

# Vehicle Detection

- Brief history of each detection
- How they work
- Discuss most used ones

Are other options



# What are detectors used for?

## Signalized Intersection

- Basic signal detection
- Vehicular presence (stop bar)
- Vehicular extension (advanced)
- Bicycle presence/extension
- Volumes and occupancy
- Approach volumes and occupancy
- Turning movement volumes
- Highway traffic data collection

Transit Priority

Classification (axle or length)

Travel time



## Interesting fact

Charles Adler, Jr., of Baltimore, MD. a railway signal engineer, developed a sensor that was activated when a driver sounded their car horn at an instrumented location. This device consisted of a microphone mounted in a small box on a nearby utility pole. Was first installed in 1928 at a Baltimore intersection.



# Loop Detection History

- First noticed accidentally on a battlefield during WWI. A telegraph linesman was running tests on a field telephone cable loop, when a radio operator, within the loop, noticed sounds in a headphone that had a faulty, short-circuited, jack-plug.
- Loops been around for decades



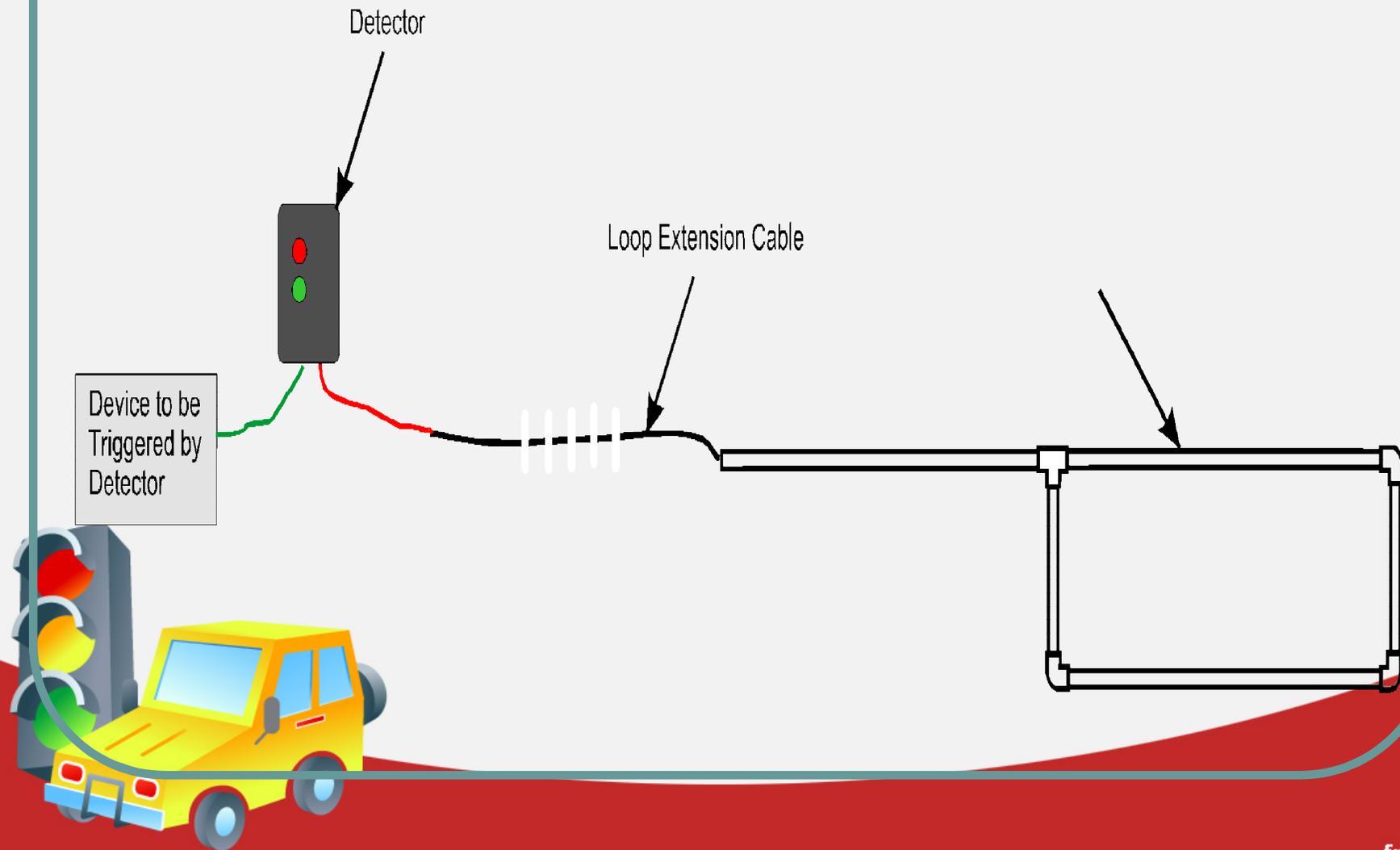
Most common form of detection

# Loop Detection How They Work

- Detect the slight change in inductance of the loop
- Loop inductance changes, so does the loop frequency
- Detector senses frequency change
- Sends frequency change to controller



# Loop Detection

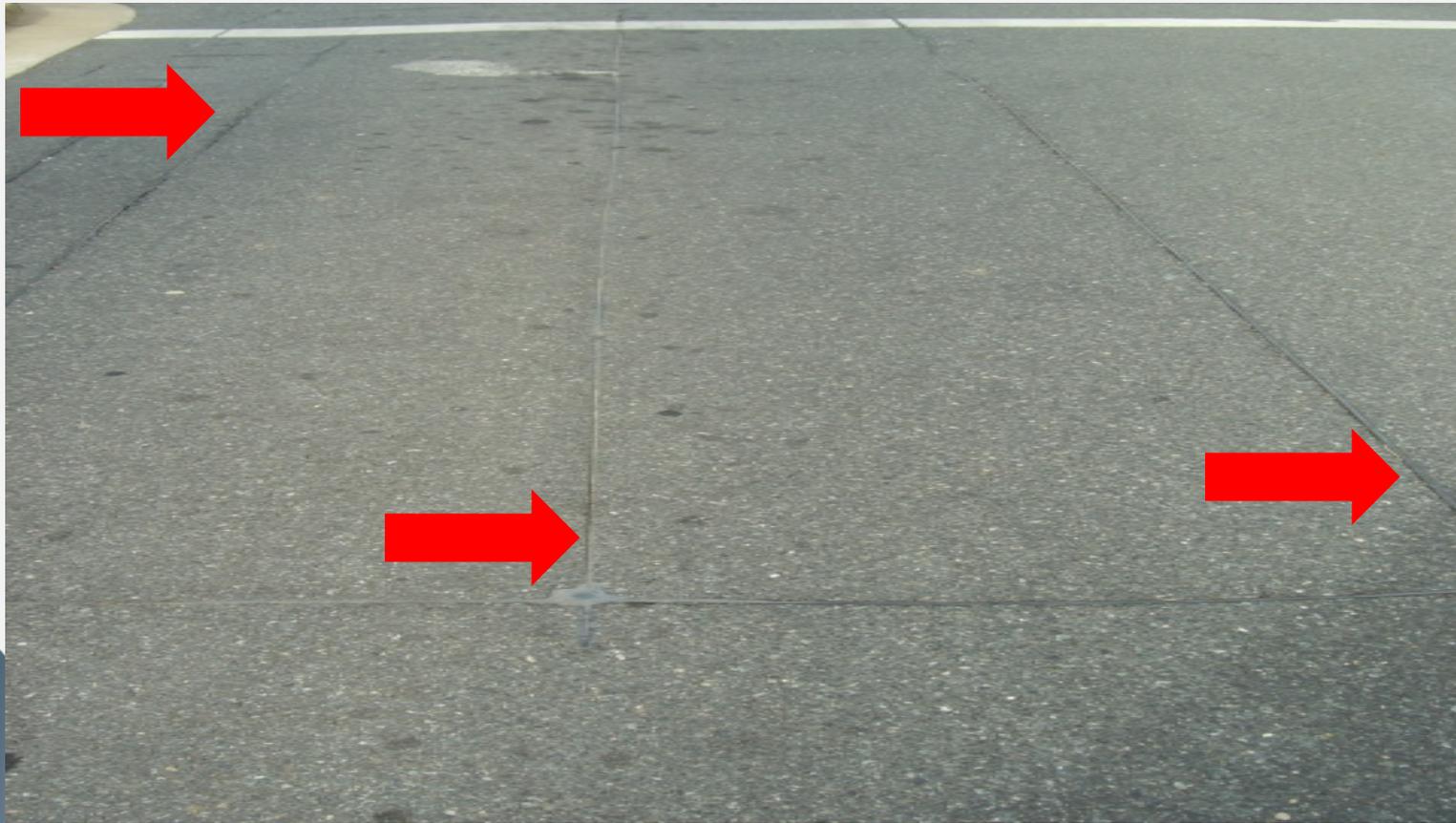


# Loop Detection

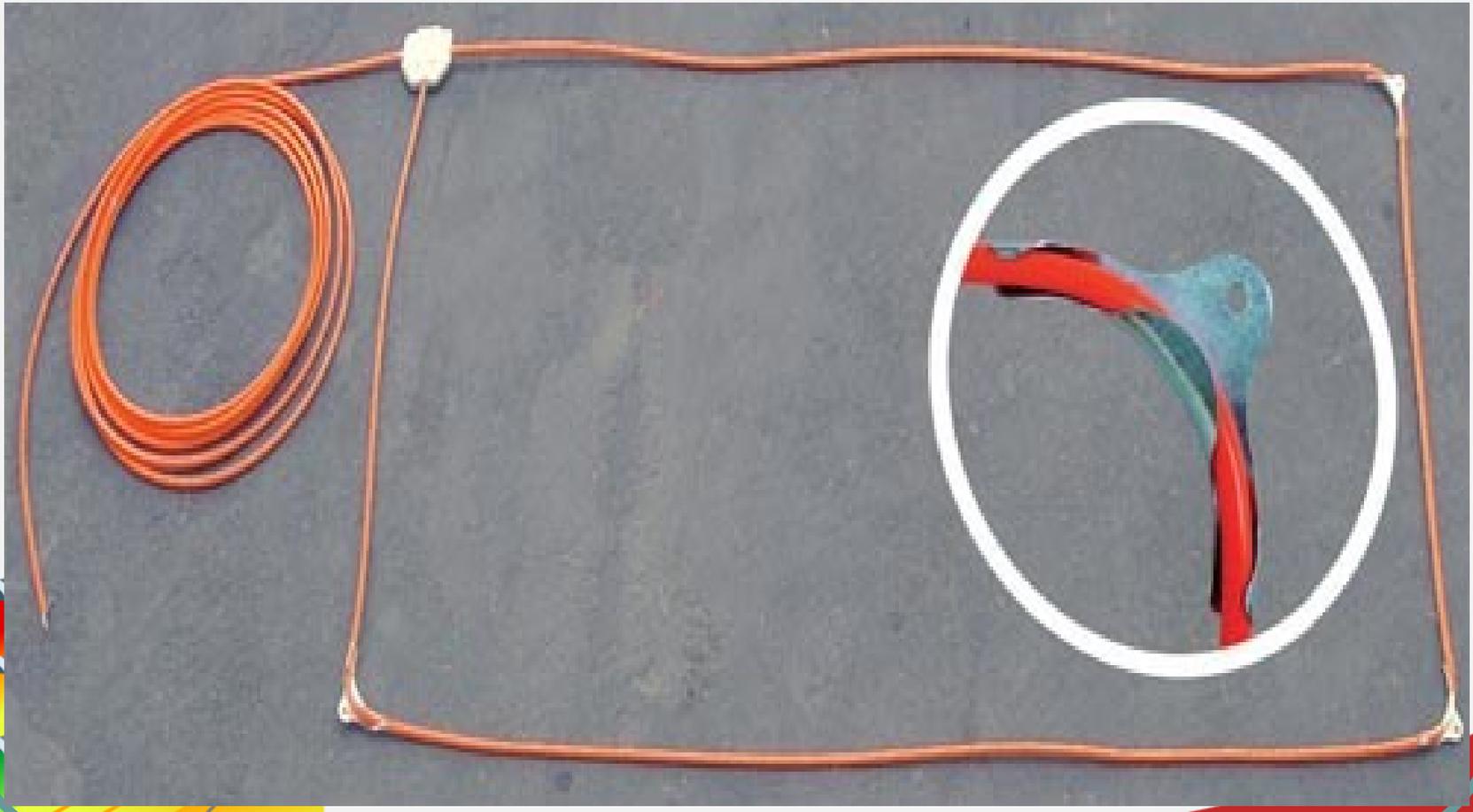
- In asphalt / concrete sawed
- Preformed loops
- Micro loops / Non evasive loops



# Loops(sawed in asphalt)



# Preformed Loops



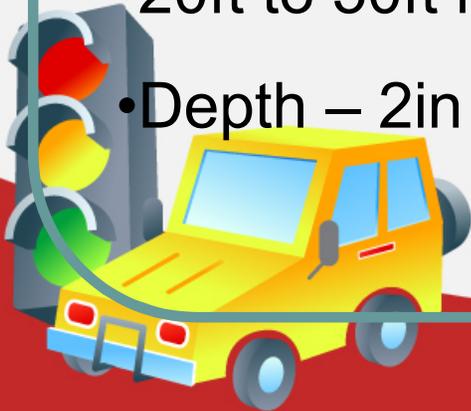
# Noninvasive Detection



# Loop Detection sizes/types

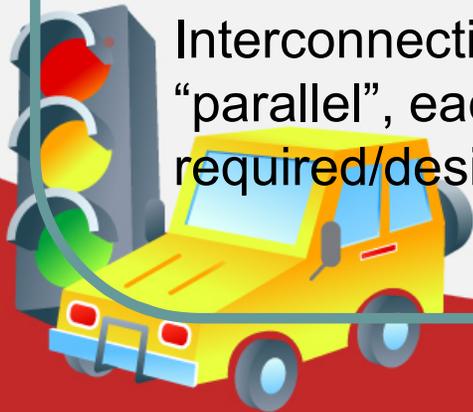


- 6ft X 6ft X 6ft
- 20ft to 50ft in length X 6ft
- Depth – 2in to 5in



# Loops

- Inductance loops are sensitive to other electrical fields in close proximity, including underground/overhead power lines
- Additionally, they will be affected by the presence of other large metallic object such as man-holes
- Complete cleaning of the slots before wire installation will significantly affect longevity of loop operation



Interconnecting several loops can be done in “series” and in “parallel”, each having a benefit and disadvantage, review required/desired operation before finalizing connection

# Loops

- Well installed loop will last years
- Mature, well-understood technology
- Minimal maintenance if installed correct
- Relativity cheap to install (5-10k per intersection)
- The equipment cost is lower when compared to non-intrusive detector technologies



Operability in harsh environment

# Loops

- Loops are messy to cut
- PPE requirements
- Failure associated with installation in poor road surfaces.
- Disruption of traffic for installation and repair.
- Installation and maintenance require lane closure.
- Inductive loops can not be installed at some sites, including bridge decks and railroad crossings



# Loops

- Resurfacing of roadways and utility repair can also create the need to reinstall.
- Subject to stresses of traffic and temperature
- Construction / Road Improvements can damage them for weeks or months
- Hard to locate if paved over

● Cable / wiring problems



# Loops Wastewater / Pollution

- Water Waste / Pollution
- Silica Dust
- Noise from machines
- Exhaust Emissions
- Dust from saw cutting and slot clean out
- Contains Silica particles, ethylene glycol, petroleum products
- California – collect and dispose of as hazardous waste.



# Loops



# Loop



# Noise / Health Concerns

- Saws produce sounds levels around 98db
- Compressors and air wands produce sound levels around 104db
- Sustained exposure to levels 90 and 95db will result in long term hearing loss.
- From any Quartz bearing stone that is cut, chipped or crushed.  
Causes Silicosis ( scar tissue in lungs – reduces lung capacity)

Can lead to the Cancer  
(less reports due to OSHA regulations)



# Equipment Exhaust Emissions

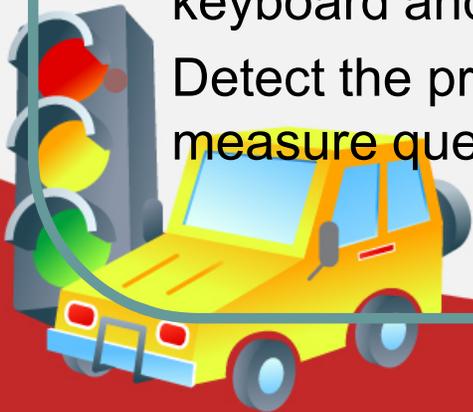
- Gas engines exhaust contains –
  - Nitrogen
  - Water vapor
  - Carbon Dioxide
  - Carbon Monoxide
  - Ozone
  - Nitrogen Oxides



# Video Detection History

- The first Video Image Processing (VIP) module comes into the world around 1990 to mid 1993
- This modular single processor board has to perform the basic tasks for handling the video, digitizing the video, analyzing the image and extracting the most important traffic data.
- The basic idea of the VIP is to keep video detection for traffic as simple as possible.
- Therefore it is designed to perform only the real needed tasks in stand alone form. It can be programmed using only a simple keyboard and monitor.

Detect the presence of vehicles, count the volume of traffic, measure queue length and to detect traffic incidents



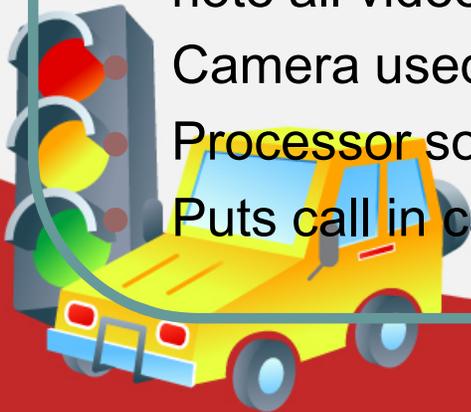
# Video Detection

- Video detection operation is very dependant on the view area/angle of the video “field of view”
- A key consideration is to ensure that the video image of the detection area is not partially or fully blocked by passing vehicle (such as a truck or bus that crosses in front of the detection zone for a far side detection zone) – typically referred to as “occlusion”
- Other problems occur when the camera is setup too low (too sharp an angle to discern a vehicle) and/or with the horizon visible (sun rise or sunset saturates the detection zone image) – note all video detection cameras should have a “sunshield”

Camera used to see traffic lanes

Processor software senses pixel changes over virtual zones

Puts call in camera processor then to controller



# Occlusion



# Sunshield



# Video Detection

- With consideration of the electronics in both the camera and the controller cabinet, the installation should include lightning protection on both the data and power cable/wires
- Maintenance of the video detection system should include alignment checks to ensure that the programmed detection zones are still proper, and that the camera “field of view” has not been altered.

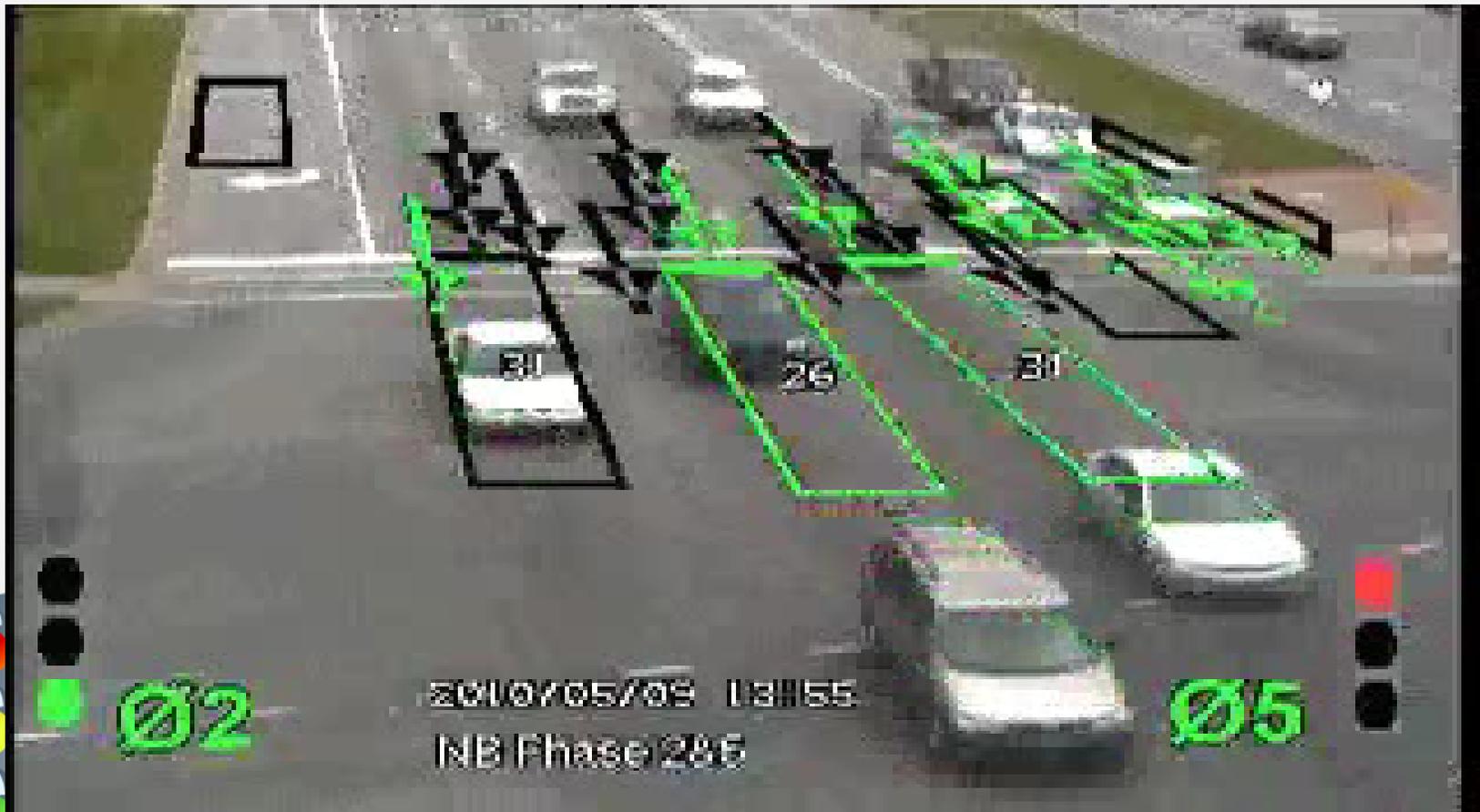


# Video Detection

- Construction and installation friendly
- Pricing (10k to 15k per intersection)
- Video detection system becoming more attractive
- Advanced abilities in software
- Rich array of data available
- Provides wide-area detection when information gathered at one camera
- Monitors multiple lanes and multiple zones/lane
- Easy to add and modify detection zones



# Software Capabilities



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NB Phase 285



# Video Detection

- Expensive
- Too much or too little camera view
- Inclement weather, shadows, vehicle projection into adjacent lanes, (occlusion), day-to-night transition, vehicle/road contrast, and water, salt grime, exhaust fumes, ice buildup, and cobwebs on the camera lens can affect performance
- Requires a certain camera mounting height for optimum presence detection and speed measurement.
- Some models susceptible to camera motion caused by strong winds.

More training needed

Constant software or firmware upgrades



# Mounting Options



# Mounting Options



# Mounting Options



# Camera view too much



# Camera View Too Little



# Video Problems

- Lightning damage
- Expensive to replace
- Cable / wiring problems
- Can be still unreliable
- Snow on camera and asphalt
- New asphalt
- Shadows



# Video Cable Problems



# Radar History Detection

- The first to use radio waves to detect "the presence of distant metallic objects" was Christian Hülsmeyer, who in 1904 demonstrated the feasibility of detecting the presence of a ship in dense fog
- Traffic Radar / early 1990's to mid 1990's
- Advance and Presence available



# Radar Detection How It Works

- Uses electromagnetic waves to identify the range, altitude, direction, or speed of both moving and fixed objects
- Transmitter emits radio wave signal out and is reflected back senses slight wavelength change



# Radar

- Generally insensitive to inclement weather
- Direct measurement of speed
- Multiple lane operation available up to 8 lanes
- Ethernet / network capable



A typical microwave detector can detect motion up to approximately 110m (350 ft.)

# Radar

- Advance detection
- Presence detection
- Wireless communication capable



No shadow problems

# Radar



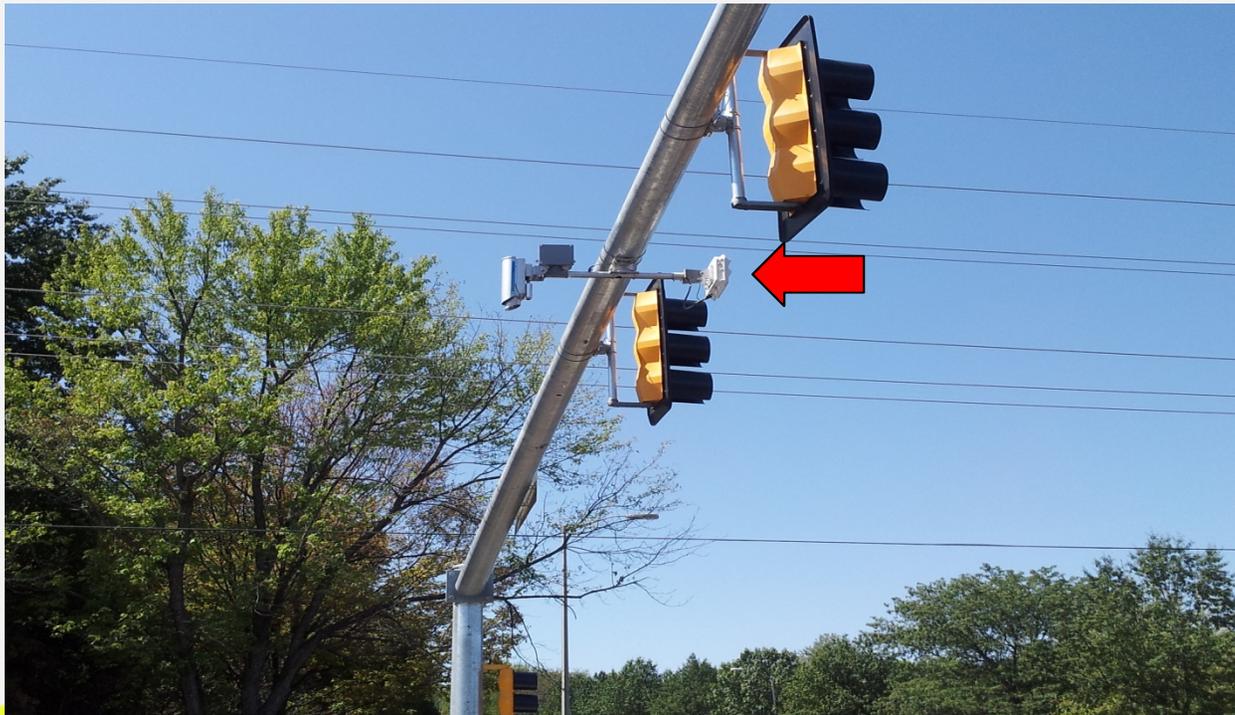
# Radar



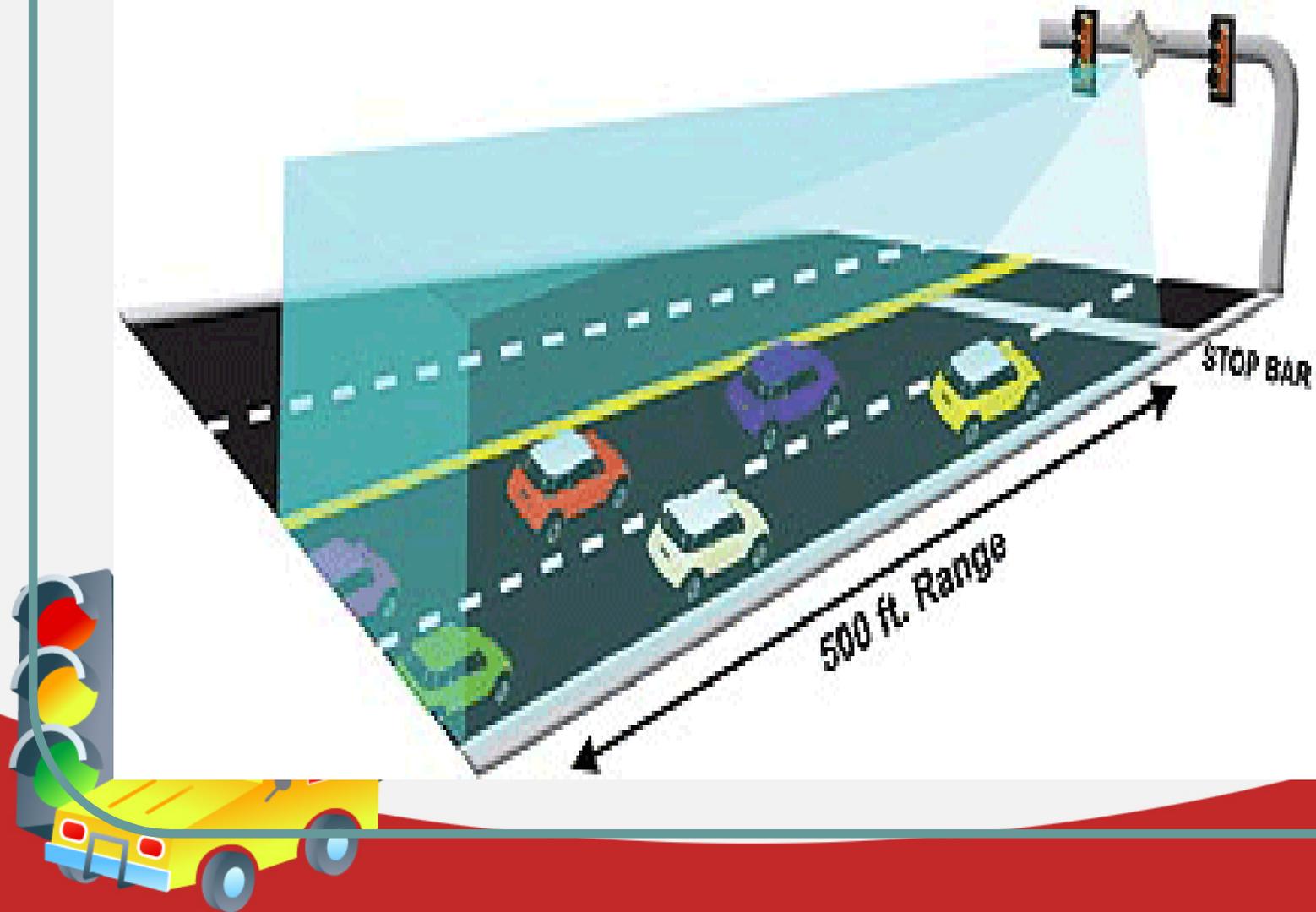
# Radar



# Radar



# Radar Detection



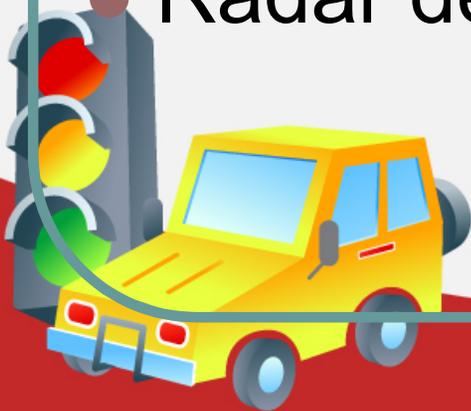
# Radar

- Still very expensive 20k to 30k per intersection
- Lightening damage
- Expensive to replace
- Cable / wiring problems
- Can be still unreliable



# Conclusion

- Loop detection still reliable
- Video detection improving and cheaper
- Radar detection improving and cheaper



# Detection

Questions?

