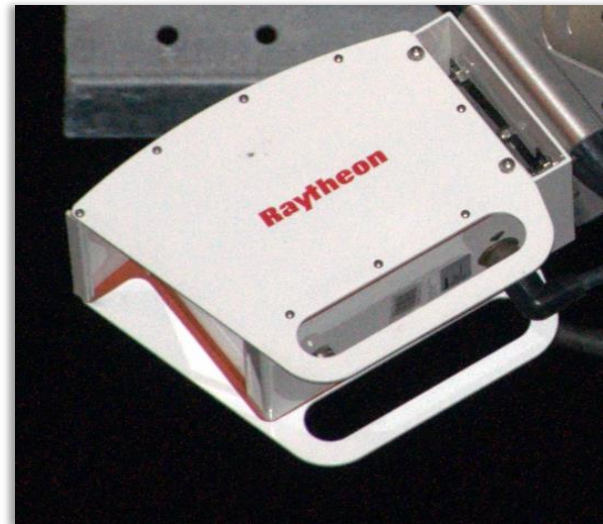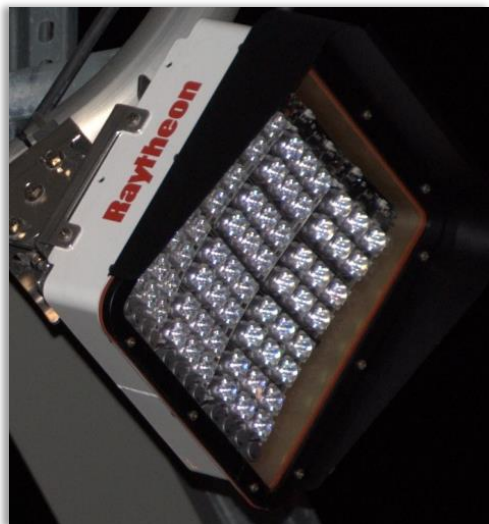# *Advances in Image Capture*

Brian Patno

Raytheon Company

AET Requires Superior Camera Imaging

Many camera subsystems offered today are simply adaptations of equipment originally designed for Violation Enforcement Systems

	VES Requirement	AET Requirement
% of Traffic applied to	< 5%	100%
Revenue Collection	Captures Violators	Generates Revenue
Human Plate-readability	50% provides effective deterrent	> 99%
Automated Plate-readability	Not required but desired	> 80-90%
System Reliability	Moderate	High

All Electronic Tolling requires an image capture design that **minimizes toll collection leakage and maximizes automated vehicle identification** across all the types of plates that may occur on your toll road
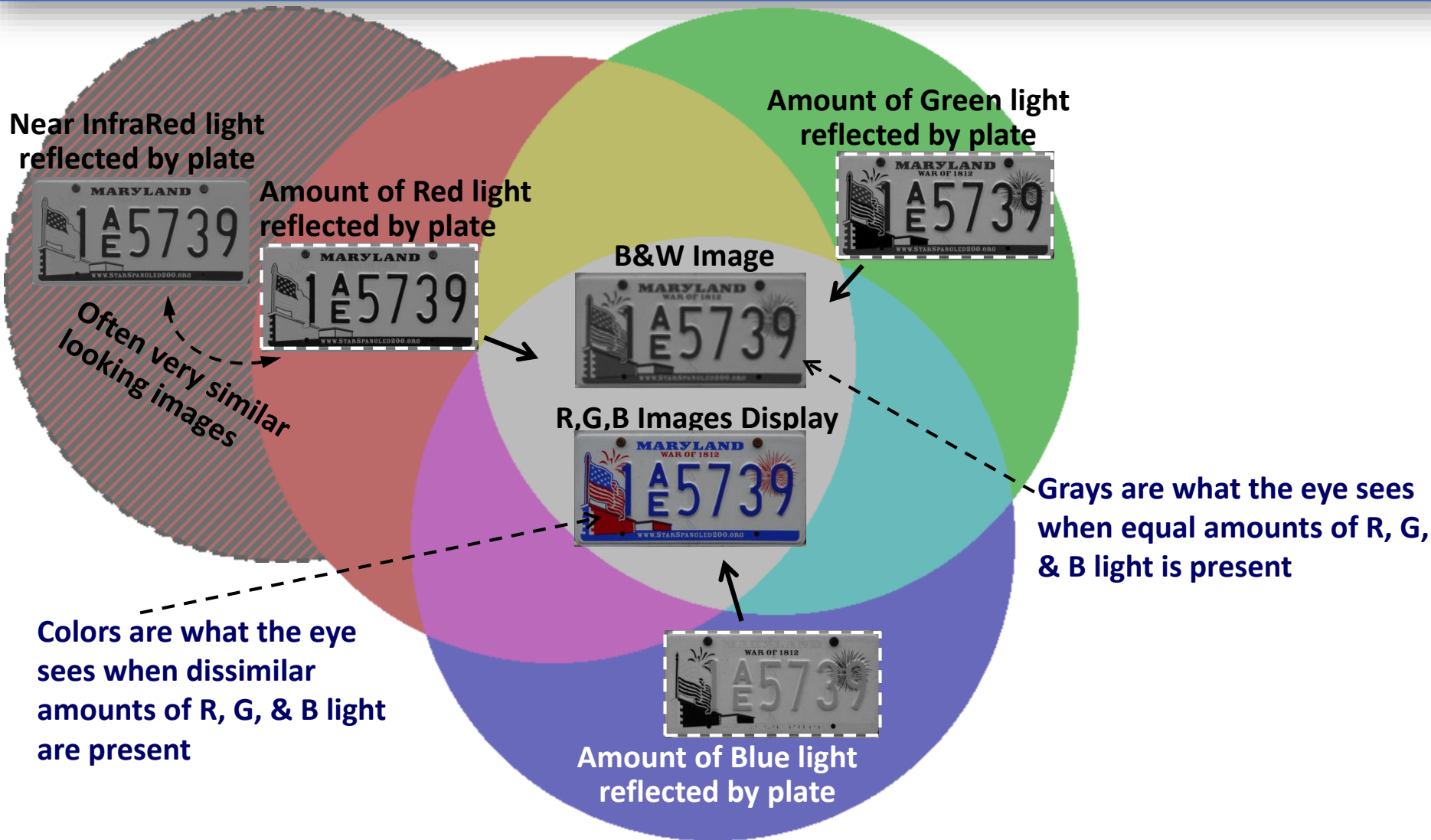
Minimize Leakage & Maximize Automation

	Character Resolution	Image Sharpness	Image Contrast
Human Readable			
High Performance Machine Readable			

To minimize leakage, images of all present and future plate styles and colorations must be human readable day and night regardless of age

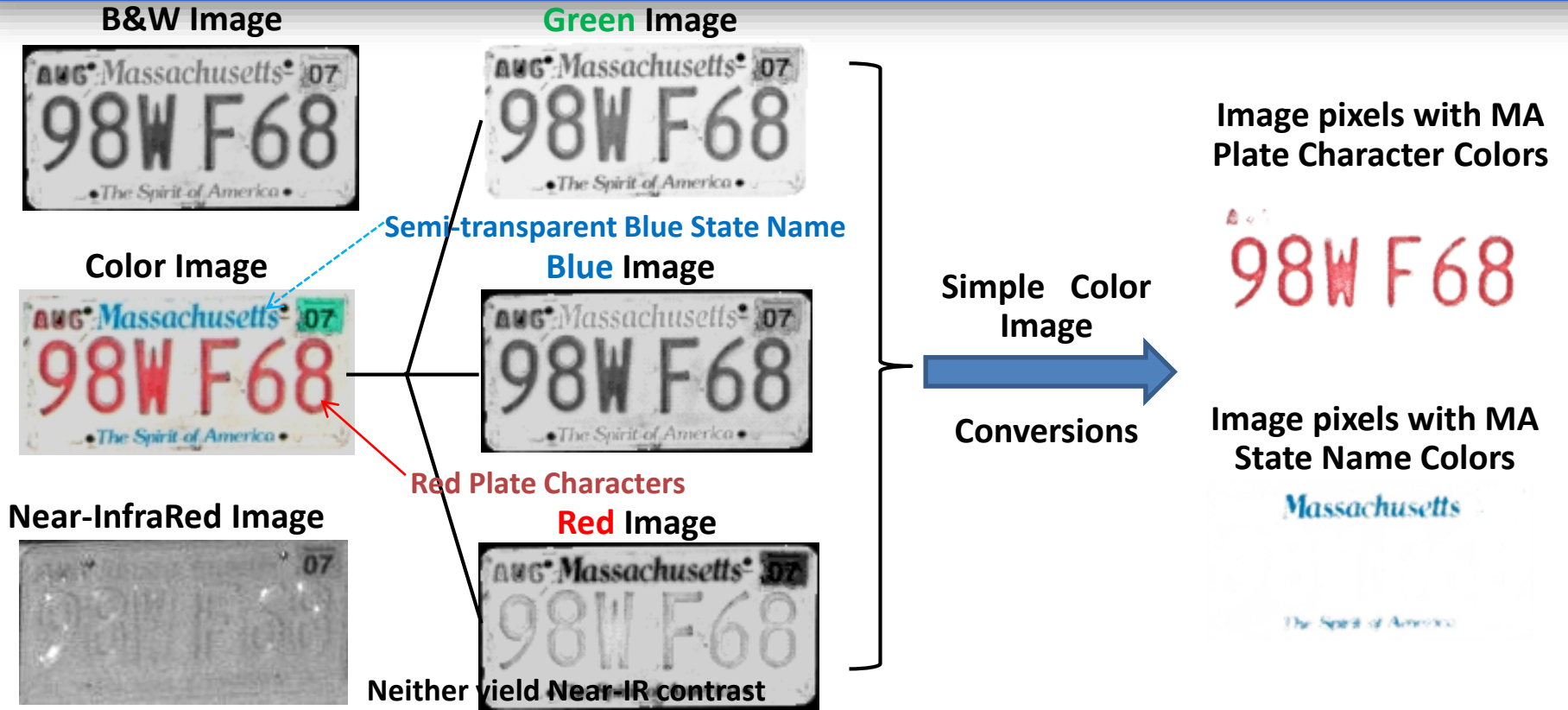**To minimize operational costs:**

- **Vast majority of commonly occurring plates must be read automatically**

- **Image quality must be high enough to consistently enable high-performance ALPR, images just capable of being human read is not good enough**

- **The vehicle should appear in all captured images (day and night) to maximize the opportunity to exploit Vehicle Fingerprint Matching technology**

- **Plates are <u>not always</u> retro-reflective and vehicles are never retro-reflective, nighttime illumination must be adequate to image non-retro-reflective objects**

Three Basic Camera Options for Imaging License Plates: B&W, Color, or Near-Infrared

IBTTA
International Bridge, Tunnel and Turnpike Association
DRIVING CHANGE SINCE 1932

Near InfraRed light reflected by plate

Amount of Red light reflected by plate

Amount of Green light reflected by plate

Often very similar looking images

B&W Image

R,G,B Images Display

Grays are what the eye sees when equal amounts of R, G, & B light is present

Colors are what the eye sees when dissimilar amounts of R, G, & B light are present

Amount of Blue light reflected by plate

Near-IR Cameras capture the amount of reflected light in a narrow waveband just below Red wavelengths which the human eye cannot see

Color Imaging is the Best Choice for Capturing and Isolating License Plate Information

B&W Image

Green Image

Color Image

Semi-transparent Blue State Name

Blue Image

Simple Color Image

Conversions

Image pixels with MA Plate Character Colors

Image pixels with MA State Name Colors

Near-InfraRed Image

Red Plate Characters

Red Image

Neither yield Near-IR contrast

Plates are designed and most easily enforced to be readable only across the visible spectrum, images from invisible wavelengths of light may not be legible

Artifacts of plate aging (or invisible but intentional alterations) can introduce unexpected background clutter in Near-IR plate images

Color Imaging enables a powerful set of techniques to be applied to help ALPR ignore clutter and detect Characters

Raytheon's SmartPIX Camera

- **Little to no blooming or smearing increases revenue**

- **Higher contrast increases OCR accuracy**

- **Wider and Higher Field of View (14 ft x 14 ft)**

- **2048 x 2048 Pixel resolution; Color and black/white**

- **Gigabit Ethernet interface for very fast transmission of images and rapid retriggering**

- **Multiple triggering options for front and rear image capture**

IR Strobe

white light option
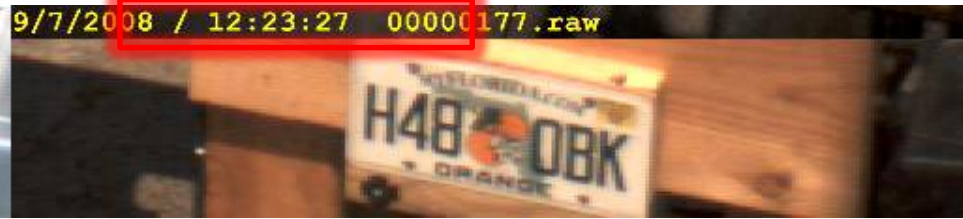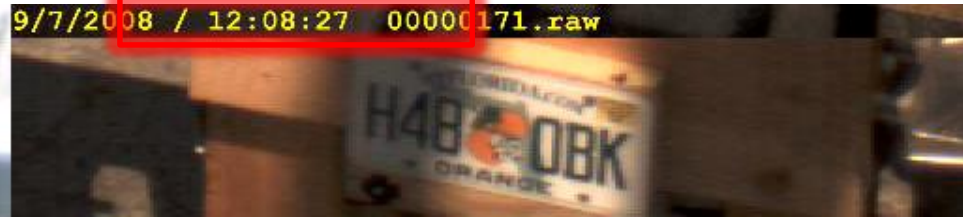
Previous CCD Technology   **SmartPIX Technology**

- **SmartPIX Imaging provides significant performance enhancements to increase revenue and lower operational cost for image revenue (violations, video tolling)**

    — **Little to no blooming and streaking**

    — **larger Field of View captures high mounted plates**

    — **Increased contrast provides higher OCR accuracy**

    — **Higher resolution**

- **Full vehicle images allow advance vehicle identification techniques (e.g., fingerprinting) to improve performance**

- **Raytheon used 17 years of AETC experience to create the latest a state-of-the-art camera to meet today's AETC needs**