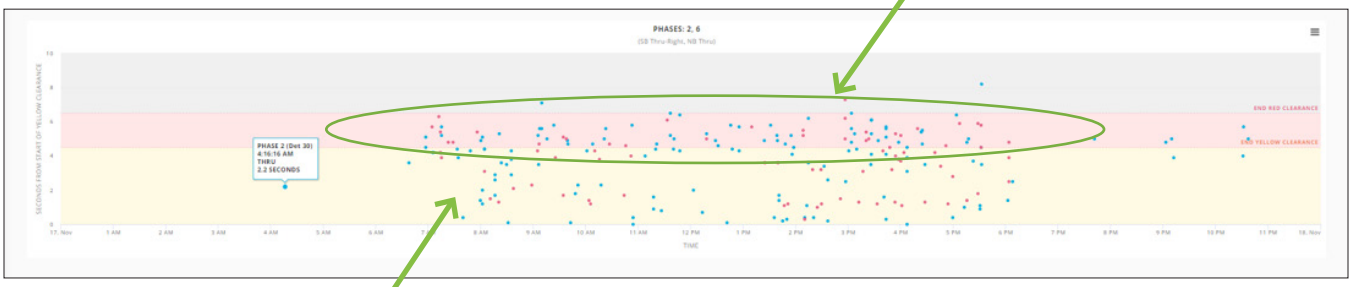




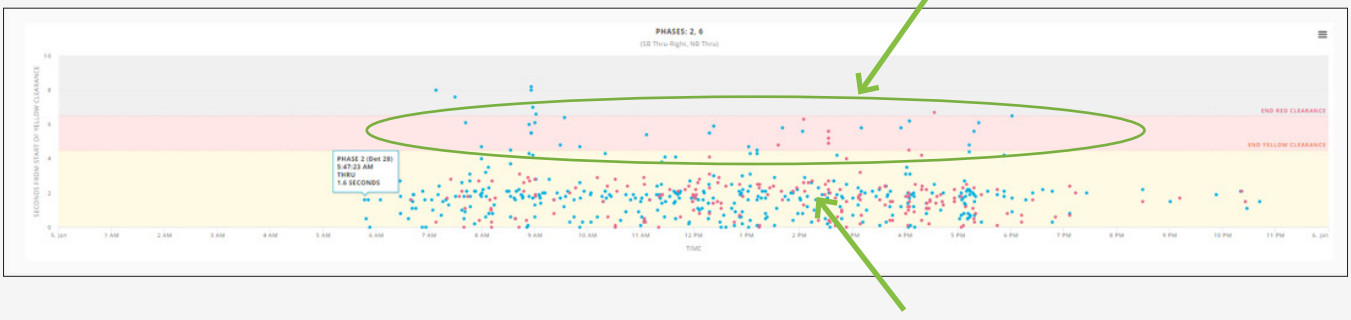


Effects of Decision Zone Detection

Before: Traditional Advanced Detection



After: Decision Zone Detection Implemented

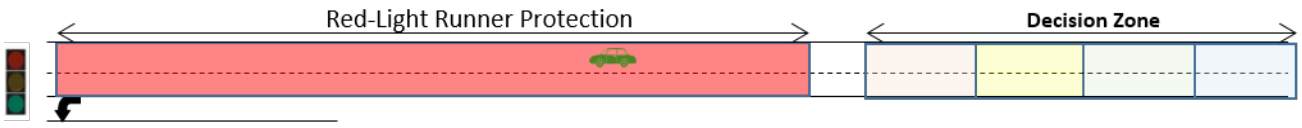


Red Protect

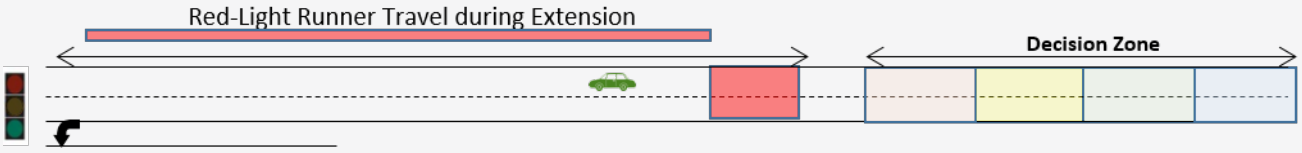
iteris®

Red Protect / Red Extend Detection

In the Vantage Next processor, the Red-light runner protection, can be a speed sensitive zone extending to the stop bar.

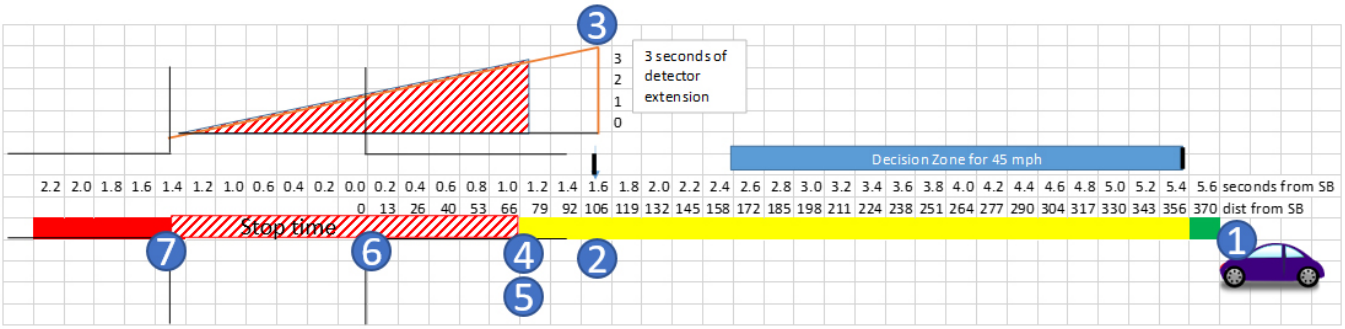


In the Vantage Edge2 processor, the red-light runner protection will be trip line with an extension timer.



Extension time on the detector is based on travel time from detector to far side of intersection.

Red Protect Detection with Trip Line

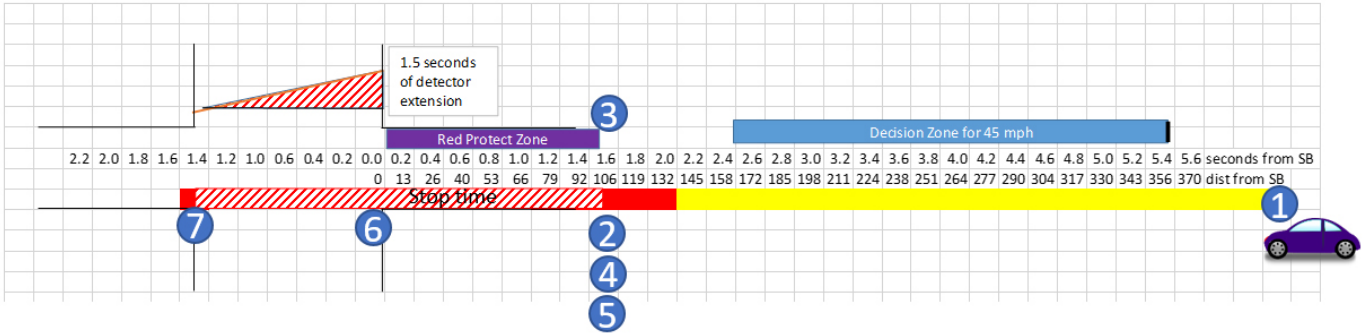


Scenario 1: Red Protect Detector (trip line) set 100' back from Stop Bar with 3 second extension (set in Vector) Vector trip line activated by vehicles traveling 45 mph or greater

1. Vehicle going 45 mph is 370' from the intersection when the signal goes yellow
2. Vehicle hits trip line detector 100' feet from the stop bar as signal turns red
3. Detector holds the call for 3 seconds
4. When Red Clearance Starts – Red Protect Detector is ACTIVE
5. Controller puts intersection in STOP TIME
6. Vehicle enters the intersection during STOP TIME
7. Vehicle clears the intersection during Red Clearance

For Red Extend Operation in Econolite Controllers – the remaining red clearance time is NOT timed when the extension timer is done. The controller continues to the next phase at that point.

Red Protect Detection with Speed-Sensitive Zone



Zone: Red Extend Detector (Speed-Sensitive Zone) set from stop bar to 100’ back from Stop Bar with 1.5 second extension (set in Vector). Vector Zone activated by vehicles traveling 45 mph or greater.

1. Vehicle going 45 mph is 500’ from the intersection when the signal goes yellow
2. Vehicle hits radar zone 100’ feet from the stop bar 1.5 seconds after the signal turns red
3. Detector holds the call WHILE VEHICLE IS TRAVELLING > 45mph
4. Red Protect Detector is ACTIVE because red clearance is timing
5. Controller puts intersection in STOP TIME
6. Vehicle enters the intersection during STOP TIME
7. Vehicle clears the intersection during Red Clearance

Additional Vantage Vector Setup with Decision Zone and Red Protect Settings

iteris®

Vantage Vector Setup with Red Protect for 55 MPH Posted Speed

Below is a table for all detection needed for decision zone protection for 55 mph approaches with Red Protection programmed in the controller. Please refer to pages 13-17 to see settings for setting up the Vantage Vector sensor in the Next Setup Tool (NST).

Trip Line	Speed (MPH)	Trip line Distance	Trip line Width	Speed Threshold	Extension	Controller Settings
Vector Dilemma Radar Zone Settings						
5	55	425	+/-20	>52	2.5	Call + Ext
4	50	385	+/-20	47-53	2.5	Call + Ext
3	45	345	+/-20	42-48	2.4	Call + Ext
Vector Intermediate Radar Zone Settings						
2	Low Speed	140	+/-20	<38	2.0	Call + Ext
Vector Red Extension Zone Settings						
1		100	+/-20	>55	2.0	Red Protect
Video Stop Bar Detection Zone Settings						
All- Each lane 40’ zone 0 Extension						Drop after gap

These setup parameters are available as a default program that can be uploaded to the processor from your laptop. The only programming needed is the distance to stop bar.

This table is available for download on the Resource Center.

Vantage Vector Setup with Red Protect for 45 to 50 MPH Posted Speed

Below is a table for all detection needed for decision zone protection for 45 to 50 mph approaches with Red Protection programmed in the controller. Please refer to pages 13-17 to see settings for setting up the Vantage Vector sensor in the Next Setup Tool (NST).

Trip Line	Speed (MPH)	Trip line Distance	Trip line Width	Speed Threshold	Extension	Controller Settings
Vector Dilemma Radar Zone Settings						
5	50	385	+/-20	>47	2.5	Call + Ext
4	45	345	+/-20	42-48	2.5	Call + Ext
3	40	305	+/-20	37-43	2.4	Call + Ext
Vector Intermediate Radar Zone Settings						
2	Low Speed	140	+/-20	<38	2.0	Call + Ext
Vector Red Extension Zone Settings						
1		100	+/-20	>45	2.0	Red Protect
Video Stop Bar Detection Zone Settings						
All- Each lane 40’ zone 0 Extension						Drop after gap

These setup parameters are available as a default program that can be uploaded to the processor from your laptop. The only programming needed is the distance to stop bar.

This table is available for download on the Resource Center.

Vantage Vector®

Available Zones and Uses